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Climate Change Mitigation: An Investigation into the Attitudes Within the UK Construction Industry

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Abstract: The mitigation of climate change and its adverse consequences is highly urgent. It has produced a global response in the form of *the Paris Agreement*, which aims to tackle global warming and adapt to it. It has resulted in enacting *the Climate Change Act 2008*, setting a target for 2050 to reduce greenhouse gas emissions. There are profound implications for all sectors across the United Kingdom, and this study focuses on the construction industry. This research aims to build on the existing literature, evaluate the attitude of UK construction professionals about the achievability of the goals set, and identify methods for improvement as an industry. This investigation combines qualitative and quantitative methods to gather secondary data from the literature and primary data via a questionnaire. The analysis shows that despite climate legislation, there is a need for more significant action to meet the agreed-upon targets. Also, the construction sector and its professionals need help to achieve the set targets. This need has hampered the confidence to achieve targets within the industry. The recommendations listed in this paper illuminate the path of overcoming these obstacles and give us a way to further research how the industry can evolve and contribute toward climate change mitigation.

Keywords: climate change; UK construction; sustainability; professional attitudes

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1. Introduction

Preventing climate change is arguably the greatest challenge humanity has ever faced. As an industry that relies heavily on materials, transport, and energy usage, construction significantly contributes to emissions released into the atmosphere in the United Kingdom (UK) and globally. Therefore, the industry must rapidly adapt if the UK is to achieve the targets in place for climate change mitigation.

In 2021, the United Nations held its 26th Climate Change Conference, where all parties (197 countries) agreed to the *Glasgow Climate Pact* to accelerate action toward achieving the goals set out in *the Paris Agreement* [1]. *The Paris Agreement*, adopted by parties in December 2015 at the 21st conference in Paris, sets a target of limiting the global increase in temperature to below 2—preferably 1.5—degrees Celsius, compared with pre-industrial levels [2]. In reaction, an amendment was made to the *Climate Change Act 2008*, a legally binding act by which the UK must comply. This amendment requires the commitment to lower the emissions to 100% by 2050 from the 1990 emission baseline [3]. It is the UK's net-zero greenhouse gas emissions target, which presents a challenge to the construction industry due to the magnitude of the emission levels produced directly or indirectly due to the nature of the industry. In 2015, construction business and industry contributed 25% toward total greenhouse gas emissions and 13% from homes in the UK [4].

The UK's *path to net zero* is detailed in *The Sixth Carbon Budget*, produced by the *Climate Change Committee*, an organisation established due to the *Climate Change Act 2008*. The *Balanced Net Zero Pathway* provides sector-based scenarios, policy recommendations, and

analyses that can help the manufacturing and construction industry reduce its emissions by 70% by 2035 and 90% by 2040 compared to its 2018 emissions. For emissions from buildings, this figure is 45–65% [5].

More recent studies have offered suggestions for enhancing progress toward the targets described. Collins and Natarajan [6] conclude that focusing on existing buildings, alongside improved design, is essential. In a study of *Zero Carbon Housing*, O'Neill and Gibbs [7] outline the need for state-driven change and active promotion from the government to increase the speed of transition toward zero carbon. Barrett and Scott [8] highlight consumer-based behavioural change and improving the efficiency of materials produced as vital to mitigating UK greenhouse gas emissions.

Previous studies highlight complex challenges in the industry and other sectors nationwide and globally. Sorrell [9] describes issues arising from the fragmented nature of the industry, linear design, and cost-centred competitive tendering, preventing the advancement and innovation of green buildings. The consensus across the construction industry is that change is slow [10], and acceleration is required to reach goals. A lack of target alignment, identified in other sectors, has been associated with preventing a shift toward low-carbon development [11].

Given the urgency of swift action and the crucial role of bottom-up change in the construction industry [12], this study concentrates on professionals in this sector. It aims to examine their knowledge, firsthand encounters, and attitudes (i.e., overall evaluation or feeling toward a particular concept) concerning legislation for mitigating climate change. Furthermore, the research will gauge professionals' confidence in the UK's capacity to meet the established targets. Participants will also be invited to provide insights into the barriers that impede climate change-mitigation efforts and propose strategies to overcome them, along with recommendations for industry-wide improvement.

2. Literature Review

This research investigates the knowledge of and attitudes toward climate change mitigation within the UK construction industry concerning the *Paris Agreement* and national targets. This critical literature review about climate change mitigation forms an extensive background on the research area and identifies any apertures that allow for further research.

The *Climate Change Committee* (*CCC*) was established through the Climate Change Act (*C.C.A*) *in 2008*. It must "lay before Parliament each year (from 2009) a report setting out the Committee's views on the progress towards meeting the carbon budgets and the 2050 target" [13]. The *2021 United Nations Climate Change Conference* (C.O.P. 26) occurred in Glasgow, Scotland. An outcome of this conference is further pledges to prevent a rise in global temperatures. It explains that the pledges made in the *Paris Agreement* had the world on track for a rise from 2.7 °C to 3.7 °C. These renewed pledges in *C.O.P. 26* will achieve the targeted 2.0 °C rise and maintain the target of a 1.5 °C rise possibility [1].

The latest report from the Climate Change Committee is the "Progress in Reducing Emissions: 2021 Report to Parliament". The report provides percentage statistics to evaluate the progress in emission reduction in the UK overall and within different sectors, including buildings (residential and non-residential) and manufacturing and construction. As explained in this report, the COVID-19 pandemic led to a short-term fall in emissions [14]. Therefore, to better understand the progress in reducing emissions and the advice given by the Climate Change Committee, the "Reducing U.K. Emissions: 2020 Progress Report to Parliament" must be considered. This report details progress, data, and recommendations based on the UK's reduction of greenhouse gas emissions from 1990 to 2019. The industry saw a significant 29% reduction from 2008 to 2018, and buildings saw limited progress, with a 13% fall in that same period when adjusted for above-average temperatures [5].

The magnitude of the net-zero challenge, emissions in the *Balanced Net Zero Pathway*, actions required in the 2020s, key dates, and more [5] are explained within the *Sixth Carbon Budget: The U.K.'s Path to Net Zero.* The Balanced Net Zero Pathways for buildings, manufacturing, and construction have shown no growth or progress in emission reduction

in buildings since 2015, and they have the aim of zero emissions in buildings by 2050, as stated in the pathway. Comparable with the manufacturing, the construction sector's net-zero pathway "sees emissions similar level reduction" [5].

Navigating the Numbers forms a report assessing the global, national, and sectoral greenhouse gas emissions, investigating the implications of the information for international cooperation on climate change mitigation [15].

This literature set outlines the global international and national sectoral targets for greenhouse gas emission reduction (including carbon-neutral goals) and global climate change mitigation.

2.1. Climate Change Prevention: UK Objectives and Legislations

Professional attitudes play a crucial role in the success of climate change-mitigation efforts in the construction industry, as these attitudes influence the adoption of sustainable practices and compliance with legislation. Janda [16] highlights the professional responsibility of architects in promoting sustainable construction and argues that their role extends beyond design to include fostering "building literacy" among users. By educating occupants on energy-conscious behaviours, architects can address sustainability through design and user engagement, maximising the building's environmental impact. Similarly, Schweber [17] discusses how green certification schemes like BREEAM affect construction professionals' perceptions of sustainability. The Egan Review lists places for people to live in the UK in an environmentally friendly way as a component of building sustainable communities. The review recommends that the government use incentives to achieve progress toward carbon emission and waste minimisation standards [18]. Sorrell [9] declares that "*new buildings should be constructed to a high standard. . .if they are inefficient, they will present a major obstacle to achieving deep cuts in carbon emissions*". Sorrell describes the many barriers preventing energy efficiency in new construction, such as industry fragmentation, reduced quality, disregard for whole-life costs, and deficiency of integration. Sanders and Phillipson [10] describe the construction industry as "slow to change", as short-term commercial incentives subjugate long-term objectives. In addition, the awareness of the impact of climate change is low within the industry itself. However, this article focuses on how the industry can adapt to climate change in terms of the UK's environmental change. Jones et al. [19] focus on Corporate Social Responsibility, a leading principle of which is the environment—climate change, energy use, sustainability and environmental impact all fall under this heading. The article concludes that companies' Corporate Social Responsibility reports focus on their aspirations, not the reality of their daily operations. The topic of Corporate Social Responsibility reports is examined thoroughly by Myers [20], stating it is intended to "inform stakeholders of a company's environmental, social and economic performance". They claim that small and private firms provide little information on their environmental progress, whereas larger companies are beginning to acknowledge the necessity of adding positive environmental value.

Within this literature group, a spectrum of topics is discussed, which can be divided into several evaluations of viable adaptations to climate change (rather than prevention) and analysis of the barriers that restrict the construction industry's effort toward climate change mitigation.

Jones [21] details the need for combined bottom-up action and top-down support in progressing toward a zero-carbon built environment. Similarly, Alwan and Jones [12] discuss bottom-up action using the framework for strategic sustainable development integrated with Building Information Modelling [12], raising the notion that a culture shift is required, as the industry comprises many small enterprises distanced from policy and initiatives. A recent paper by O'Neill and Gibbs [7] examines the resistance to and the failure of the transition to Zero Carbon Housing within the UK, focusing clearly on policy dismantling, sustainability politics, and how future transitions can respond to the "climate emergency". In relation to zero-carbon housing, Collins and Natarajan [6] claim that efforts

are required to improve existing stock and better new build designs whilst discussing gas and electric consumption in dwellings within the UK and the effect on carbon emissions.

An interesting UK case study on five different policy scenarios to reduce overall work time to lower greenhouse gas emissions concludes that switching to a four-day working week would be most effective, arguing that the significance of the emission reduction indicates that the option should be strongly considered [22]. In another case study involving the UK, Barrett and Scott [8] analyse the "links between dematerialisation and climate change mitigation" via adopting an environmentally extended input–output model to assess the impact of material efficiency on reducing UK greenhouse gas emissions by 2050. This discussion involves many sectors, with construction strategies playing a significant role. Giesekam and Tingley [23] review the response to the P.A. and national climate mitigation targets from UK construction firms, highlighting the current insufficient targets and the need for "the alignment of sectoral decarbonisation trajectory".

This literature group depicts a slow but changing industry regarding policy and initiatives such as zero-carbon housing and a framework for strategic sustainable development. However, it explains that greater and faster development is required to achieve international and UK climate change targets, with a clear focus on action from the bottom-up (smaller firms) being necessary.

2.2. Climate Change Mitigation: Construction Industry

A study by Sunet al. [24] concludes that the awareness of sustainable building among small builders is "elementary", with "limited" knowledge and great variety between attitudes toward sustainable homes. They cite a lack of incentive to adopt new, more sustainable methods. In the Australian construction industry, perceptions are that without a clear definition of carbon-neutral building, there remains a significant barrier to achieving the carbon-neutral target [25]. Another article focusing on Hurlimann et al. [26] investigates how well the Australian construction industry is prepared "to adapt to climate change risk", with an analysis of the perceptions of key stakeholders. Opoku [27], all key stakeholders must "engage in raising awareness of the effects of biodiversity loss as a result of construction activities". The purpose of the paper is to allow government agencies, industry names, and other organisations to understand the role of the built environment in achieving sustainable development goals.

A study on adopting green building practices in Qatar, a developing country, shows that adopting green building practices can be enhanced through government support, environmental concern, and green engagement [28]. Alkhaddar and Wooder [29] emphasise the importance of deep learning within the industry, stating that it provides potential for continuous improvement, which is key as the UK takes action to reduce its carbon footprint.

Giesekam and Densley-Tingley [30] state that introducing carbon intensity targets can motivate reductions in embodied carbon to reach sectoral and national climate mitigation targets, recommending the standardisation of target setting and reporting. Röck and Saade [31] investigate the increased embodied greenhouse gas emissions of building materials used in energy-efficient buildings. A review of the use of Life-Cycle Assessment as a management tool for assessing environmental concerns highlights issues which impede the application of a Life-Cycle Assessment [32].

Within this portion of the literature, a range of themes are considered. Fundamental areas (concerning climate change mitigation) are awareness of sustainable building, incentives for adopting sustainable building, and barriers preventing green building methods. There is a focus on what organisations, governments, and stakeholders must do to improve the progression toward sustainable development goals such as the Paris Agreement.

There are studies on climate change mitigation in other sectors as well. Brandt and Herold [33] link agricultural productivity in Kenyan dairy production to climate change mitigation, with results showing the potential of "feed intensification" and "manure management" to reduce greenhouse gas emissions. Fawzy and Osman [34] discuss the need for conventional mitigation technologies and negative emissions technologies to reduce

carbon dioxide levels, alongside geoengineering techniques to reduce global temperatures to meet the targets set in *the Paris Agreement*. A comparison of the emission reduction targets for energy and transport sectors within Southeast Asia has revealed "wide variation in the types of targets", with a further analysis being required to understand what effect the current plans and policies in place will have on carbon dioxide emissions [11]. Larkin and Kuriakose [35] argue that cost-optimisation models underestimate the urgency of the 2 °C, highlighting the need for further engagement with the Paris Agreement, carbon budgets, and climate risks for society. Bulkeley and Kern [36] describe the need for local, and not just international, attention to mitigation policy.

Linked to the construction industry, Balsara and Jain [37] assess the climate change-mitigation strategies of the cement manufacturing industry in India, stating fuel emission reduction and process emission reduction to be the two greatest factors. Another study on the manufacturing industry reviews the current expectations and agreements and how technology within manufacturing can contribute toward these goals whilst identifying a multiscale strategy for climate change mitigation for this sector [38].

This area of the literature presents solutions, targets, and strategies for climate change mitigation within a range of sectors, such as agriculture, manufacturing, energy, and transport, with the majority calling for further innovation in technology and improvement of policy and strategy to reach the global targets set as part of *the Paris Agreement*.

This critical literature review has identified gaps that can be further investigated to fulfil the goals of this research. An area that has been touched upon but not thoroughly explored is the awareness, attitudes, and knowledge of UK construction-industry stakeholders, management, and workforce on climate change mitigation.

The aim is to investigate the understanding of legislation and policy, such as the Paris Agreement and the Climate Change Act 2008, across all levels of the industrial hierarchy and to evaluate whether the people in this sector believe the UK is doing enough to reach the current targets.

3. Methodology

This study employs a mixed-methods approach to capture the complexity of attitudes toward climate change mitigation within the UK construction industry. Qualitative data, gathered through open-ended survey responses, identified key themes—such as economic constraints and regulatory challenges—that informed the structure of the quantitative survey. This allowed us to tailor the quantitative questions to address the most relevant issues raised by respondents. Additionally, qualitative findings provided essential context for interpreting the quantitative results, such as understanding whether financial, regulatory, or operational barriers primarily drive scepticism toward achieving net-zero targets. By integrating these two methods, the study enhances the findings' depth and validity, offering a more comprehensive understanding of the industry's attitudes.

In this approach, first the secondary data are collected from the relevant literature, and then they are qualitatively analysed. The result of the qualitative analysis provides input for the design of a survey questionnaire. This survey questionnaire is then used to collect primary data to be quantitively analysed, taking a pragmatic approach to identify possible issues within the field of study and provide solutions to these problems.

This exploratory research utilises quantitative and qualitative methods to collect primary raw data. Qualitative research explores a topic's meanings, concepts, definitions, characteristics, metaphors, symbols, and descriptions. On the other hand, quantitative research deals with quantifiable aspects, such as counting, measuring, determining the extent, and analysing the distribution of the subject matter [39].

The literature review required qualitative research methods to identify and analyse the challenges faced by the UK in preventing climate change and how these challenges relate to the construction industry within the UK. These challenges include the legislation, standards, and treaties the UK must comply with to mitigate climate change (Table 1). This information was used in the design of the survey questionnaire.

Table 1. Literature research areas.

Topic Category	Time Searched	Keywords
UK construction industry and climate change; Pre-Climate Change Act 2008	2000–2008	UK Climate change Construction industry Sustainability Mitigation
UK construction industry and climate change; Post-Climate Change Act 2008	2008–2023	UK Climate change Construction industry Sustainability Mitigation Environment Zero carbon
Attitudes toward and knowledge of climate change mitigation—construction industry	2000–2023	Attitudes Knowledge Understanding Climate change Mitigation Construction industry
Attitudes toward and knowledge of climate change mitigation—other sectors	2000–2023	Attitudes Knowledge Understanding Climate change Mitigation Industry

The data collected from the survey questionnaire were analysed quantitatively. The aim was to have the questionnaire completed by professionals working in various roles and for varying types of construction organisations. Microsoft Forms was used to format, distribute, and complete the questionnaire. This questionnaire included an information sheet and ethical and consent information. The opening question was used to confirm that each participant had read, understood, and agreed with the information in the consent section through a yes or no question. I distributed the questionnaire via sharing the link on LinkedIn and email.

The questionnaire starts with questions about the demographics of the respondents, asking questions regarding participants' positions, organisation type, and number of years in the industry. Sixteen multiple-choice questions follow this and then, finally, two questions in which the participant could provide a short answer expressing their opinions and giving recommendations regarding the issues discussed in the questionnaire. The questionnaire was produced by identifying critical points identified in the literature and industry studies to gauge the appropriate response of the construction professionals. The survey was distributed via LinkedIn, targeting professionals in the construction industry. Over two months, we collected 40 responses from UK-based construction professionals. This method facilitated random sampling but introduced a bias toward professionals who are active on this social media platform. This is considered a limitation of this study. This limitation could impact the generalisability of the results to the wider UK construction industry. Future studies with larger sample sizes would be beneficial to validate these findings and ensure robustness of statistical significance.

4. Data Analysis

The primary raw data indicate that, despite current efforts, strategies, and improvements, industry professionals believe the UK cannot reach the net-zero greenhouse gas emissions target by 2050. However, the data suggest that the industry can change to contribute to limiting global warming, working toward the goals of the Paris Agreement. The

following subsections further detail industry professionals' attitudes of climate change action.

4.1. Awareness Within the UK Construction Industry

The participants were requested to indicate their awareness of the UK construction industry. Most participants were aware of the legislation, target, or terminology presented. The response (Figure 1a,b) indicates that 70% were aware of the Climate Change

Figure 1. (**a**,**b**) Awareness of climate change legislation.

Act 2008 before participation in this questionnaire. Similarly, 72% were about the Paris Agreement. The data displayed a prominent awareness among participants regarding climate change-mitigation matters. Despite this, the percentage of participants answering "no" to these questions indicates that several people are not aware of the question subjects.

Responses also indicate that most professionals (80%) are aware of the UK's net-zero greenhouse gas emissions target for 2050. C.S.R. awareness is 3% lower, at 77% (Figure 2a,b). The results indicate that most professionals are aware of the climate change issues and associated legislation.

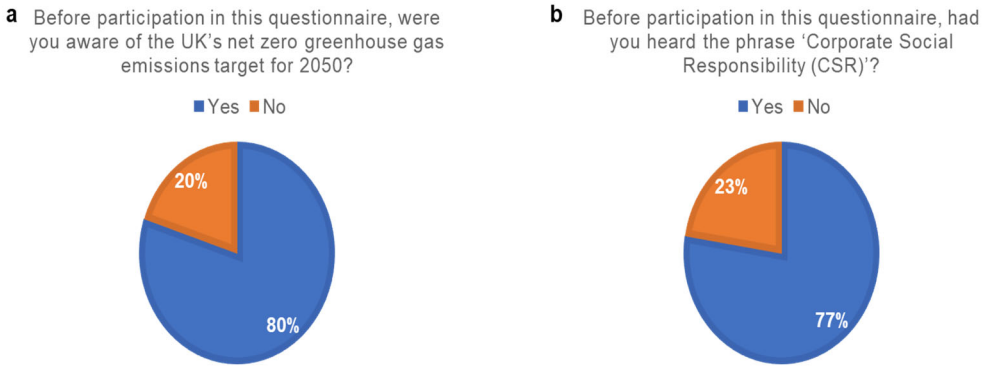

Figure 2. (**a**,**b**) Awareness of targets and terminology.

4.2. Experience of Climate Change-Mitigation Processes

There is a need to grasp the on-ground effort for climate change mitigation. The following questions were utilised to investigate participants' workplace experiences concerning climate change-mitigation processes. The participants agree with the statements regarding increased green buildings and efforts to minimise greenhouse gas emissions.

The data illustrate majority agreeance with the statement 65%, alongside a further 13% strongly agreeing (Figure 3a), demonstrating that there has been an increase in focus toward green construction practices and, therefore, climate change mitigation. This is confirmed by 50% agreeing and 10% strongly agreeing that they have experienced efforts to minimise greenhouse gas emissions (Figure 3b), a huge factor in climate change prevention.

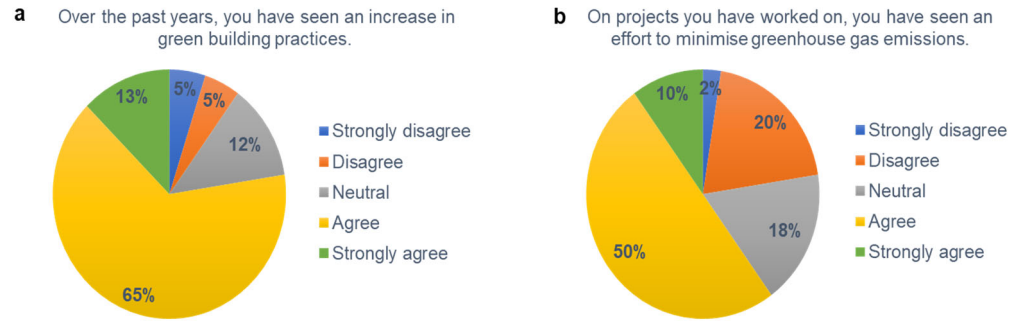

Figure 3. (**a**,**b**) Practices and efforts.

4.3. Opinions and Attitudes

The following questions were used to understand the opinions and attitudes of participants on what has been achieved within the industry and their confidence in the capability of the UK to meet climate change-mitigation targets.

A majority of 55% disagree that sufficient time/money has been allocated toward learning about climate change and mitigating it (Figure 4a). Similarly, a substantial proportion (50%) also disagrees that it is possible to reach the net-zero gas emissions target by 2050 (Figure 4b).

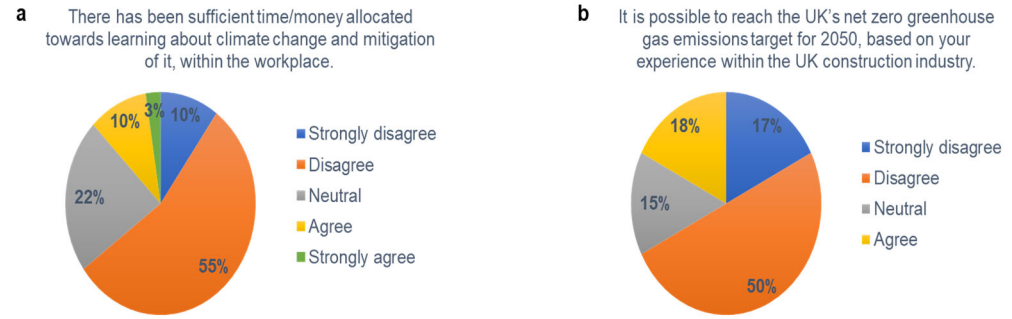

Figure 4. (**a**,**b**) Education and targets.

The attitudes vary significantly when asked if the UK construction industry is capable of change to contribute toward the goals of the Paris Agreement (Figure 5). In total, 33% agreed, 30% disagreed, and 20% were neutral. Although more agree with this statement than when asked about the UK's ability to meet its net-zero greenhouse gas emissions target for 2050 (Figure 4b), there is not overwhelming confidence that the goals of the Paris Agreement can be reached.

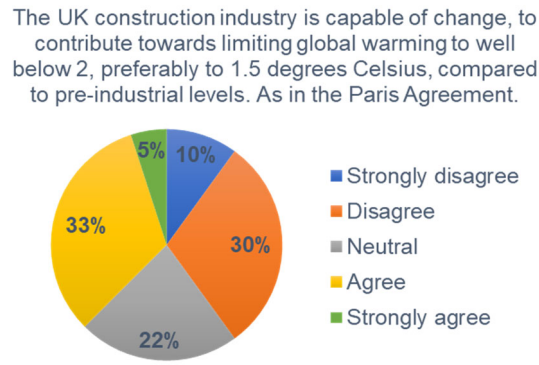

Figure 5. UK and the Paris Agreement.

4.4. Recommendations by the Participants

The analysis was based on the written questionnaire responses, categorised into different types of barriers or improvements reported by the participants. The frequency of each category mentioned was counted. It should be noted that many participants listed multiple answers, and each response was considered. Furthermore, the level of detail provided in the responses varied among participants, so the count of mentions for each category does not necessarily reflect the size of the participant cohort.

4.4.1. Barriers

The survey asked participants to outline climate change-mitigation barriers in the construction industry. The data indicate that the "economic constraints" are the most significant barrier to climate change mitigation (Figure 6). Twenty-six participants mentioned it, 65% of the cohort and 49% of the total received responses.

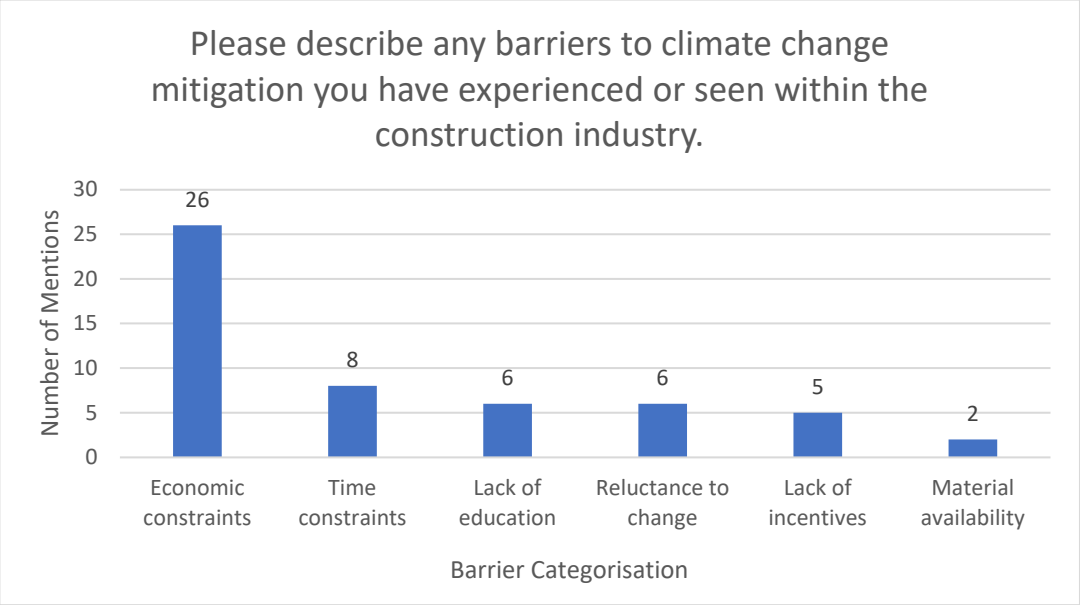

Figure 6. Barriers to climate change mitigation.

The overwhelming response of "economic constraints" demonstrates that the significant barrier to climate change mitigation, in the opinion of industry professionals, is the lack of money available for investment due to tight profit margins. The second is "time constraints", which go hand in hand with this issue due to the relationship between making money (profit) and time within the industry.

4.4.2. Recommendations for Improvement

The responses indicate that the industry recognises the necessity for incentivisation to prioritise climate change mitigation (as shown in Figure 7). The substantial number of mentions regarding incentives suggests that professionals within the industry believe there is a need for stronger motivation among companies to focus on climate change mitigation. Relying solely on targets will not be sufficient to achieve the industry's goal of reaching net-zero status. Furthermore, the findings reveal seven recommendations for both improved education and material enhancements, highlighting the importance of focusing attention and making significant improvements across various areas.

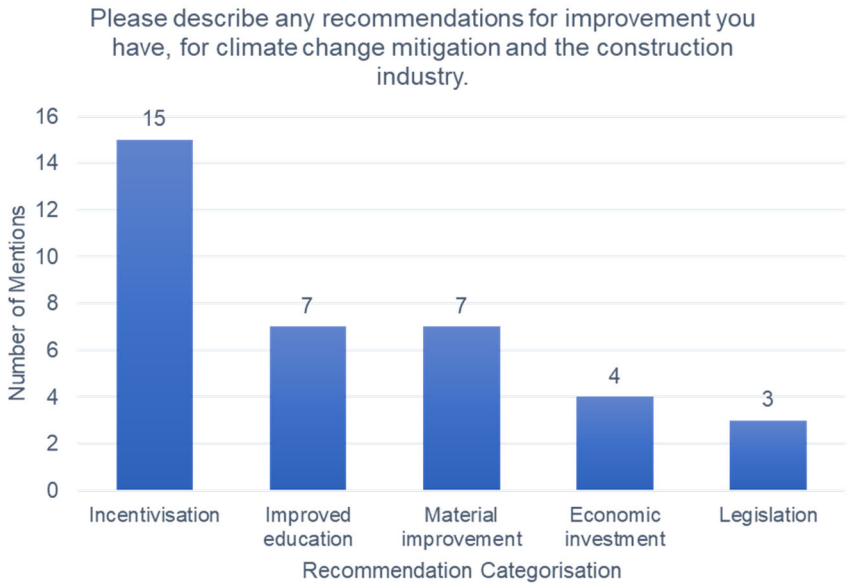

Figure 7. Recommendations for improvement.

The results indicate a notable level of awareness regarding climate change mitigation within the construction industry. After analysing the experiences of professionals in the field, it is evident that there is a divergence of opinions and mixed responses. Surprisingly, climate change-mitigation issues are not as prominent in participants' workplaces as initially expected. However, the findings highlight that many participants have observed an increase in climate change-mitigation measures throughout their tenure in the industry. The prevailing sentiment among the participants is that insufficient resources and time have been dedicated to comprehending effective climate change-mitigation strategies. Furthermore, there is scepticism regarding the UK's capacity to achieve the ambitious target of achieving net-zero greenhouse gas emissions by 2050. According to the participants, economic constraints are the most significant barrier preventing climate change mitigation, and they recommend incentivisation to reach climate change-mitigation goals within the UK construction industry.

4.5. Hierarchy Levels and Climate Change

The participants who completed the questionnaire had different job roles. The cohort was divided based on varying levels of responsibility to examine the potential variations in responses. The job titles provided by participants were used to create a hierarchical system, representing the individual's influence and responsibility within their respective companies. The hierarchy consisted of Levels 1, 2, 3, and 4, with descending order indicating the level of influence on the company (refer to Table 2). The distribution of participants across these levels varied (see Figure 8). Where applicable, these hierarchy levels were compared to other responses in the data and analysed to identify any relationships between the responses and the participant's role within their company. This analysis aimed to provide insights into the reasoning behind the responses.

Table 2. Hierarchy-level table.

Hierarchy Level	Job Roles
1	Owners, managing directors, executives
2	Contract directors, construction managers/directors
3	Contracts managers, project managers, senior surveyors
4	Site managers, surveyors, assistant site managers

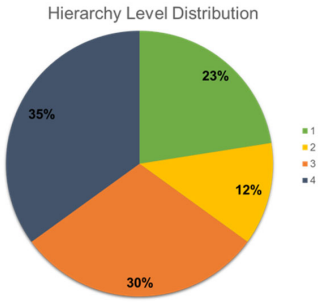

Figure 8. Hierarchy level distribution.

The data analysis shows that most respondents (70%, 72%, 80%, and 77%) know the relevant legislation, targets, and terminology (refer to Figures 1 and 2). This awareness is crucial for UK construction professionals to actively contribute to climate change-mitigation efforts. The significant proportion of individuals within the cohort demonstrating awareness suggests that the targets and legislation have been effectively communicated within the industry, representing a promising advancement toward achieving the set targets. It represents progress compared to the findings of Myers [20], who indicated a lack of emphasis on sustainability, with only larger companies giving it due consideration. However, the proportion of individuals within the industry who remain unaware of the legislation and targets indicates that communication needs improvement, requiring more robust efforts to change industry practices. These results suggest that awareness and knowledge of climate change mitigation within the UK construction industry have significantly improved compared to previous studies [24], which reported minimal changes in awareness from earlier research, along with poor knowledge and enthusiasm.

When comparing the hierarchy levels, it is noteworthy that 67% of participants at Level 1 disagree that climate change mitigation is regularly discussed in their workplace (see Figure 9). This finding suggests that individuals with the highest level of influence within their companies do not communicate regularly about climate change mitigation. To address this issue, recommendations by some authors [26] propose the translation of climate change information and knowledge into practical resources that construction industry professionals can effectively utilise. Similarly, participants at Level 4 also expressed disagreement with the statement, potentially due to the lack of communication at higher levels of influence, consequently affecting their respective organisations. On the other hand, responses from other hierarchy levels exhibit greater variation, likely influenced by the differences between their employer/companies.

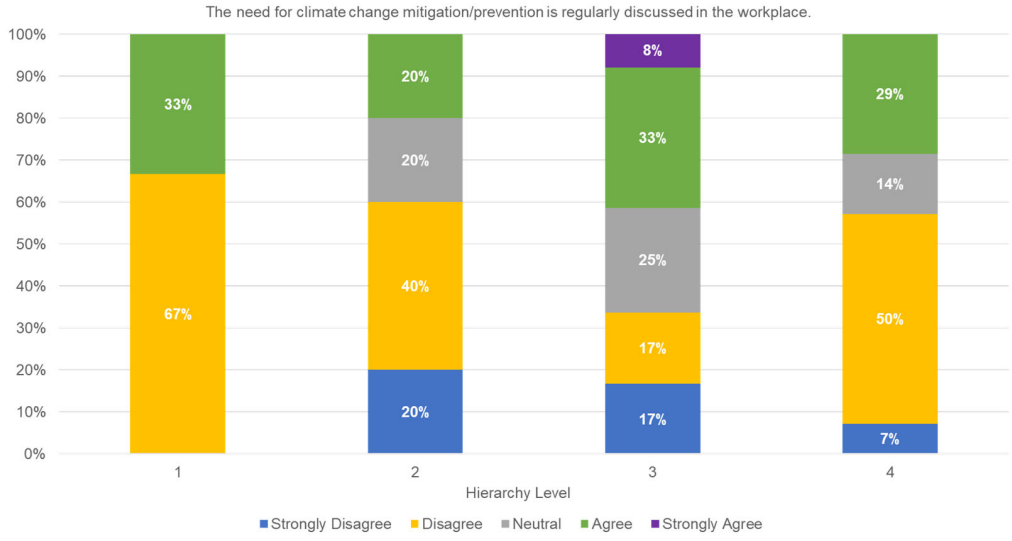

Figure 9. Hierarchy level vs. the need for climate change mitigation.

Another significant finding is that 57% of participants at Level 4 disagree that green construction practices are regularly discussed and promoted in their workplace (refer to Figure 10). This indicates that most individuals working at the ground level of their companies do not perceive the need to communicate or advocate for green construction practices. It suggests the existence of a prevailing industry culture where green construction practices are not considered an essential part of daily operations. This observation aligns with the notion that company aspirations are not always manifested in their day-to-day practices due to the competitive nature of the construction industry [19].

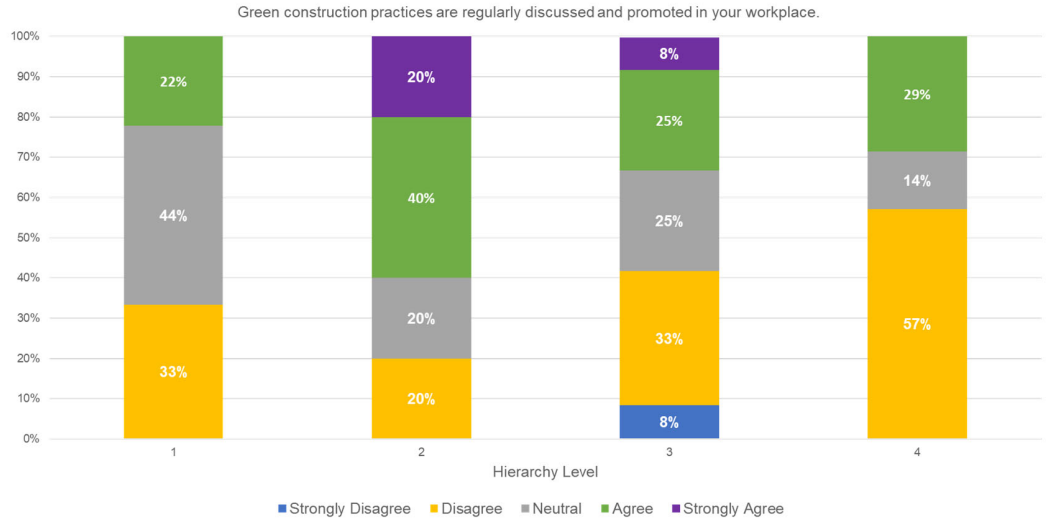

Figure 10. Hierarchy level vs. green construction practices.

5. Statistical Data Analysis

This section presents a detailed statistical analysis of how professional roles influence awareness, experience, confidence, and perceptions of barriers related to climate change mitigation within the construction industry.

Using a range of methods, including chi-square tests, *t*-tests, ANOVA, Principal Component Analysis (PCA), and Multiple Regression, this analysis explores vital factors, such as awareness of climate policies; experience with mitigation practices; confidence in achieving climate goals; and perceptions of barriers, like economic constraints and lack of incentives.

Each analysis provides insights into the factors affecting professionals' engagement with sustainability efforts, identifying areas where targeted interventions may enhance climate change-mitigation strategies. The section is divided into five key areas: awareness, experience, confidence, perceived barriers, and job hierarchy.

5.1. Awareness Analysis

Awareness of climate policies, such as the Climate Change Act (2008), the Paris Agreement, the UK Net Zero Target (2050), and CSR standards, is essential for fostering engagement with climate change-mitigation strategies within the construction industry.

5.2. Methodology

Two statistical tests were used to assess awareness levels:

- Chi-square test: This test was employed to determine if awareness of one policy (e.g., the Paris Agreement) was associated with other policies (e.g., the Climate Change Act).
- *t*-test for group comparison: An independent *t*-test was used to assess whether significant differences in awareness exist between managerial and non-managerial professionals.

5.3. Results

5.3.1. Chi-Square Test

A chi-square test examined the relationship between awareness of different climate policies. The analysis focused on whether awareness of one policy increases the likelihood of being aware of others. The result of this test is shown in Table 3.

Table 3. Climate policy and awareness.

Climate Policy	Managerial (Aware)	Non-Managerial (Aware)
Climate Change Act (2008)	80%	70%
Paris Agreement	85%	72%
UK Net Zero Target (2050)	90%	75%
Corporate Social Responsibility	88%	78%

The chi-square statistic was 3.32, with a *p*-value of 0.344, indicating no significant association between awareness of different policies. This suggests that awareness of one policy does not ensure awareness of others. These results align with those of Schweber [17], who noted that policy-specific awareness campaigns may not be equally effective across various areas.

5.3.2. *t*-Test for Group Comparison

A *t*-test was conducted to compare the two groups' average awareness levels across the four key policies to investigate the differences between managerial and non-managerial professionals. The result of this test is shown in Table 4.

Table 4. *t*-test group—climate policy and awareness.

Group	Mean Awareness (%)	Standard Deviation
Managerial	85.75%	5.12%
Non-managerial	73.75%	3.86%

The *t*-test showed a *t*-statistic of 4.30 and a *p*-value of 0.005, indicating a significant difference in climate policy awareness between managerial and non-managerial staff. Managerial professionals are generally more aware, likely due to their involvement in decision-making and sustainability strategies [14].

5.4. Discussion and Inferences

The disparity in awareness of climate policies indicates that professionals may not be uniformly informed, suggesting that current awareness efforts are insufficient. Schweber [17] notes that these knowledge gaps can weaken climate change-mitigation strategies.

Furthermore, the difference in awareness between managerial and non-managerial professionals highlights information asymmetry in the construction industry. Managerial staff involved in strategic decision-making tend to understand climate policies better, aligning with the literature that shows that higher-level employees have greater access to policy information [40].

The following bar chart (Figure 11) visually illustrates the differences in awareness levels between managerial and non-managerial professionals for each of the four climate policies.

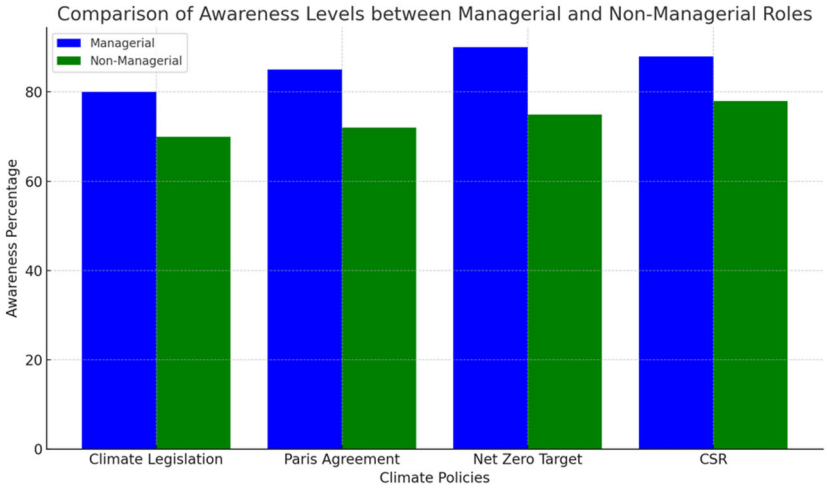

Figure 11. Awareness levels of key climate policies among managerial and non-managerial professionals.

5.5. Recommendations

To address the identified awareness gaps, we recommend the following strategies:

- Targeted awareness campaigns: Develop educational programs for non-managerial staff to improve their understanding of critical climate policies. Ensuring information is disseminated at all levels can foster a more unified approach to sustainability [14].
- Cross-role communication: Encouraging collaboration between managerial and non-managerial staff could bridge the awareness gap, enabling non-managerial employees to be more involved in decision-making processes related to sustainability.
- Regular updates: Implementing systems to update all employees on new or revised climate legislation regularly can prevent knowledge gaps and ensure that all professionals are equally informed about their responsibilities in achieving climate targets.

6. Experience of Climate Change Mitigation in the Workplace

6.1. Introduction

Experience with climate change-mitigation practices, such as green building techniques and reducing greenhouse gas (GHG) emissions, is crucial for reducing the construction industry's environmental impact. While these strategies are essential for lowering the sector's carbon footprint [41], the differences in how managerial and non-managerial professionals engage with them have not been well explored. This study aims to highlight these differences and enhance people's understanding of their approaches to climate change mitigation.

6.2. Methodology

Two statistical tests were used to evaluate the experience levels of professionals:

- Chi-square test: This test was employed to assess whether there were significant associations between the experiences of managerial and non-managerial professionals regarding climate mitigation practices.
- *t*-test for group comparison: An independent *t*-test was conducted to compare the mean experience levels between the two groups for two primary areas: green building practices and GHG emissions reduction.

6.3. Results

6.3.1. Chi-Square Test

The chi-square test was used to assess whether there is a significant association between the experiences of managerial and non-managerial professionals in the workplace across green building practices and GHG emissions reduction. The result of the test is shown in Table 5.

Table 5. Climate mitigation practice.

Climate Mitigation Practice	Managerial (Experience)	Non-Managerial (Experience)
Green building practices	85%	65%
GHG emissions reduction	82%	68%

In the analysis of green building practices, the chi-square statistic was 5.04 (p-value = 0.002), indicating a significant difference between groups. For GHG emissions reduction, the chi-square statistic was 3.76 (p-value = 0.009), also showing a significant difference.

These results suggest that managerial professionals have significantly more experience in green building and emissions reduction than non-managerial staff, aligning with prior studies highlighting managers' roles in leading sustainability initiatives [41].

6.3.2. *t*-Test for Group Comparison

An independent t-test was conducted to explore the magnitude of these differences further. The mean experience percentages of managerial and non-managerial professionals were compared for both climate mitigation areas. The result of the test is presented in Table 6.

Table 6. t-test: group comparison of climate mitigation experience.

Group	Mean Experience (%)	Standard Deviation
Managerial	83.5%	4.87%
Non-managerial	66.5%	3.95%

The t-test results for green building practices indicated a t-statistic of 5.04 and a p-value of 0.002, showing a significant difference between groups. For GHG emissions reduction, the t-statistic was 3.76, with a p-value of 0.009. These findings confirm that managerial professionals have more experience with climate change-mitigation practices than non-managerial staff.

The following bar chart (Figure 12) illustrates the differences in experience levels between managerial and non-managerial professionals for both green building practices and GHG emissions reduction.

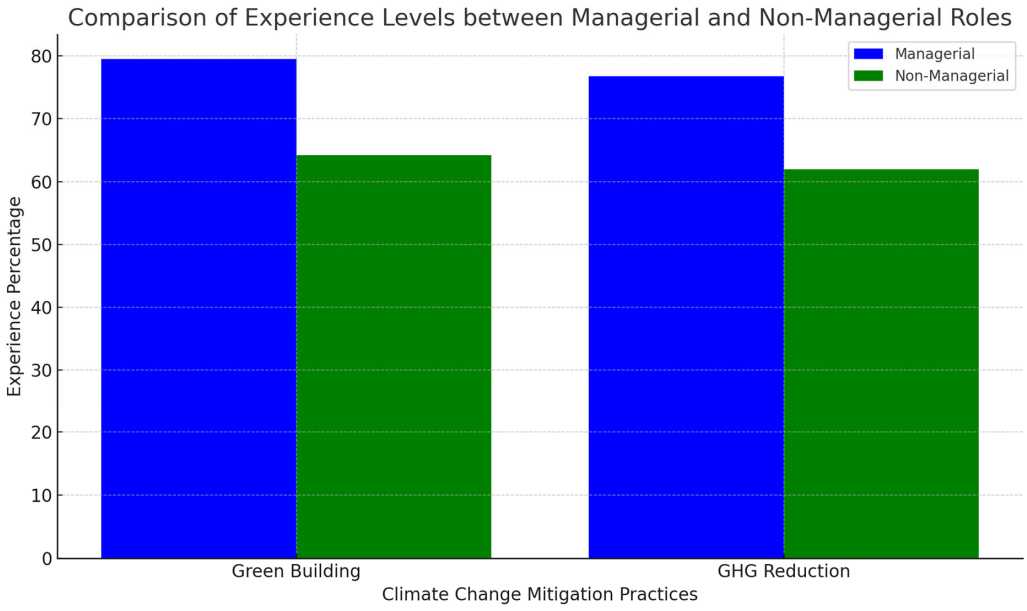

Figure 12. Experience levels of green building and GHG reduction among managerial and non-managerial professionals.

6.4. Discussion and Inferences

The *t*-test results for green building practices indicated a *t*-statistic of 5.04 and a *p*-value of 0.002, showing a significant difference between groups. For GHG emissions reduction, the *t*-statistic was 3.76, with a *p*-value of 0.009. These findings confirm that managerial professionals have more experience with climate change-mitigation practices than non-managerial staff.

6.5. Recommendations

To address disparities in climate change-mitigation experience, the following is recommended:

- Hands-on training: Develop practical training for non-managerial staff to enhance their involvement in green building and emissions reduction [42].
- Collaborative initiatives: Promote collaboration between managerial and non-managerial staff on sustainability projects to bridge experience gaps [41].
- Ongoing development: Regularly update training programs to keep all professionals informed of the latest advancements in climate change mitigation.

7. Confidence in Achieving Climate Change Goals

7.1. Introduction

Confidence in achieving the UK's net-zero target for 2050 and commitments under the Paris Agreement is essential for assessing the construction industry's readiness to adopt sustainability practices. Studies suggest that education, awareness, experience, and economic constraints influence this confidence [14,43]. This section examines these relationships through parametric and non-parametric analyses to identify the critical drivers of confidence in meeting climate change targets.

7.2. Methodology

This study employed parametric and non-parametric statistical techniques to investigate the factors influencing confidence. The following tests were used:

- Exploratory Factor Analysis (EFA) and Principal Component Analysis (PCA) to reduce dimensionality and identify latent factors contributing to confidence.
- Multiple Regression to assess the influence of education, economic constraints, and their interaction on confidence.
- Mann–Whitney U Test, Kruskal–Wallis Test, and Spearman's Rank Correlation to explore the non-parametric relationships between confidence and factors such as education, job role, and years of experience.

7.3. Results

Principal Component Analysis (PCA)

The PCA identified three primary components: Component 1 represents "awareness and engagement with climate policies", Component 2 reflects "economic and logistical constraints", and Component 3 pertains to "confidence levels and educational background". These components capture the key variables that shape attitudes toward climate change mitigation in the construction industry. The PCA revealed that the first three components explain over 95% of the variance in the dataset, with the first component alone explaining 61.81% of the variance. These components are primarily influenced by awareness, experience, education, and economic constraints. The following scree plot (Figure 13) illustrates the variance each component explains.

The component loading plot (Figure 14) shows how the original variables load onto the first three components, demonstrating that education and economic constraints load heavily onto Component 2, while awareness and experience are more associated with Component 1.

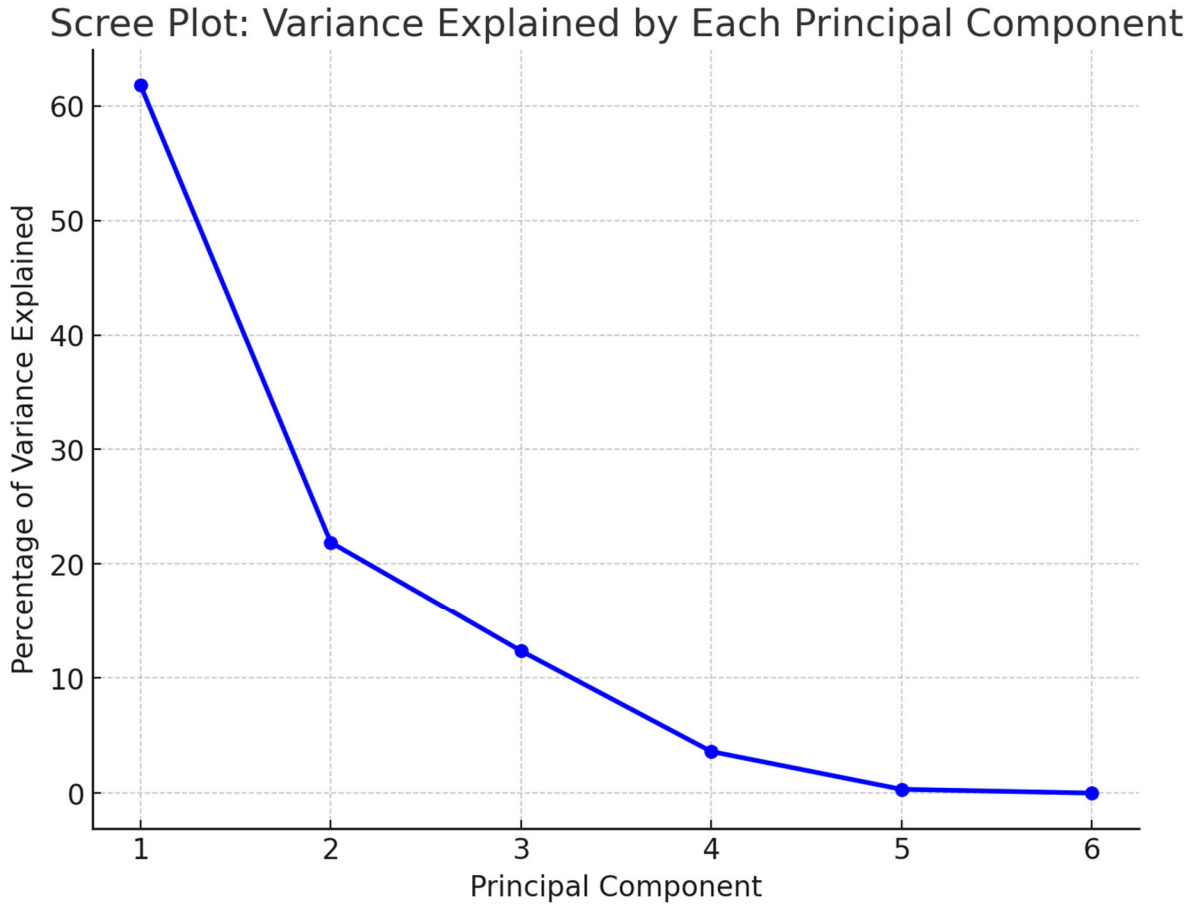

Figure 13. Scree plot showing variance explained by each principal component.

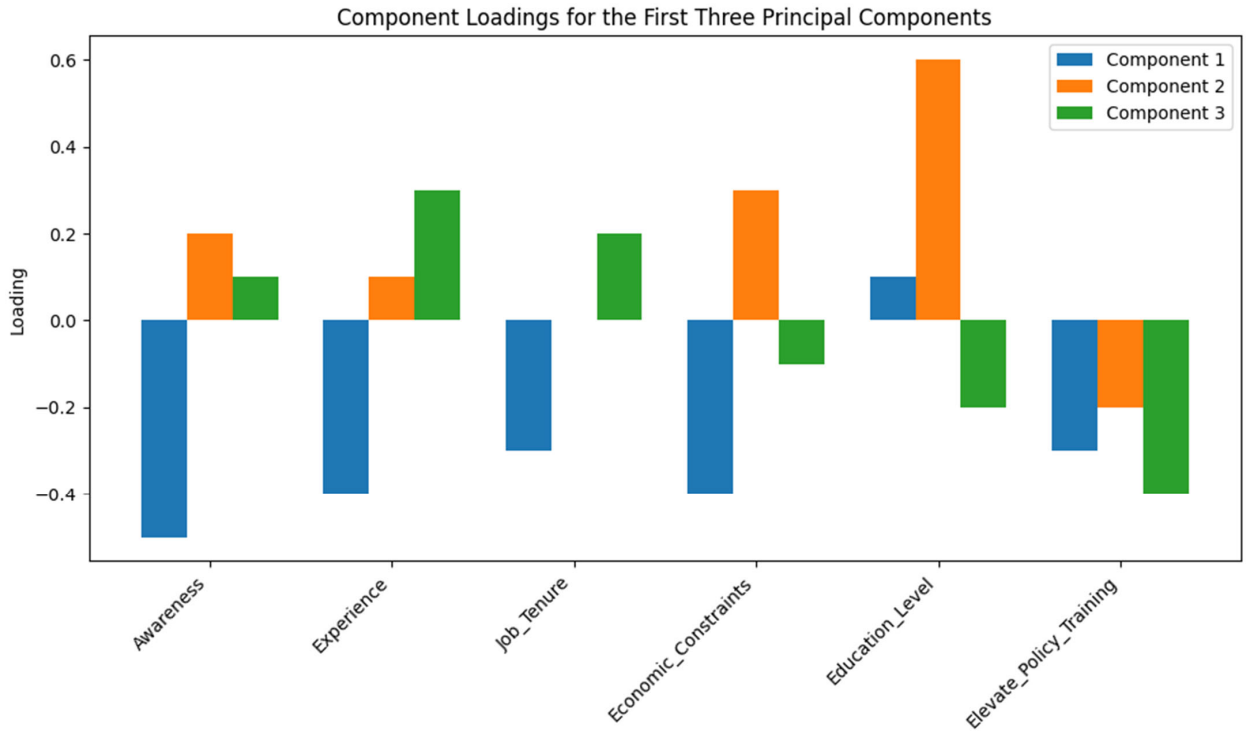

Figure 14. Component loading plot for principal components.

7.4. Regression with Interaction Terms

A regression analysis with interaction terms between education and economic constraints was conducted to assess their joint impact on confidence. The regression results (R-squared = 0.822) indicated that the model explains over 80% of the confidence variance, highlighting these factors' significance. However, while economic constraints had a negative impact on confidence, neither education nor the interaction term was statistically significant. The result of the analysis is presented in Table 7.

Table 7. Regression results with interaction terms.

Variable	Coefficient	*p*-Value
Education level	0.667	0.374
Economic constraints	−1.333	0.116
Education * economic constraints	0.667	0.519

7.5. Mann–Whitney U Test: Education and Confidence

A Mann–Whitney U Test was conducted to compare the confidence levels between professionals with higher education (e.g., postgraduate) and those with lower education (e.g., undergraduate) as shown in Figure 15. The test produced a U-statistic of 15.0 and a *p*-value of 0.052, indicating a borderline significant difference in confidence levels between the two groups.

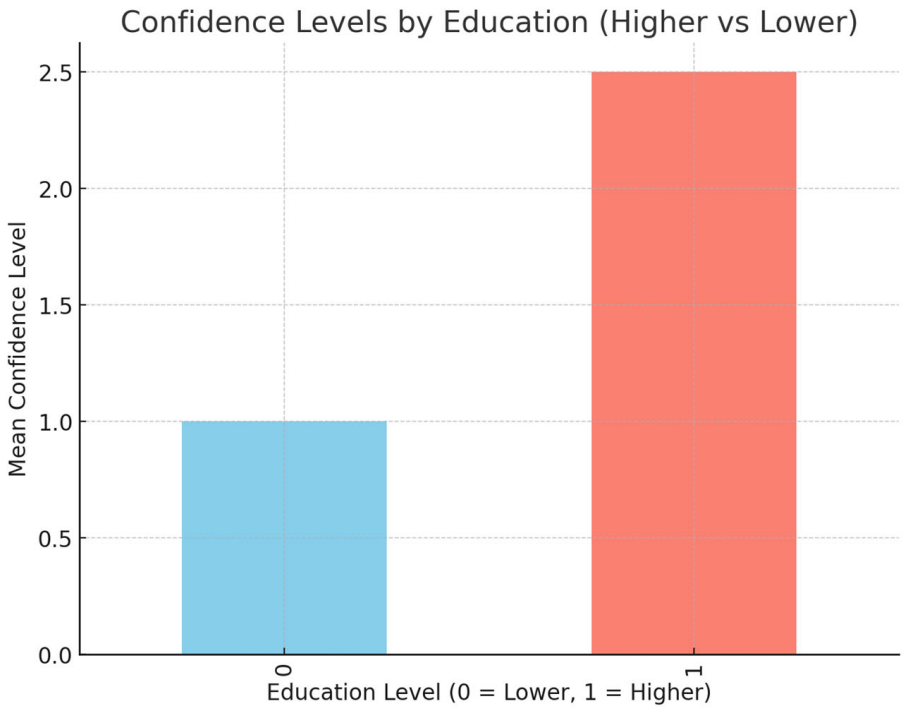

Figure 15. Confidence levels by education (higher vs. lower).

7.6. Kruskal–Wallis Test: Job Role and Confidence

The Kruskal–Wallis Test compared the confidence levels of managerial and non-managerial professionals as shown in Figure 16. The results yielded a Kruskal–Wallis statistic of 0.598 and a *p*-value of 0.439, showing that job role does not significantly affect confidence.

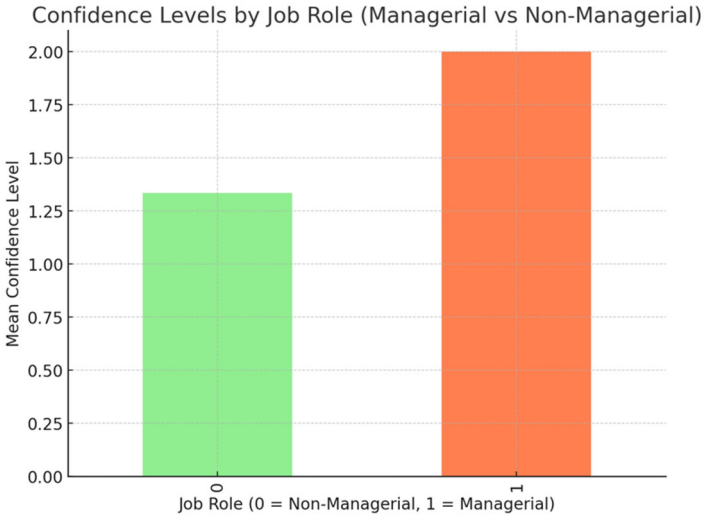

Figure 16. Confidence levels by job role (managerial vs. non-managerial).

7.7. Spearman's Rank Correlation: Years of Experience and Confidence

Spearman's rank correlation was used to explore the relationship between years of experience in sustainability-related roles and confidence. The correlation coefficient was 0.148, with a *p*-value of 0.726, indicating a weak and non-significant correlation between experience and confidence levels.

7.8. Discussion and Inferences

The analysis reveals that education and economic constraints affect confidence in achieving climate change goals. Higher education may boost confidence; however, this effect is not conclusive. Conversely, more significant economic challenges correlate with lower confidence.

Job roles and years of experience do not significantly impact confidence, suggesting that seniority in sustainability roles does not guarantee higher confidence. The Principal Component Analysis (PCA) identified awareness, experience, and education as key factors, explaining much of the variance in confidence.

7.9. Conclusions

The results show that education and economic constraints influence confidence but not significantly. Job roles and experience have minimal impact, suggesting that external factors like organisational support and clear policies play a more significant role. Further research with a larger sample size is needed to understand the drivers of confidence in the construction industry.

8. Perceptions of Barriers to Climate Change Mitigation

8.1. Introduction

Professionals in the construction industry face various challenges in mitigating climate change, including economic constraints, time limitations, a lack of education, reluctance to change, insufficient incentives, and material availability. Understanding how different groups perceive these barriers is essential for creating effective interventions.

Research by Haigh and Griffiths [43] highlights that these barriers can hinder progress. This section aims to achieve the following:

1. Explore whether perceptions of one barrier (e.g., economic constraints) relate to others (e.g., lack of education);
2. Assess if certain groups (e.g., managerial vs. non-managerial) perceive more significant barriers than others.

8.2. Methodology

To address these objectives, the following statistical analyses were conducted:

- Chi-square tests examined relationships between the perceptions of different barriers (e.g., whether those who perceive economic constraints are also likely to perceive a lack of education or reluctance to change).
- *t*-tests compared the perceptions of barriers across job roles (managerial vs. non-managerial) and experience levels.

8.3. Results

8.3.1. Relationships Between Perceived Barriers: Chi-Square Tests

Chi-square tests were performed to explore relationships between economic constraints and other barriers, such as time constraints, lack of education, reluctance to change, lack of incentives, and material availability. The results are summarised in Table 8 and Figure 17.

Table 8. Chi-square results for economic constraints and other barriers.

Barrier	Chi-Square Statistic	*p*-Value
Time constraints	2.13	0.144
Lack of education	2.13	0.144
Reluctance to change	0.50	0.479
Lack of incentives	0.00	1.00
Material availability	0.00	1.00

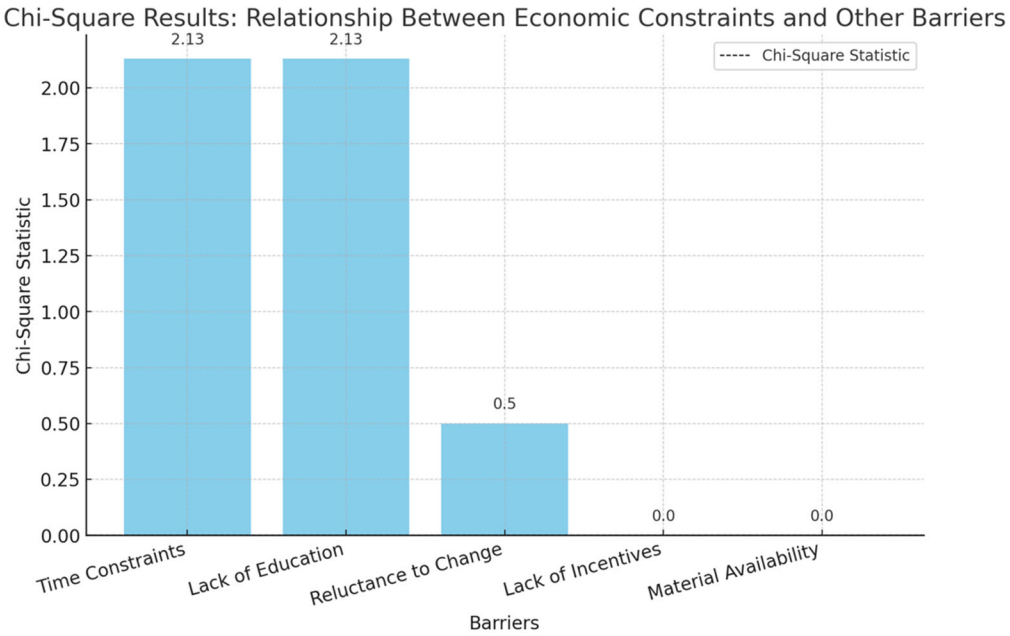

Figure 17. Bar chart of chi-square statistics for barriers.

Key Findings

- The borderline relationship between economic constraints and both time constraints and lack of education suggests that these barriers may be interconnected, as professionals perceiving financial challenges might also face time- and knowledge-related obstacles.

- These findings align with the existing literature that emphasises the interrelatedness of barriers in climate change mitigation [14]. Professionals might benefit from strategies that address multiple barriers simultaneously rather than isolating them.

8.3.2. Group Comparisons: *t*-Tests

t-tests were conducted to compare perceived barriers across job roles (managerial vs. non-managerial) and experience levels. The results are presented in Table 9 and Figure 18.

Table 9. *t*-test results for job-role comparisons.

Barrier	*t*-Statistic	*p*-Value
Reluctance to change	0.65	0.537
Lack of incentives	−1.84	0.116
Material availability	−0.16	0.875

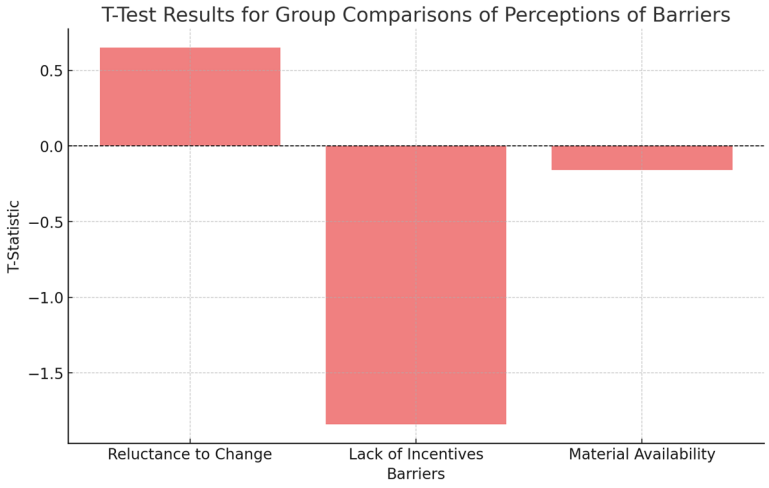

Figure 18. *t*-test results for group comparisons.

Key Findings

- Reluctance to change: There is no significant difference in the perception of reluctance to change among managerial and non-managerial professionals.
- The perception of lack of incentives shows a potential trend (*p*-value = 0.116), suggesting that further investigation could be warranted to explore whether non-managerial staff perceive this barrier more significantly.
- Material availability is perceived similarly across managerial and non-managerial groups, with no significant differences.

Economic constraints emerged as the most prominent barrier to climate change-mitigation efforts in the UK construction industry, as demonstrated by the Multiple Regression analysis (R^2 = 0.822). This indicates that the financial pressures faced by companies often outweigh their capacity to meet sustainability targets. This issue is exacerbated by the high upfront costs associated with green technologies and sustainable construction materials, limiting industry-wide adoption of environmentally friendly practices.

8.4. Discussion and Inferences

The analysis indicates no significant relationships among most perceived barriers; however, there is a borderline significance between economic constraints, time limitations, and lack of education. Professionals facing financial challenges view time and knowledge gaps as crucial obstacles to climate change mitigation. While perceptions of barriers

are consistent across roles, non-managerial professionals have noted a lack of incentives, suggesting a need for more transparent communication about available support.

8.5. Conclusions

Barriers to climate change mitigation in the construction industry are consistent across professional groups. Key challenges include economic constraints, time limitations, and a lack of education. Future research should consider a larger sample size and explore factors like organisational support and policy clarity. Addressing these issues could improve the industry's effectiveness in combating climate change.

Impact Mechanism

The construction industry operates on tight profit margins, and transitioning to green practices often increases project costs. Without significant financial support, companies will likely prioritise short-term profitability over long-term sustainability. Additionally, smaller firms are disproportionately affected by these financial constraints, further limiting the sector's ability to meet national climate goals.

- Alleviating the impact of economic constraints: Several strategies can be employed to mitigate these challenges:
- Financial incentives: Introducing tax-relief schemes or government subsidies aimed at green construction practices would reduce the financial burden on companies. This could encourage wider adoption of sustainable building technologies.
- Government support for innovation: Increased government investment in R&D to develop low-cost, low-carbon building materials would lower the entry cost for companies aiming to implement sustainable practices.
- Public–private partnerships: Collaboration between the public sector and construction firms could accelerate the transition to greener practices. Public investment in large-scale green projects would allow the private sector to adopt more sustainable practices without prohibitive costs.

9. Demographics and Job Hierarchy

9.1. Introduction

Understanding the impact of job hierarchy on professionals' awareness, experience, confidence, and perceptions of climate change mitigation is critical to assessing how organisational structures shape attitudes toward sustainability. This section examines the relationship between hierarchical roles (Level 1 to Level 4) and these factors.

Research by Haigh and Griffiths [43] underscores the role of organisational context in shaping sustainability perceptions. The objectives of this section are as follows:

1. Evaluate differences in awareness, experience, confidence, and perceptions based on hierarchical roles.
2. Use ANOVA to assess the influence of these roles on the variables.

9.2. Methodology

To achieve these objectives, ANOVA was employed to compare means across the company's four levels of hierarchical roles. The dependent variables for the analysis include the following:

- Awareness: Measured on an ordinal scale.
- Experience: Categorical variable indicating the number of years in the industry.
- Confidence: Measured on a Likert scale (e.g., 1–5).
- Perceptions of barriers: As discussed previously.

9.3. Results

9.3.1. Relationships Between Perceived Barriers: ANOVA Analysis

ANOVA tests were performed to explore differences in awareness, confidence, and experience across hierarchical roles. The results are summarised in Table 10 and Figure 19.

Table 10. ANOVA results for awareness, confidence, and experience by hierarchical role.

Variable	F-Statistic	*p*-Value
Awareness	2.02	0.115
Confidence	1.17	0.324
Experience	1.37	0.257

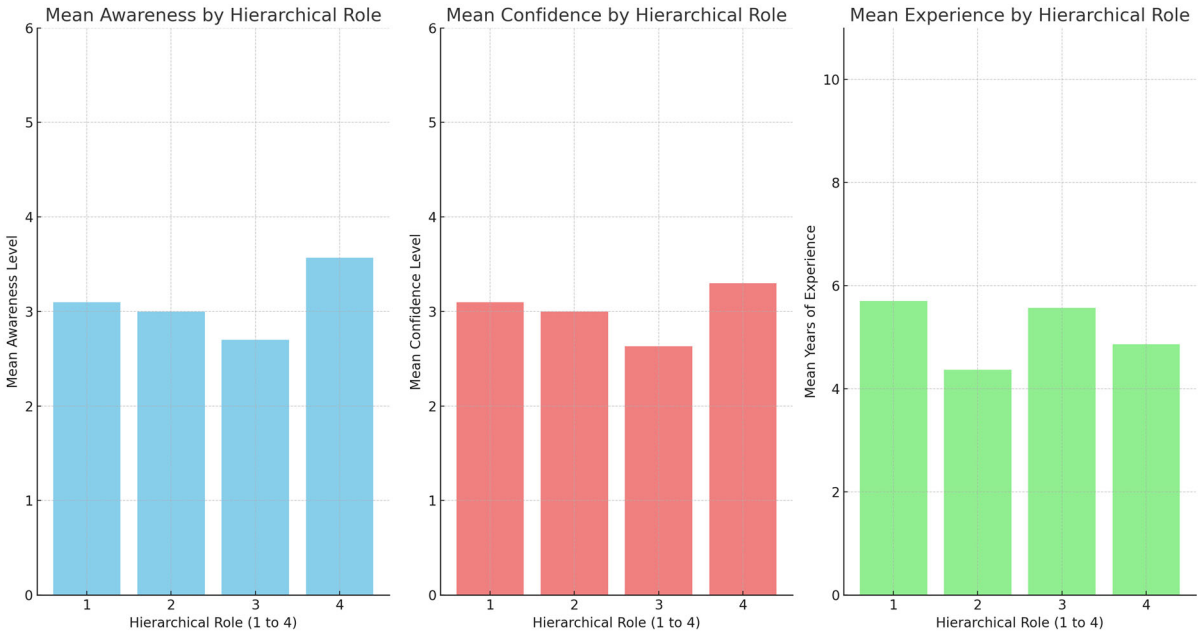

Figure 19. ANOVA results for awareness, confidence, and experience by hierarchical role.

Key Findings

- Awareness: The result is not statistically significant ($p > 0.05$), suggesting that perceptions of awareness do not significantly differ across hierarchical roles.
- Confidence: This result is also not statistically significant, indicating no differences in confidence levels across hierarchical roles.
- Experience: The analysis shows no significant differences in experience across hierarchical roles, as indicated by the non-significant *p*-value.

9.4. Discussion and Inferences

The analyses show no significant differences in awareness, confidence, and experience across hierarchical roles. However, they provide important insights into how professionals perceive challenges in climate change mitigation.

The absence of significant results suggests that barriers to climate change are recognised across all levels, indicating that all professionals need awareness and confidence, regardless of their position [14]. Future research could further explore this area, particularly with larger sample sizes and more diverse datasets, to capture more nuanced differences. Additionally, incorporating qualitative methods, such as interviews or focus groups, could help understand the underlying factors that shape these perceptions.

9.5. Statistical Analysis: Key Findings

The demographics and job hierarchy analysis indicate that perceptions of barriers to climate change mitigation appear consistent across different hierarchical roles. Although awareness, confidence, and experience did not significantly differ, this study highlights the importance of ensuring that all professionals, regardless of their position, are equipped with the knowledge and confidence to tackle climate challenges effectively. Future research should continue to investigate these dynamics, including the role of organisational support and external incentives. This statistical analysis reveals critical insights into the construction industry's approach to climate change mitigation.

- The Awareness Analysis identified a significant gap between managerial and non-managerial staff, with the latter showing lower awareness of crucial climate policies, underscoring the need for targeted educational programs.
- The Experience Analysis showed that managerial professionals have more hands-on experience with green building practices and GHG emissions reduction, highlighting the need for more inclusive training for non-managerial staff.
- In the Confidence Analysis, education was positively linked to confidence, while economic constraints significantly hindered it. Addressing these financial barriers is essential for boosting confidence across all roles.
- The section on perceptions of barriers (Section 8) found that non-managerial staff felt more constrained by a lack of incentives, emphasising the importance of improving incentive programs and communication.
- Finally, the job hierarchy analysis showed no significant differences across roles in awareness, experience, or confidence, suggesting that equal access to resources and training should be a priority.

In summary, closing the gaps in awareness, experience, and confidence, particularly for non-managerial staff, is vital to fostering more effective climate change mitigation across the construction industry.

10. Discussion

According to the results, insufficient money and time are spent learning about climate change and its mitigation in construction (Figure 4a). Reduced investment and education may be due to low prioritisation of environmental impact, alongside the availability of money and time. Without the education of the workforce, the industry will find it extremely difficult to improve and progress to contribute toward achieving the UK's goals for climate change mitigation. As underlined by Zuo and Read [25], industry knowledge in Australia is crucial in helping the carbon-neutral concept progress.

The *t*-test results further validate this, showing a significant gap in awareness between managerial and non-managerial professionals ($p < 0.005$). Managerial staff exhibited higher awareness of key climate policies, such as the UK Net Zero Target and the Paris Agreement, indicating a disparity that could hinder the UK's progress. These results reinforce the need for targeted educational programmes to close the awareness gap among non-managerial staff. The data suggest that the opinion of those working within the construction industry is that the UK is incapable of reaching the net-zero greenhouse gas emissions target for 2050, based on their experience in the workplace (Figure 4b). This indicates that, from what they have seen in the industry, there is little faith in the UK's ability to reduce greenhouse gas emissions to such an extent. This was further investigated by asking if the UK is capable of change to contribute toward limiting global warming below 2—preferably to 1.5—degrees Celsius, compared to pre-industrial levels (as in the Paris Agreement; Figure 10). Here, slightly more belief is displayed, suggesting that some people think the construction industry can change (33% agree and 5% strongly agree). However, there is no confidence in limiting global warming to the levels described in the Paris Agreement. Some researchers [35] describe the need for meaningful action to reduce emissions and increase the probability of avoiding a 2 °C rise in global temperature,

with the current likelihood being very low. The chi-square test further supports these perceptions, revealing significant disparities in experience with green building practices and GHG emissions reduction between managerial and non-managerial professionals ($p < 0.009$). Managerial staff reported more hands-on experience in implementing these sustainability practices. This suggests that non-managerial staff are not as engaged in climate mitigation efforts, which could explain the lack of confidence in meeting climate goals. Inclusive training programmes are needed to actively involve non-managerial professionals in sustainability initiatives.

The reasons for this lack of confidence were investigated by asking participants to describe any barriers to the UK's ability to mitigate climate change that they had experienced (Figure 6). The barriers suggested include economic constraints, time constraints, lack of education, reluctance to change, and lack of incentives and material availability. Economic constraints appear to be the standout leader in barriers to climate change mitigation, indicating that the need to meet the target profit margin outweighs the need to meet climate change targets for companies across the UK construction industry. The Multiple Regression analysis strengthens this conclusion, showing that economic constraints significantly reduced confidence in achieving climate change goals ($R^2 = 0.822$). The results suggest that economic pressures, rather than education levels, are the primary obstacle to confidence across all hierarchical roles. Addressing these financial barriers is essential for building confidence in the UK construction industry's ability to meet its climate mitigation targets.

The need to meet financial targets links clearly with the recommendations for improvement made by the participants (Figure 7). These recommendations include incentivisation, education, and improvement of materials and economic investment. These results suggest that financial incentivisation is required to motivate companies to make proactive changes toward more sustainable methods and green construction practices. Alongside improving the workforce's education, this may include learning about methods to reduce greenhouse gas emissions and the reasons why this transformation is necessary. The need for education is at the core of the Egan Review 2004, where recommendations are made for the government to work with education providers, professional institutions, and employers more to increase their understanding of the role in sustainable communities [18]. The *t*-test results corroborate this, showing that **non-managerial professionals** were significantly more likely to cite a **lack of incentives** as a barrier ($\boldsymbol{p = 0.116}$) compared to their managerial counterparts. This finding highlights the importance of financial incentives as a crucial motivator for encouraging non-managerial staff to engage in green construction practices.

Participants also suggest the improvement of materials and economic investment. This indicates that the goals set for the UK are unattainable unless the industry focuses and invests heavily into improving what is used to build rather than solely the method through which it is carried out. For example, Röck and Saade [31] discuss the need to reduce embodied greenhouse gas emissions, and they state that materials with net-zero greenhouse gas emissions are required from the production industry. The **PCA** analysis further supports this recommendation, showing that **education** positively correlates with **confidence** in achieving climate goals. Improving the workforce's understanding of climate change-mitigation practices will empower professionals to engage more effectively with sustainability efforts. Additionally, innovation in construction materials, as highlighted by Röck and Saade [31], will be necessary for reducing the embodied carbon emissions in buildings.

11. Conclusions

11.1. Findings and Conclusions

This study has outlined the state of awareness and knowledge of UK construction industry professionals toward climate change and associated legislation and measures. Below are the key conclusions derived from the study:

The UK construction industry shows a high awareness of climate change mitigation and changes due to legislation. However, confidence in achieving net-zero targets by 2050 is

lacking, particularly among non-managerial staff, due to limited practical experience with climate change-mitigation practices. To bridge this gap, targeted educational programmes and the involvement of all levels of staff in sustainability initiatives are essential. Industry division exists in its contribution to preventing global temperature rise as per the Paris Agreement, likely due to varied experiences and organisational differences. Managerial staff are more engaged with hands-on sustainability practices, but non-managerial staff must be included through better access to training and on-the-ground involvement. This reflects findings from the chi-square test, which showed significant disparities in hands-on experience between managerial and non-managerial professionals. These findings indicate improved awareness compared to past studies. To ensure progress, the industry must be informed about targets and legislation. Training and awareness programs on biodiversity and the built environment are recommended for construction professionals.

Climate change mitigation and green construction practices are not routinely discussed in the construction industry, even among influential professionals. This lack of discussion extends to ground-level employees, indicating a gap between legislation and implementation in the UK. The *t*-test further demonstrated that non-managerial staff were more likely to cite a lack of incentives as a significant barrier, emphasising the need for financial motivators to improve participation in green construction practices. This aligns with Saleh and Al-Swidi's [28] findings in Qatar, highlighting the importance of governmental support, green engagement, and environmental concern for implementing green construction practices.

The focus on sustainable development is increasing, encompassing various elements beyond climate change mitigation. However, there is a lack of resolution regarding the environmental impact on business choices. Construction companies must prioritise considering their projects' contribution to greenhouse gas emissions and the environment. As Khasreen and Banfill [32] concluded, a matter of urgency is required to consider buildings' embodied energy and environmental impact. Expanding education and providing clear guidelines for sustainable practices will empower professionals to align with environmental goals.

Legislation has impacted the construction industry, leading to increased green practices and efforts to reduce greenhouse gas emissions. However, there is a lack of implementation, policy, and incentives. The Multiple Regression analysis confirmed that economic constraints significantly reduce confidence in achieving climate goals, underlining the need for government-led incentives and financial support to drive action. This highlights the need for more government support and promotion to translate measures into action. Political support, guidance, resources, and incentives are crucial for climate protection [36]. Professionals express the need for more investment in climate change education. Without it, achieving zero carbon goals will be challenging.

Confidence is low in the construction industry regarding the UK's ability to achieve net-zero greenhouse gas emissions by 2050. Professionals attribute this to economic constraints, lack of education, resistance to change, and lack of incentives. Overcoming these barriers is crucial for limiting global warming. Recommendations from professionals include incentivisation, education, improving materials, and economic investment, all of which are essential to reaching the UK's climate change targets. These findings align with the existing literature [10,18,27,36].

11.2. Further Research and Limitation of the Study

This investigation identifies areas for improvement in the construction industry and the UK, suggesting avenues for further research. Besides the recommended improvements, research can explore advanced strategies, like negative emissions technologies and work-time reduction [22], for climate change mitigation. This research will provide insights into enhanced approaches for addressing climate change by collecting data from UK-based professionals through a survey. Despite the efforts of the authors to eliminate some types of bias, such as social-desirability bias, by adopting anonymous data collection, there are still some limitations and biases inherent in this research. The number of samples was

limited to 40 UK-based construction professionals on LinkedIn over two months, causing limitations and bias toward the active people on this platform during that time.

11.3. Recommendations

Based on the findings of this study, the following recommendations are proposed for government and industry stakeholders:

- Financial Incentives for Sustainable Construction:
  The Multiple Regression analysis confirmed that economic constraints are a major barrier to achieving climate change goals. To address this, the government should offer targeted financial incentives such as tax relief or grants for companies that adopt low-carbon technologies and sustainable construction practices. These incentives will be crucial in offsetting the initial costs associated with green practices, encouraging broader industry participation, especially for small- and medium-sized enterprises (SMEs).
- Educational Programmes and Training:
  The *t*-test results identified a significant gap in awareness and practical experience between managerial and non-managerial staff. To address this, tailored educational programmes should be implemented across all levels of the workforce, ensuring that sustainability principles are well understood and practised. These programmes should focus on developing skills in green construction, climate change legislation, and the use of energy-efficient technologies.
- Investment in Sustainable Building Materials:
  Meeting the UK's climate targets will require significant improvements in the materials used in construction. Government and industry should collaborate to invest in research and development (R&D) for low-carbon and net-zero emission building materials. Encouraging innovation in this area will be critical to reducing the embodied carbon of buildings and achieving long-term sustainability.
- Policy Enforcement and Clarity:
  The research highlighted that a lack of clear policy enforcement undermines confidence in achieving climate targets. To address this, the government should provide clearer guidelines and stronger enforcement mechanisms for climate change regulations. Ensuring that companies, particularly smaller firms, understand how to comply with and benefit from these regulations will drive the industry toward net-zero emissions by 2050.
- Inclusive Climate Change Strategies:
  Non-managerial staff often feel disconnected from climate change initiatives. To foster a more inclusive approach, the government and industry should promote strategies involving all staff levels in sustainability initiatives. Recognition and reward schemes for participation in green initiatives will ensure that all employees are engaged in achieving climate change goals, creating a culture of sustainability throughout the industry.

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