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Exploring the Values of Sustainability and the Cost of Going Green: A Case of Building Research Establishment Environmental Assessment Method (BREEAM)

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ABSTRACT: Despite the expansion of BREEAM and the benefits of adopting sustainable building practices, there are concerns that the cost of going green may outweigh the benefits. Whilst previous studies have not provided adequate clarity in this regard, there is consensus among scholars that BREEAM provides indirect benefits that can be considered as added value. This paper aims to investigate the potential cost implication and benefits of sustainable building practices from the lens of the Building Research Establishment Environmental Assessment Method (BREEAM) in the UK. Adopting survey research strategy, questionnaires, and interviews with 34 construction industry professionals in Southeast England were conducted to investigate their perceptions of BREEAM, the extra value it contributes to projects, and the possible limitations hindering its wider adoption. Findings show that while there is an upfront investment associated with achieving BREEAM certification, the benefits of such certification include added values such as improved environmental performance, increased market appeal, improved indoor air quality, reduced carbon emissions, and lower operational costs. This study validates the need to encourage wider adoption of sustainable building practices and promote the use of the BREEAM methodology in the UK. This research provides a foundation for future research and development in this area, with the goal of reducing carbon emissions and promoting sustainable development.

Keywords: BREEAM; Benefits; Cost; Construction industry; Sustainability; Values

1. Introduction

The built environment is one of the largest emitters of greenhouse gases globally accounting for 39% of global energy-related CO_2 emissions [1,2]. This is more prominent in cities which are responsible for up to 80% of global energy consumption [3]. This is primarily due to the energy-intensive nature of construction activities, such as the production of materials, transportation, and building operations. For existing building stock, the challenge is inefficiency in energy consumption and capacity for adaptive reuse [4]. The United Kingdom Green Building Council (UKGBC) reported that in 2018, the total emissions by the built environment reached 42%. This raises a concern to address this challenge before it poses a global threat of irreversible damage.

Historically, the global environmental concern regarding construction and its impact on CO_2 emissions dates to the 1970s coinciding with the world's first energy crisis emphasising the urgency for sustainable practices in the construction industry [5]. Grant [6], Skjerven and Martins [7] and Grover et al. [8] explored the development of modern construction and emphasised that the industry must be responsive to its environmental context to be sustainable and that architects must consider the long-term consequences of their design decisions on the natural environment. However, despite the pressing concerns over the impact of construction on the environment, not much was achieved between then and 1987, when the United Nations (UN) Brundtland Commission developed its sustainable construction framework to combat climate change, with the introduction of Green Buildings. The idea is to ensure that development of today does not negatively affect future generations by defining sustainability as meeting the needs of the present without compromising the ability of future generations to meet their own needs [9].

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Green buildings have been conceptualised by the Office of the Federal Environmental Executive (OFEE) in the two following ways. Firstly as "increasing the efficiency with which buildings and their sites use energy, water, and materials" and secondly "reducing building impacts of human health and the environment, through better siting, design, construction, operation, maintenance, and removal throughout the complete life cycle" [10]. Green buildings are designed to minimise their impact on the environment and promote sustainability by incorporating features like renewable energy systems, green roofs, and rainwater harvesting systems to further reduce their environmental impact. As awareness of the importance of sustainability continues to grow, the demand for green buildings is on the rise as documented in Weerasinghe and Ramachandra et al. [11], Yin et al. [12], and Yang et al. [13]. Governments, businesses, and individuals around the world are increasingly prioritising sustainability in building design and construction. This is perhaps to help the built environment in contributing to deliver the Sustainable Development Goals (SDGs) and other global agenda such as the Paris Agreement.

On the other hand, the increasing awareness of the environmental impact of buildings has led to a growing interest in building environmental assessments (BEA). BEA tools have been developed globally to evaluate sustainable construction practices, as well as forethinking life cycle energy efficiency to prioritise sustainable building practices, and continued expansion of BEA tools [14]. BEA tools support the goals of Agenda 21 by promoting sustainable building practices and encouraging the construction of environmentally friendly buildings [15], which emphasise the need for sustainable development to meet the needs of the present generation without compromising the ability of future generations to meet their own needs [16]. Additionally, BEA tools have been recognised as a potential solution to mitigate carbon emissions by promoting sustainable practices in building construction and operations [14]. Globally, there are several BEA tools available such as Leadership in Energy and Environmental Design (LEED); Building Research Establishment Environmental Assessment Method (BREEAM); Green Star in Australia; HQE in France; and Comparative of Assessment System for Built Environment Efficiency (CASBEE) in Japan.

The Building Research Establishment Environmental Assessment Method (BREEAM) was launched in 1990 in Watford, England [17], and is a widely recognised and well-established method for assessing and improving the environmental sustainability of buildings [18]. BREEAM has been involved in ensuring that buildings have been built sustainably. An example of this is the Shard in London which is one of Europe's tallest buildings that achieved an 'Excellent' BREEAM rating because 95% of its construction materials comes from recycled sources [19]. Several successes of BREEAM through demonstration projects suggests that it is essential for stakeholders and investors to comprehend the advantages of the uptake BREEAM as an environmental assessment method in delivering green buildings [17]. Additionally, stakeholders and investors need to understand both the potential values as well as potential costs implications raising key questions around its accessibility and affordability, balancing of environmental benefits with its potential costs, and maintaining relevance and effectiveness in promoting sustainable development.

As a result, despite the benefits of adopting sustainable building practices and the continued expansion of BEA tools, there are concerns that the cost of going green may outweigh the benefits [20]. This perceived high cost can lead to reluctance to embrace sustainable building practices, hindering progress towards reducing carbon emissions [21]. To this end, it is crucial to address the potential cost-benefit trade-offs of sustainable building practices and BEA tools to encourage wider adoption of sustainable practices and mitigate carbon emissions in the UK. Although there are many advantages to implementing sustainable construction, there are concerns that the expenses associated with adopting environmentally friendly practices could be greater than the benefits, with stakeholders hesitant to invest in sustainable technologies due to perceived high costs [22]. In addition, in a survey by the Urban Land Institute, cost remains a concern to a more widespread adoption and acceptability of sustainable building practices. It is perceived that sustainable technologies are too expensive, which can discourage stakeholders [23]. Additionally, the recent Brexit, COVID-19 pandemic, and war in Ukraine have led to construction material shortages and increased costs of raw materials, adding to concerns about adopting sustainable practices [24].

Several studies have highlighted the importance of sustainable design and construction practices for reducing the environmental impact of buildings [5,25,26] and promoting occupant well-being [27–29] with BREEAM emerging as a popular tool for assessing the sustainability of buildings in the UK and other countries [19]. However, there appears to be no evidence in literature of a study exploring the cost implications of implementing BREEAM standards within the commercial refurbishment sector, particularly in comparison to conventional building practices. While some studies have suggested that green building practices can result in long-term cost savings through reduced energy and maintenance costs [30,31], others have raised concerns about the up-front costs of implementing sustainable design features [32,33]. Therefore, a research gap exists in understanding the balance between the benefits of sustainability and the costs of implementing green building practices, specifically in the context of BREEAM Refurbishment and fit-out. The choice of BREEAM for this study amongst other BEA tools is because of its pioneering position as the first green building rating system in the world. Beyond the UK where it was launched, its has been used widely in other countries through the national scheme operators. Additionally, it has come in various protocols and standards depending on the type of project. These include: BREEAM New Construction, BREEAM Refurbishment and fit-out, BREEAM In-use, BREEAM Communities, and BREEAM Infrastructure amongst others. According to BRE [34], over 1 million certificates have been issued covering about 2.9 million registered buildings which spread across 103 countries. It is important to note that the various standards and protocols have been continually revised to ensure that it meets the ever-evolving sustainability challenges.

To this end, the aim of this paper is to explore the values of sustainability offered by BREEAM and to investigate the economic costs and benefits associated with adopting the sustainable building practices the methodology advocates for, with a focus on the refurbished commercial fit-out.

This paper is structured as follows: Section 2 explores BREEAM from the perspective of the sustainability values that it delivers and its associated cost. Section 3 presents the methodology for this paper followed by the results and findings in Section 4. The discussion of issues that emerged from the findings is captured in Section 5 with key conclusions and areas for future research in Section 6.

2. Overview of BREEAM: Sustainability Values and Associated Cost

2.1. Building Research Establishments Assessment Method

The Building Research Establishment Environmental Assessment Method (BREEAM) is noted as the world's foremost environmental assessment method and rating system for buildings [35]. Developed by the Building Research Establishment (BRE) and launched in 1990, BREEAM was the world's first green building rating system, which aims to sustainably shape the built environment, through scientifically proven data and technology; fundamentally assisting the global climate target and net zero emissions by 2050 as documented in United Nations [36]. It aims to comprehensively evaluate the sustainability and environmental performance of buildings [37]. BREEAM provides a framework for assessing the environmental impact of buildings and encourages the adoption of sustainable design practices. It also provides a benchmark for building sustainability, helping to drive the development of more sustainable buildings. The assessment process is designed to be simple, transparent, and accessible, allowing building owners, developers, and architects to understand the environmental performance of their buildings [38].

The Building Research Establishment (BRE) aims to challenge the potential threat, and provide a sustainable built environment, through its 10-category assessment:

(i) Management; (ii) Health and wellbeing; (iii) Energy; (iv) Transport; (v) Water; (vi) Materials; (vii) Waste; (viii) Land use and ecology; (ix) Pollution; and (x) Innovation.

Each of the above measures a project or building's sustainable value by its economic, environmental, and social dimensions [39]. The scores obtained in each category are used to calculate an overall sustainability score for the building [37]. This is also helpful to provide a final BREEAM rating which offers assurance on performance, quality, and value of the asset [40]. This rating could be 'outstanding', 'excellent', 'very good', 'good', 'pass', and 'unclassified'. According to Mann [41], achieving the highest levels of BREEAM's building standards costs on average between 10–12% more than abiding by standard building practices. This suggests that it is beneficial for developers to consider sustainable assessment methods and identify if a BREEAM accredited project offers a financial return.

2.2. BREEAM Refurbishment and Fit-Out

The BREEAM Refurbishment and Fit-Out (RFO) Compliance Note provides guidance for assessing the sustainability of refurbishment and fit-out projects. The note sets out the requirements and procedures for achieving BREEAM certification for such projects, as well as providing guidance on how to achieve the highest possible rating (BRE Global, 2014a). According to the BRE Global (2014b), the assessment process for refurbishment and fit-out projects is divided into several stages.

- First, the project team must complete a pre-assessment to identify the sustainability goals and targets for the project.
- Second is the design-stage assessment, which evaluates the sustainability of the design proposals and identifies any areas where improvements can be made (BRE Global, 2014a).
- Third is that once the design has been finalised, a post-construction assessment is carried out to evaluate the sustainability of the completed project. This includes an assessment of the building's energy and water use, as well

as the materials and products used in the construction process. The assessment also considers the building's indoor environmental quality, including factors such as lighting, thermal comfort, and air quality [38].

To achieve the highest possible BREEAM rating for refurbishment and fit-out projects, the compliance note recommends several sustainable design strategies, including the use of low-carbon and renewable energy sources, the incorporation of water-efficient fixtures and fittings, and the use of sustainable materials and products. The note also emphasises the importance of engaging with stakeholders throughout the project, including occupants, building managers, and maintenance staff (BRE Global, 2014b).

2.3. Sustainability Values of BREEAM Accreditation

The term value in sustainability denotes the incorporation of economic, social, and environmental aspects into the decision-making process to promote the long-term well-being and equilibrium among these three dimensions [42,43]. It is a triple bottom line approach which requires consideration of economic, social, and environmental factors in business operations as echoed by Patala et al. [44] and Wagner and Kabalska [45]). Therefore, embedding sustainability values into business activities can lead to the creation of shared value, which means generating both economic and social benefits simultaneously [46]. Additionally, BREEAM seeks to enhance sustainable value for both building investors and users. This involves an assessment of the building's lifespan and the satisfaction of its users, while also adding value to the environment and economy through sustainable construction practices [38].

2.3.1. Stakeholders Values and Challenges for Engagement

An investigation into the perceptions of building owners, managers, and occupants suggests that the stakeholders perceive BREEAM as having a positive impact on building performance. These include improved energy efficiency, enhanced user satisfaction, and increased market value [47,48]. In a more recent study, Farid et al. [49] noted that stakeholder engagement has a positive impact on the environmental performance of buildings, because it allows for the identification of specific sustainability goals and the development of strategies to achieve them.

However, whilst there are several barriers to stakeholder engagement in BREEAM assessments, Schweber [50] noted that inadequate knowledge and awareness is the most critical. This is because many building users and other stakeholders may not be familiar with the BREEAM assessment process, its benefits, or how they can contribute to it resulting in lack of interest and participation in the assessment. Furthermore, another significant barrier is time and resource constraints. Stakeholder engagement can be time-consuming and resource-intensive, particularly for large or complex building projects. This is because, building users and other stakeholders may have other priorities or competing demands which can make it difficult to fully engage with the BREEAM assessment process [51]. Other barriers which can contribute to inadequate engagement and participation and that can ultimately impact the success of sustainable building projects are: non-provision of incentives for stakeholders to participate, inadequate communication and feedback between stakeholders and assessors in terms of clarity around stakeholder roles and responsibilities.

2.3.2. Occupancy Values

According to Taylor and Pineo [52], BREEAM certification can positively impact user satisfaction in several ways. For example, BREEAM encourages the use of sustainable materials, which can improve indoor air quality and reduce the risk of health problems for occupants. Additionally, BREEAM promotes the use of natural light and ventilation, which can enhance the well-being and productivity of office workers, employee well-being, and overall organisational performance. Mendell et al. [53] noted that higher indoor environmental quality is associated with improved productivity, reduced absenteeism, and increased job satisfaction among building occupants. BREEAM recognises the importance of user satisfaction and incorporates several criteria into its assessment process that is designed to promote comfort, health, and well-being for building occupants.

2.3.3. Economical Values

The economical values of BREEAM certification have shown to include an increase in the value of properties, reduce operating costs, and improve marketability [54]. Additionally, van Overbeek et al. [55] argued that BREEAM-rated buildings tend to have higher vacancy rates and rental incomes. Jones Lang Lasalle [19] noted that BREEAM-certified buildings in the UK achieved higher rents and higher occupancy rates compared to non-certified buildings. Additionally, the capital value of BREEAM-certified buildings was 3–4% higher than non-certified buildings.

Furthermore, BREEAM certification was seen as an important factor in attracting tenants and achieving higher rental values whilst reducing void periods and improving the resale value of properties [56]. However, Hasan and Zhang [57] identify a potential economic disadvantage which is that the cost of achieving and maintaining green certification can be high and can be particularly challenging with limited resources.

2.3.4. Environmental Values

BREEAM-rated buildings have been found to have lower carbon emissions, reduced energy consumption, and better indoor air quality [54] which according to van Overbeek et al. [55] can result in a positive impact on the health and well-being of occupants, as well as contribute to the achievement of global sustainability goals. In another study, Soulti and Leonard [58] discovered that BREEAM-certified buildings in the UK achieved an average reduction of 25% in CO_2 emissions and a 22% reduction in energy consumption compared to non-certified buildings. In addition, BREEAM-certified buildings achieved an average reduction of 9% in water consumption and a 14% reduction in waste generation. It is noteworthy that these reductions also yield economic values from significant savings on operating costs.

However, there is some evidence that BREEAM accreditation may not always translate into better environmental performance especially its adoption to assess the sustainable use of architectural culteral heritage [59]. Moreover, there is a concern that the focus on certification may result in neglect of other environmental issues such as water and waste management [60]. which could lead to negative environmental impacts and undermine the overall sustainability of the building.

2.4. Costs Associated with BREEAM Accreditation

There are various costs associated with obtaining a BREEAM accreditation for a building project [61], which typically include the fees for the assessment, certification, and registration, as well as the costs associated with meeting the design criteria and implementing the necessary measures to achieve the desired rating level. However, these costs may vary depending on the type, size, and complexity of the building project.

2.4.1. Initial Upfront Cost *vs.* Cost Saving of a BREEAM Accreditation

Amoah-Korsah et al. [62] noted that obtaining a BREEAM accreditation can result in significant upfront costs but could also lead to substantial cost savings in the long run. The upfront costs associated with obtaining a BREEAM accreditation include expenses related to design modifications, documentation, and certification fees. However, the long-term cost savings associated with BREEAM accreditation can include reduced energy consumption, lower operational costs, and increased asset value.

The BRE offer a costing tool software which is designed to provide building owners and developers with a comprehensive analysis of the lifecycle costs and environmental impact of their building projects [63]. The tool is based on the Environmental Assessment Method (ENVEST) and can assess the cost-effectiveness of various sustainability measures, such as energy-efficient building materials, renewable energy technologies, and water conservation measures.

As a result, the ENVEST BRE costing tool has been used in several building projects to assess the financial and environmental impacts of sustainability measures as noted in Kim et al. [64]. In addition, it provides stakeholders with the initial knowledge of the cost of construction and potential economical savings prior to progressing with the project.

Overall, while there may be upfront costs associated with obtaining a BREEAM accreditation, the potential for long-term cost savings makes it a worthwhile investment for building owners and developers.

2.4.2. Cost *vs.* Value of Delivering a BREEAM Accredited Building

The debate regarding cost versus value in BREEAM has been examined in various studies. Fuerst and van de Wetering [65] explored the relationship between the cost of BREEAM certification and the value it provides for educational buildings and concluded that while the cost of the assessment can be a barrier for some projects, the long-term benefits of BREEAM certification, such as improved environmental performance and reduced operational costs, can offset the initial cost. Similarly, Fuerst and McAllister [66] argued that while the cost of Green buildings can add to the initial construction costs, the long-term benefits, such as reduced energy consumption and increased market appeal, can significantly enhance the value of the building.

Consequently, BREEAM as a global assessment method for sustainable buildings, has been widely accepted and used by the construction industry. According to BRE Global [38], buildings that have been certified under BREEAM have demonstrated improved environmental performance, increased market appeal, and reduced operational costs.

While the cost of BREEAM certification can be a barrier for some projects, the long-term benefits can provide significant value for building owners, users, and the environment.

2.4.3. BREEAM Methodology as a Carbon Emission Reduction Strategy

BREEAM can be an effective carbon emission reduction strategy. Taylor [67] and Soulti, E., & Leonard [58] investigated the carbon emissions of office buildings in the UK and discovered that those certified with BREEAM had lower carbon emissions compared to non-certified buildings. Corroborating this, Ward et al. [68] and Stronach [69] analysed the carbon emissions of public and residential buildings respectively in China and found that BREEAM certification led to a significant reduction in carbon emission. In addition to this is significant positive impact on the energy efficiency.

The above suggests that the cost versus value debate in BREEAM certification is complex and multi-faceted and requires a thorough analysis of the specific project goals and circumstances. While the cost of BREEAM certification can be a barrier, the long-term benefits, such as improved environmental performance and increased market appeal, can provide significant value for building owners and users.

3. Methodology

The survey research strategy was adopted which involved engagement with built environment professionals (such as clients, building manager, and design consultant) and clients that have relevant knowledge of the BREEAM accreditation. The choice of a survey is due to its efficiency and accessibility, and its wide distribution can be enforced with a firm completion date [70]. In terms of approach, a mixed method concurrent approach incorporating both quantitative and qualitative data collection was adopted. Data was collected through a questionnaire administered online using multiple-choice questions which allows for consistent predetermined answers that can be analysed empirically. Using purposive sampling, 43 built environment professionals who were familiar with the BREEAM methodology were contacted within London and Southeast England, out of which 34 responded representing 79% response rate. The questionnaire which comprises of closed-ended questions but provided opportunity for respondents to provide comments was structured into 2 sections has 17 questions in all. Section 1 sought to obtain the particulars of respondents asking questions relating to year of work experience, company size, and level of involvement with BREEAM-rated projects amongst others. Section 2 which has 11 questions teased out questions relating to the cost of BREEAM as regards its financial implications and whether developers would embrace the assessment tool.

In addition to this, and using the same sampling technique, in-depth interviews comprising of 10 questions were conducted with a main contractor BREEAM assessor, a design consultant, and a building operating manager to provide a further in-depth perspective of the BREEAM accreditation processes and sustainable systems that can be designed and installed to boost the economic value of a building whilst reducing life cycle costs.

As the research involved human participants, an ethical approval was granted by the University of Greenwich Faculty of Engineering and Science Research Ethics Committee with reference number FES-FREC-22-04.04.14.

One of the limitations of this study is perhaps the sample size which can be expanded in future study. In addition, other regions outside the London and Southeast England (which was the focus of this study) can be considered due to possible different economic climate. For instance, it would be interesting to conduct similar study outside the UK where BREEAM is in operation. Furthermore, a case study strategy would have been adopted alongside the survey to provide an in-depth study of a BREEAM-rated project exploring the cost and the derived associated benefits.

4. Results and Findings

For the questionnaires administered, 23.5% of respondents have worked in the construction industry for 1–5 years, 23.5% for 6–10 years, 26.5% for 11–15 years, and 26.5% for 15 years or more. This suggests that the majority (53%) of respondents have worked in the construction industry for over a decade, indicating a level of experience and knowledge that could inform the industry's practices and developments. In addition to this, 91.2% and 76.5% of the respondents are involved in commercial and fit-out projects respectively. Also, 79.4% are main contractors overseeing and executing construction projects while 14.7% are subcontractors. 47.1% of participants have been involved in 1–5 BREEAM-rated projects within the last 10 years, with 23.5% having been involved in 6–10 projects. This data indicates that the participants are experienced with BREEAM-rated projects, potentially reflecting an increasing demand for environmentally sustainable construction practices.

For the interviews, the participants will be labelled as follows for ease of presenting the result: BREEAM assessor—Participant A; Mechanical & Electrical Design Consultant—Participant B; and Building Property Manager—Participant C.

4.1. Additional Cost of BREEAM-Rated Projects and Willingness of Stakeholders

On a 5-point agreement scale, 41.2% completely agreed that including BREEAM in commercial refurbishment projects brings additional costs. Other results showed that 38.2% agreed, 20.6% neither agreed nor disagreed, and none of the respondents disagreed, or completely disagreed. This means that most of respondents (79.4%) are of the opinion that introducing BREEAM comes with an extra cost.

Furthermore, majority of respondents (41.2%) estimated these costs to be between 2.1% to 3% of the total project value, with a significant proportion (23.5%) of the respondent expecting costs to be even higher, between 3.1% to 4%. While it is noteworthy that a small percentage of respondents (5.9%) expected no additional costs, the fact that a substantial portion (11.8%) estimated costs of 5% or more indicates that there is a significant potential financial impact associated with pursuing a BREEAM accreditation.

88.2% of the respondents believed that developers would be willing to financially invest in a BREEAM accreditation as presented in Figure 1. This is the summation of those that would accept this always, those that would accept on a few projects and those that would accept only a small additional cost.

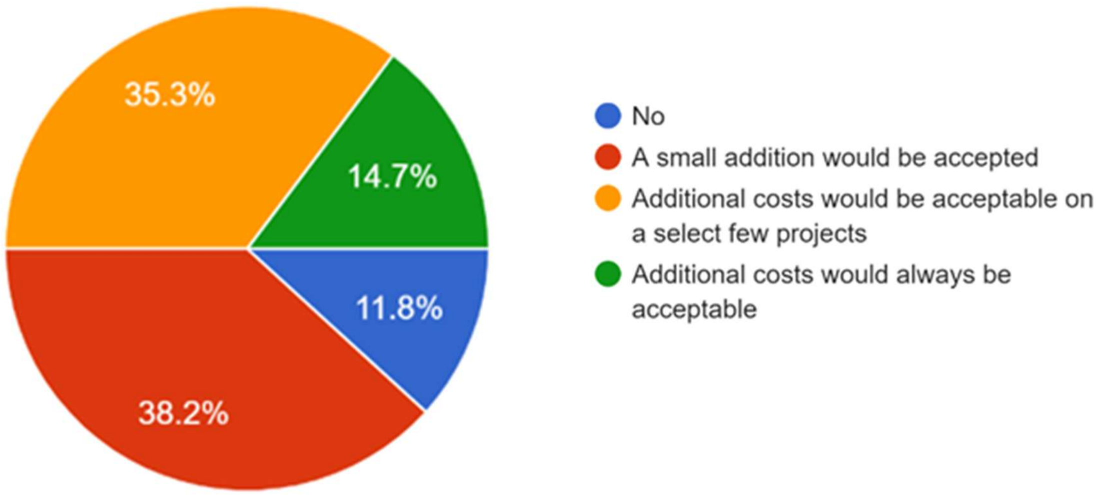

Figure 1. Willingness of developers to accommodate additional costs related to BREEAM.

Also, 39.4% of the respondents agreed that tenants or buyers would accept a small additional cost, while 27.3% believed that additional costs would be acceptable on select few projects. The data suggests that the willingness of developer's additional investment may incur an increased return in rental or purchase prices.

Additional costs for BREEAM certification and sustainable design implementation were highlighted in interviews with Participants A, B, and C. All participants noted that costs varied depending on the scope of the project, design complexity, and accreditation level. However, there were some differences in their views on the costs associated with BREEAM.

Participant A stated that:

"The additional costs associated with using BREEAM in a commercial refurbishment project can vary depending on the project scope and the level of BREEAM accreditation sought. However, there are costs associated with hiring an accredited BREEAM assessor or consultant, conducting assessments, and implementing sustainability measures to meet BREEAM requirements, not to mention the increased cost for sustainable methods such as PV."

Participant B noted that costs also included certification fees, additional design and construction costs, and expenses for newer technologies. Participant B further emphasised that the initial investment was higher, but the long-term benefits were worth it:

"The costs of implementing BREEAM are likely to be higher than those of a non-BREEAM accredited project, but the long-term benefits of BREEAM may make it a worthwhile investment."

Overall, while all participants identified additional costs associated with BREEAM, they had differing views on the extent and impact of these costs.

4.2. Ease of Use and Efficiency of BREEAM

Figures 2 and 3 show that 67.6% of the respondents considered BREEAM's efficiency to be above average. However, 70.5% considered its ease of use as poor to average. Therefore, while most respondents rated BREEAM's efficiency, a significant proportion of respondents found BREEAM's ease of use not to be satisfactory for first time users.

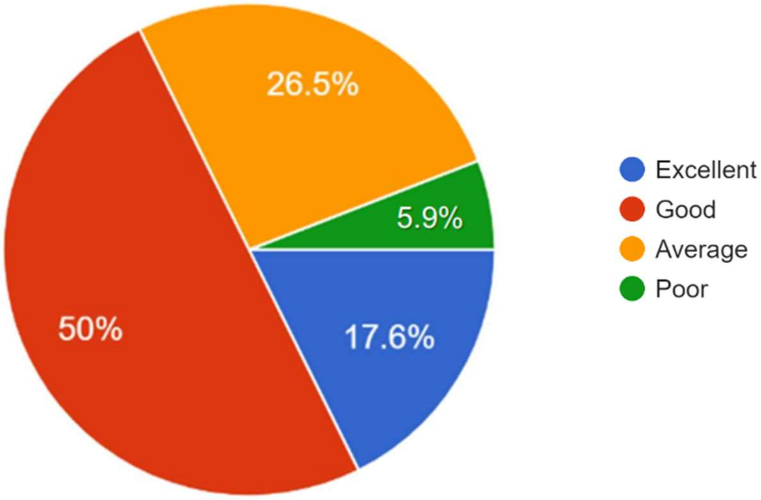

Figure 2. Rating of efficiency of BREEAM scheme as regards how it sets out its requirements as well as monitors and assesses credit criteria.

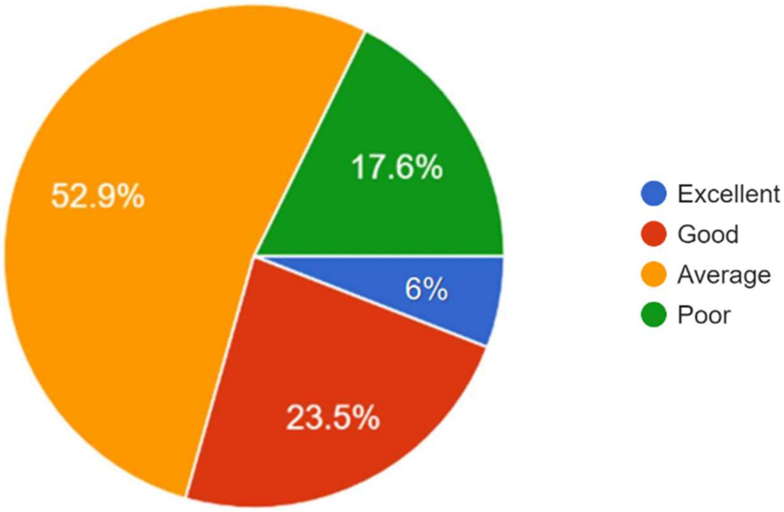

Figure 3. Ease of use of BREEAM methodology.

Regarding BREEAMs Ease of use, Participant A stated:

"The ease of use for first-time users of BREEAM largely depends on their level of experience and familiarity with sustainability and green building practices."

Furthermore, Participant A's further recommendations included taking time to learn the process and working with an experienced assessor. In addition, the participant recommended training courses and utilising BREEAM's online resources.

"For someone using BREEAM for the first time, I would recommend attending a BREEAM training course or working with an accredited BREEAM assessor to ensure a thorough understanding of the process and requirements. BREEAM also provides guidance documents and templates for each assessment category, which can be helpful resources."

Participant B shared a similar view, noting that BREEAM provides clear guidance through the online resources and that once learned, the system is simple to navigate. However, also emphasised that it can be difficult for first-time users and recommended utilising training sessions, guidance documents, and experienced professionals. Participant B's views can be seen below:

"For first-time users, BREEAM can be quite difficult and may require additional training or support. But BREEAM framework provides clear guidance on the sustainability criteria and targets that must be met, which can help to simplify the process. As well as that, once learned it can be pretty simple to navigate. In addition, to someone using BREEAM for the first time, I would recommend attending training sessions or workshops."

Overall, it seems that familiarity with the BREEAM system and utilising available online resources are important factors in achieving ease of use, while experience and training can also be helpful for some users.

4.3. Financial and Non-Financial Values of BREEAM

Figures 4 and 5 present the financial and non-financial benefits of BREEAM accreditation. Interestingly, 50% of the respondents believed that the cost of BREEAM brings a number of financial benefits that may not be easily identified. Additionally, 26.5% believed that the cost of BREEAM is easily outweighed by the additional value added through achieving high-scoring certification. Finally, 67.6% of the respondents agreed that BREEAM has further values that are difficult to measure empirically. Therefore, it is noted that the respondents believe that the financial benefits may not be easily identified, and that the additional value added through achieving high-scoring certification outweighs the cost of BREEAM.

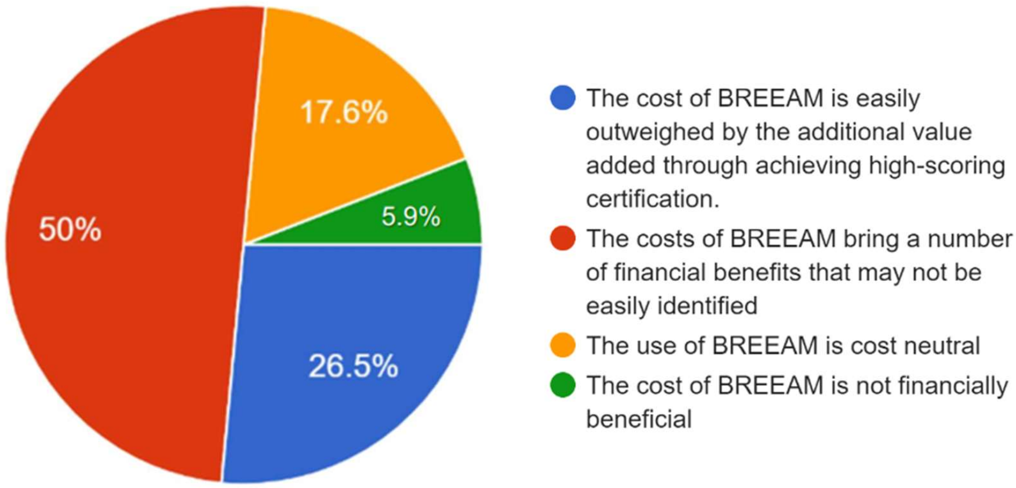

Figure 4. Perception of developers on the financial values that BREEAM adds to project.

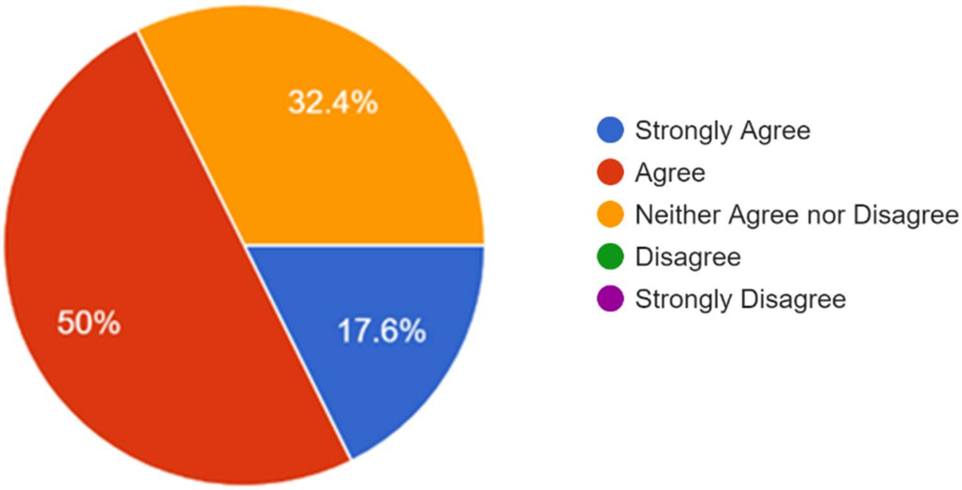

Figure 5. Agreement of developers that BREEEAM has further values that are difficult to measure empirically.

All three participants in the interview highlighted the numerous values of BREEAM in promoting sustainability in building projects. Some of the similarities they identified include the life cycle benefits of reduced energy consumption and improved environmental performance, which can lead to lower operating costs and increased marketability.

Participant B stated that:

"Using BREEAM in a commercial refurbishment project can have significant life cycle benefits, including reduced energy consumption, improved indoor air quality, and reduced waste generation."

Furthermore, all participants agreed that BREEAM helps to identify areas for improvement in old buildings and encourages the use of renewable energy sources such as photovoltaics. Additionally, all three participants noted that BREEAM sets high standards for sustainable performance that go beyond regulatory requirements and can assist in achieving wider sustainable goals.

Participant A noted that:

"BREEAM sets high standards for sustainability performance, encouraging projects to go beyond regulatory requirements and strive for excellence in sustainability. This can lead to innovation and the development of new sustainability solutions."

However, there were also some differences in the specific benefits highlighted by each participant. For example, Participant A focused more on the positive impact of BREEAM on stakeholder perception and the potential for cost savings on energy bills:

"Using BREEAM can have a positive impact on stakeholder perception, once they understand that the initial upfront cost of the BREEAM accreditation can reduce their annual energy expenditure."

While Participant C emphasised the reduced costs of implementing PV systems and the potential for cheaper bills compared to other properties that they manage:

"We have seen a reduced cost in electricity due to the addition of the solar system we have had installed during the build compared to other buildings I manage without solar."

Despite these differences, all three participants agreed that BREEAM acts as a common language for sustainability that can be used by stakeholders, contractors, and designers involved in the built environment. By promoting sustainable practices at all stages of the building life cycle, BREEAM can help to reduce environmental impact, improve building performance, and enhance user satisfaction.

5. Discussion

5.1. Significant Benefits and Cost Implication of BREEAM Certification

The survey indicates that a significant proportion of respondents found BREEAM to be a suitable approach for commercial refurbishment projects. This agrees with BRE Group [71] and the benefits of a BREEAM accreditation, including the promotion of sustainable building practices and the creation of shared value by considering financial, social, and environmental factors.

In addition, the BREEAM accreditation can also enhance a building's overall value and appeal to stakeholders, including tenants, investors, and regulators as documented by BRE Global [38]. Furthermore, the results agree with Stronach [69] that BREEAM can demonstrate a commitment to sustainable building practices and environmental performance, attracting and retaining tenants who prioritise sustainability, as well as investors and regulators who seek to reduce the environmental impact of buildings and their operations.

The consensus from the study indicates an agreement with Shibani et al. [61], that pursuing BREEAM accreditation incurs additional costs, such as fees for assessment, certification, and registration, as well as costs associated with meeting design criteria and implementing necessary measures. While there is a difference in the estimated additional costs noted by Mann [41] and the survey respondents, both sources indicate that there is a financial impact associated with pursuing BREEAM accreditation.

5.2. Sustainability Values of BREEAM Certification

The findings agree with Jones Lang LaSalle [19] and Parker ([56] statements regarding the willingness among industry professionals and potential tenants to pay additional costs for buildings with BREEAM accreditation, potentially indicating a growing awareness of the values of sustainable building practices. In addition, whilst there may be significant upfront costs associated with obtaining a BREEAM accreditation, there may also be long-term cost savings due to reduced energy consumption, lower operational costs, and increased asset value, further confirming the statements by Wong et al. [54]. In addition, the results suggest that BREEAM is seen as a tool that can help achieve wider sustainable goals beyond regulatory requirements by identifying areas for improvement in old buildings and encouraging the use of renewable energy sources such as photovoltaics, and Heat Pump systems, further aligning with the commitments noted by BRE Global [72].

5.3. Barriers to Obtaining BREEAM Certification

There are several barriers to obtaining a BREEAM accreditation. This study highlighted that the need for stakeholder engagement is crucial, with active participation in the design stage being critical. This further aligns with AlWaer et al. [51], which finds that stakeholders may have other priorities or competing demands on their time, which can make it difficult to fully engage with the BREEAM assessment process. Overcoming these barriers requires stakeholder training and a collaborative approach to problem-solving.

5.4. Limitations of Study

Whilst this study has attempted to explore the values of sustainability and cost of going green using BREEAM as case study, future research can address the limitations of the study especially on the small sample size where 34 built professionals from London and Southeast England who are familiar with BREEAM participated out of the 43 contacted. Perhaps future study can adopt both random and snowballing techniques where the respondents can have the opportunity to nominate colleagues who may be interested in participating in the research. Additionally, the Building Research Establishment (BRE) can be engaged in the study since the organisation administers BREEAM and certifies built professionals to become BREEAM assessors and BREEAM advisory professionals. Additionally, because this study was conducted within a short duration, future study can have a longer duration which has the potential to broaden the participation.

6. Conclusions

This paper investigated the values of sustainability compared to the extra expenditure incurred to deliver sustainable building using the Building Research Establishment Environmental Assessment Method (BREEAM). The findings showed that BREEAM is a comprehensive framework and effective tool for assessing and improving the environmental sustainability of buildings. The benefits of BREEAM certification include improved environmental performance and increased market appeal, which provide significant value for building owners and users. In addition to this is improved indoor air quality, reduced carbon emissions, and lower operational costs. However, the uptake of BREEAM in commercial refurbishment projects comes with additional costs with a high potential of financial return from initial investment in addition to its effectiveness as alluded to by majority of the respondents. The costs associated with the project varied based on its scope, design complexity, and accreditation level. Despite additional upfront costs, the benefits of improved energy efficiency, reduced carbon emissions, and lower operating costs outweighed the initial investment. In fact, the value added through achieving high-scoring certification outweighed the cost of BREEAM implementation. It would be suggested that the findings of this research could be useful for industry professionals and stakeholders to raise awareness of the benefits of using BREEAM and encourage its wider adoption.

However, based on the findings for this study, there is a need for further research to explore the long-term financial benefits and the return on investment associated with sustainable development. While this paper highlights the potential benefits of the BREEAM certification, it is important to understand the long-term financial implications of sustainable development, as well as the extent to which these benefits outweigh the initial costs. Future research could focus on conducting a comprehensive cost-benefit analysis of sustainable development projects, assessing the actual energy savings achieved, and evaluating the impact of green buildings on tenant retention rates and property value. Additionally, there is a need to explore the potential for sustainable development to mitigate the risks associated with climate change and contribute to the broader goal of environmental sustainability. Overall, further research is necessary to support the business case for sustainable development and inform decision-making by building owners, developers, and policymakers.

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Author Contributions

Conceptualization, J.J. and A.S.A.; Methodology, J.J.; Software, J.J.; Validation, A.S.A.; Formal Analysis, J.J.; Investigation, J.J.; Resources, J.J.; Data Curation, J.J.; Writing—Original Draft Preparation, J.J.; Writing—Review & Editing, A.S.A.; Visualization, J.J.; Supervision, A.S.A.; Project Administration, A.S.A.

Ethics Statement

An ethical approval was granted on 7 June 2023 by the University of Greenwich Faculty of Engineering and Science Research Ethics Committee with reference number FES-FREC-22-04.04.14.

Informed Consent Statement

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

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

1. Abergel T, Dulac J, Hamilton I, Jordan M, Pradeep A. 2019 Global Status Report for Buildings and Construction. Global Alliance for Buildings and Construction. 2019. Available online: https://iea.blob.core.windows.net/assets/3da9daf9-ef75-4a37-b3da-a09224e299dc/2019_Global_Status_Report_for_Buildings_and_Construction.pdf (accessed on 1 December 2022).
2. Batool K, Ali G, Khan KU, Kamran MA, Yan N. Integrating role of green buildings in achieving carbon neutrality in an era of climate emergency. *Sustain. Dev.* **2024**, *32*, 4186–4201. doi:10.1002/sd.2883.
3. Kristijan B, Perc M, Lukman RK. The complexity and interconnectedness of circular cities and the circular economy for sustainability. *Sustain. Dev.* **2023**, *32,* 2049–2065. doi:10.1002/sd.2766.
4. Benites HS, Osmond P, Prasad D. A neighbourhood-scale conceptual model towards regenerative circularity for the built environment. *Sustain. Dev.* **2022**, *31*, 1748–1767. doi:10.1002/sd.2481.
5. Maqbool R, Saiba MR, Altuwaim A, Rashid Y, Ashfaq S. The influence of industrial attitudes and behaviours in adopting sustainable construction practices. *Sustain. Dev.* **2022**, *31*, 893–907. doi:10.1002/sd.2428.
6. Grant EJ. Mainstreaming environmental education for architects: the need for basic literacies. *Build. Cities* **2020**, *1*, 538–549.
7. Skjerven A, Martins AN. Architecture, design and planning towards sustainable development: Regional approaches. *Sustain. Dev.* **2019**, *27*, 197–198. doi:10.1002/sd.1877.
8. Grover R, Emmitt S, Copping A. Trends in sustainable architectural design in the United Kingdom: A Delphi study. *Sustain. Dev.* **2020**, *28*, 880–896. doi:10.1002/sd.2043.
9. United Nations. Sustainability, United Nations. United Nations. 1987. Available online: https://www.un.org/en/academic-impact/sustainability#:~:text=In%201987%2C%20the%20United%20Nations,to%20meet%20their%20own%20needs.%E2%80%9D (accessed on 16 April 2023).
10. Howard JL. The Federal Commitment to Green Building: Experiences and Expectations Office of Federal Environmental Executive (US, Sustainable Finance in Sustainable Health Care System. Washingon DC. 2003. Available online: https://www.amazon.com/Federal-Commitment-Green-Building-Expectations/dp/1503231267 (accessed on 16 April 2023).
11. Weerasinghe AS, Ramachandra T. Implications of sustainable features on life-cycle costs of green buildings. *Sustain. Dev.* **2020**, *28*, 1136–1147. doi:10.1002/sd.2064.
12. Yin S, Wu J, Zhao J, Nogueira M, Lloret J. Green buildings: Requirements, features, life cycle, and relevant intelligent technologies. *Internet Things Cyber-Phys. Syst.* **2024**, *4*, 307–317.
13. Yang JK, Thuc LD, Cuong PP, Van Du N, Tran H. Evaluating a driving index of nonresidential green building implementation for sustainable development in developing countries from a Vietnamese perspective. *Sustain. Dev.* **2022**, *31*, 1720–1734. doi:10.1002/sd.2478.
14. Haapio A, Viitaniemi P. A critical review of building environmental assessment tools. *Environ. Impact Assess. Rev.* **2008**, *28*, 469–482. doi:10.1016/j.eiar.2008.01.002.
15. Adewumi AS, Opoku A, Dangana Z. Sustainability assessment frameworks for delivering Environmental, Social, and Governance (ESG) targets: A case of Building Research Establishment Environmental Assessment Method (BREEAM) UK New Construction. *Corp. Soc. Responsib. Environ. Manag.* **2024**, *31*, 3779–3791.
16. United Nations. United Nations Conference on Environment and Development, United Nations. 1992. Available online: https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf (accessed on 16 April 2023).
17. BRE. BREEAM: A History, BRE Group—Building a Better World Together. 2021. Available online: https://www.breeam.com/about-us/breeam-a-history/ (accessed on 16 April 2023).

18. BRE. A Guide to How BREEAM Works. 2024. Available online: https://breeam.com/about/how-breeam-works (accessed on 16 April 2024).
19. Jones Lang LaSalle. Why the Shard Stands Out on London's Skyline, Real Estate Advisors & Professionals. 2018. Available online: https://www.jll.co.uk/en/trends-and-insights/cities/why-the-shard-stands-out-on-londons-skyline (accessed on 16 April 2023).
20. Liu G, Li X, Tan,Y, Zhang G. Building green retrofit in China: Policies, barriers and recommendations. *Energy Policy* **2020**, *139*, 111356. doi:10.1016/j.enpol.2020.111356.
21. Ramaswami A, Russell AG, Culligan PJ, Sharma KR, Kumar E. Meta-principles for developing smart, sustainable, and healthy cities. *Science* **2016**, *352*, 940–943.
22. World Green Building Council. Doing Right by Planet and People: The Business Case for Health and Wellbeing in Green Building, World Green Building Council. 2018. Available online: https://www.worldgbc.org/news-media/doing-right-planet-and-people-business-case-health-and-wellbeing-green-building (accessed on 16 April 2023).
23. Urban Land Institute. Embedding Sustainability in Real Estate Transactions, Urban Land Institute. 2019. Available online: https://uli.org/wp-content/uploads/ULI-Documents/Embedding-Sustainability-in-Real-Estate-Transactions.pdf (accessed on 16 April 2023).
24. Waddell H. Construction Materials Shortages: Assessing Your Risk, Pinsent Masons, Pinsent Masons. 2021. Available online: https://www.pinsentmasons.com/outlaw/analysis/constructionmaterials-shortages-assessing-your-risk (accessed on 16 April 2023).
25. Rwelamila PD, Talukhaba AA, Ngowi AB. Project procurement systems in the attainment of sustainable construction. *Sustain. Dev.* **2000**, *8*, 39–50.
26. Oke AE, Oyediran AO, Koriko G, Tang LM. Carbon trading practices adoption for sustainable construction: A study of the barriers in a developing country. *Sustain. Dev.* **2023**, *32*, 1120–1136. doi:10.1002/sd.2719.
27. Helne T, Hirvilammi T. Wellbeing and Sustainability: A Relational Approach. *Sustain. Dev.* **2015**, *23*, 167–175. doi:10.1002/sd.1581.
28. Hu M, Simon M, Fix S, Vivino AA, Bernat E. Exploring a sustainable building's impact on occupant mental health and cognitive function in a virtual environment. *Sci. Rep.* **2021**, *11*, 5644. doi:10.1038/s41598-021-85210-9.
29. Kubiszewski I, Mulder K, Jarvis D, Constanza R. Toward better measurement of sustainable development and wellbeing: A small number of SDG indicators reliably predict life satisfaction. *Sustain. Dev.* **2021**, *30*, 139–148. doi:10.1002/sd.2234.
30. Abdulsalam R, Chan M, Masrom MA, Nawawi AH. Benefits and challenges of implementing green building development in Nigeria. *Built Environ. Proj. Asset Manag.* **2024**, *14*, 399–413.
31. Liu W, Huang X, He Z, Wang Y, Han L, Qiu W. Input-Output Benefit Analysis of Green Building Incremental Cost Based on DEA-Entropy Weight Method. *Buildings* **2022**, *12*, 2239. doi:10.3390/buildings12122239.
32. Hwang B, Tan JS. Green building project management: Obstacles and solutions for sustainable development. *Sustain. Dev.* **2012**, *20*, 335–349. doi:10.1002/sd.492.
33. Chegut A, Eichholtz P, Kok N. The price of innovation: An analysis of the marginal cost of green buildings. *J. Environ. Econ. Manag.* **2019**, *98*, 102248. doi:10.1016/j.jeem.2019.07.003.
34. BRE. Explore BREEAM: Explore the Data Behind BREEAM Projects. 2024. Available online: https://tools.breeam.com/projects/explore/index.jsp (accessed on 23 October 2024).
35. BRE Global. BREEAM Brochure, The World'S Foremost Environmental Assessment Method and Rating System for Buildings. BREEAM. 2011. Available online: https://tools.breeam.com/filelibrary/BREEAM_Brochure.pdf (accessed on 1 October 2022).
36. United Nations. Net Zero Coalition, United Nations, Net Zero Coalition. United Nations. 2022. Available online: https://www.un.org/en/climatechange/net-zero-coalition (accessed on 16 April 2023).
37. BRE Group. BREEAM—Bre Group, BRE Group—Building a Better World Together. 2023. Available online: https://www.breeam.com/about/ (accessed on 16 April 2023).
38. BRE Global. BREEAM UK New Construction 2018 Technical Manual, BREEAM New Construction 2018 (UK). 2018. Available online: https://files.bregroup.com/breeam/technicalmanuals/NC2018/ (accessed on 16 April 2023).
39. Sustainable Value. 2012. Available online: https://www.sustainablevalue.com/ (accessed on 15 November 2022).
40. BRE Group. HOW BREEAM Works—Bre Group, BRE Group—Building a Better World Together. 2022. Available online: https://bregroup.com/products/breeam/how-breeam-works/ (accessed on 16 April 2023).
41. BAM. Sustainability: Building a sustaianable tomorrow. 2024. Available online: https://sustainability.bam.co.uk/insights/2014-04-22-is-breeam-outstanding-worth-it#:~:text=Achieving%20the%20highest%20levels%20of,But%20is%20it%20worth%20it%3F (accessed on 11 December 2024).
42. Theis T, Tomkin J. *Sustainability: A Comprehensive Foundation*, Illustrated ed.; 12th Media Services: Atlanta, GA, USA, 2012.
43. Evans E, Fernando L, Yang M. Sustainable value creation—From concept towards implementation. In *Sustainable Manufacturing. Challenges, Solutions and Implementation Perspectives*; Stark R, Seliger G, Bonvoisin J, Eds.; Springer: Cham, Switzerland, 2017; pp. 149–200. doi:10.1007/978-3-319-48514-0_13.

44. Patala S, Jalkala A, Keranen J, Vaisanen S, Tuominen V. Sustainable value propositions: Framework and implications for technology suppliers. *Ind. Mark. Manag.* **2015**, *59*, 144–156. doi:10.1016/j.indmarman.2016.03.001.
45. Wagner R, Kabalska A. Sustainable value in the fashion industry: A case study of value construction/destruction using digital twins. *Sustain. Dev.* **2022**, *31*, 1652–1667. doi:10.1002/sd.2474.
46. Porter ME, Kramer RM. Creating shared value. *Harv. Bus. Rev.* **2011**, *89*, 62–77.
47. Ponterosso P, Gaterell M, Williams J. Post occupancy evaluation and internal environmental monitoring of the new BREEAM "Excellent" Land Rover/Ben Ainslie Racing team headquarters offices. *Build. Environ.* **2018**, *146*, 133–142. doi:10.1016/j.buildenv.2018.09.037.
48. Ferreira A, Pinheiro MD, de Birto J, Mateus R. A critical analysis of LEED, BREEAM and DGNB as sustainability assessment methods for retail buildings. *J. Build. Eng.* **2023**, *66*, 105825. doi:10.1016/j.jobe.2023.105825.
49. Farid HM, Iram S, Shakeel HM, Hill R. Enhancing stakeholder engagement in building energy performance assessment: A state-of-the-art literature survey. *Energy Strategy Rev.* **2024**, *56*, 101560. doi:10.1016/j.esr.2024.101560.
50. Schweber L. The effect of BREEAM on clients and construction professional. *Build. Res. Inf.* **2013**, *41*, 555–568.
51. AlWaer H, Sibley M, Lewis J. Different stakeholders' perceptions of sustainability assessment. *Archit. Sci. Rev.* **2008**, *51*, 48–59.
52. Taylor T, Pineo H. Health and Wellbeing in BREEAM. Watford: BRE Global. 2015. Available online: https://tools.breeam.com/filelibrary/Briefing%20Papers/99427-BREEAM-Health---Wellbeing-Briefing.pdf (accessed on 11 December 2024).
53. Mendell MJ, Fisk WJ, Kreiss K, Levin H, Alexander D, Cain WS, et al. Improving the health of workers in Indoor Environments: Priority Research Needs for a national occupational research agenda. *Am. J. Public Health* **2002**, *92*, 1430–1440. doi:10.2105/ajph.92.9.1430.
54. Wong DH, Zhang C, Di Maio F, Hu M. Potential of BREEAM-C to support building circularity assessment: Insights from case study and expert interview. *J. Clean. Prod.* **2024**, *442*, 140836. doi:10.1016/j.jclepro.2024.140836.
55. van Overbeek R, Ishaak F, Geurts E, Remøy H. The added value of environmental certification in the Dutch office market. *J. Eur. Real Estate Res.* **2024**, doi:10.1108/JERER-04-2023-0010.
56. Parker J. A BSRIA Report: The Value of BREEAM. Berkshire: BSRIA. 2024. Available online: https://tools.breeam.com/filelibrary/BREEAM%20and%20Value/The_Value_of_BREEAM.pdf (accessed on 11 December 2024).
57. Hasan MS, Zhang R. Critical Barriers and Challenges in Implementation of Green Construction in China. International Journal of Current Engineering and Technology. 2016. Available online: https://www.researchgate.net/publication/317002238_Critical_Barriers_and_Challenges_in_Implementation_of_Green_Construction_in_China (accessed on 9 December 2024).
58. Soulti E, Leonard D. The Value of BREEAM: A Review of Latest Thinking in the Commercial Building Sector. Watford: BRE Global. 2016. Available online: https://tools.breeam.com/filelibrary/Briefing%20Papers/BREEAM-Briefing-Paper----The-Value-of-BREEAM--November-2016----123864.pdf (accessed on 9 December 2024).
59. Grodzka EM, Solbiati C. The problem of assessing the sustainability of adapted historic buildings with BREEAM certification using examples in Poland and Great Britain. *Int. J. Sustain. Eng.* **2023**, *16*, 140–154.
60. Liu C, Wang F, Mackillop F. A critical discussion of the BREEAM Communities method as applied to Chinese eco-village assessment. *Sustain. Cities Soc.* **2020**, *59*, 102172. doi:10.1016/j.scs.2020.102172.
61. Shibani A, Agha A, Hassan D, Naomi F. The Impact of Green Certification BREEAM on the occupancy rates of Commercial Buildings in the UK. *Int. J. Innovation Engineering Res. Technol.* **2021**, *8*, 153–167. Available online: https://pureportal.coventry.ac.uk/en/publications/the-impact-of-green-certification-breeam-on-occupancy-rates-of-co (accessed on 9 December 2024).
62. Amoah-Korsah A, Ayinla K, Madanayake U, Keates R, Seidu RD, Young B. Perceptions of BREEAM in the Construction Industry. International Conference on the Leadership and Management of Projects in the digital age (IC:LAMP 2022). 2022. Available online: https://openresearch.lsbu.ac.uk/item/92vwy (accessed on 9 December 2024).
63. BRE. IMPACT Compliant Tools. 2024. Retrieved from IMPACT. Available online: https://bregroup.com/products/impact/impact-compliant-tools (accessed on 9 December 2024).
64. Kim T, Lee S, Chae CU, Jang HL. Development of the CO_2 Emission Evaluation Tool for the Life Cycle Assessment of Concrete. *Sustainability* **2017**, *9*, 2116. doi:10.3390/su9112116.
65. Fuerst F, Van de Wetering J. How does environmental efficiency impact on the rents of commercial offices in the UK? *J. Prop. Res.* **2015**, *32*, 193–216.
66. Fuerst F, McAllister P. Green noise or green value? Measuring the effects of environmental certification on office values. *Real Estate Econ.* **2011**, *39*, 45–69.
67. Taylor T. Assessing Carbon Emissions in BREEAM. Watford: 2015, BRE Global. Available online: https://tools.breeam.com/filelibrary/Briefing%20Papers/Assessing-Carbon-Emissions-in-BREEAM--Dec-2015-.pdf (accessed on 9 December 2024).
68. Ward C, Yates A, Brown V. Assessing the Performance of Sustainable Buildimgs in China. Watford: 2017, BRE Global. Available online: https://tools.breeam.com/filelibrary/Briefing%20Papers/94231-BRE_BREEAM-3Star-mapping-A4.pdf (accessed on 9 December 2024).

69. Stronach T. First Residential Project in China Gets BREEAM In-Use Certification. 2020 Retrieved from BRE. Available online: https://bregroup.com/news/china-breeam-in-use-certification-landsea-green-life (accessed on 9 December 2024).
70. Dillman DA, Smyth JD, Christian LM. *Internet, Phone, Mail, and Mixed Mode Surveys: The Tailored Design Method,* 4th ed.; John Wiley & Sons Inc.: Hoboken, NJ, USA, 2014.
71. BRE Global. BRE Group: Knowledge Base, Knowledge Base. 2014. Available online: https://kb.breeam.com/ (accessed on 16 April 2023).
72. BRE Global. BREEAM Refurbishment and Fit-Out—Bre Group, BRE Group—Building a Better World Together. 2014. Available online: https://bregroup.com/products/breeam/breeam-technical-standards/breeam-refurbishment-and-fit-out/ (accessed on 16 April 2023).