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Exploring Sustainable Interior Design Implementation Barriers: A Partial Least Structural Equation Modeling Approach

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Abstract: Although sustainability has been an issue in the built environment for some time, it has not yet been fully addressed in sustainable interior architecture and design. This research aimed to identify and analyze obstacles preventing sustainable interior architecture and design implementation. As a result, the partial least structural equation modeling approach (PLS-SEM) has been requested to evaluate these obstructions. Therefore, after identifying 30 possible barriers through a literature search, a survey questionnaire was issued to 100 interior designers to evaluate their significance. According to the findings, governmental obstacles are the most pressing, followed by those related to information, knowledge, awareness, technology, training, attitudes, the market, and economics. This study's conclusions may benefit professional interior architects, designers, academics, statutory authorities, administrations, and politicians. The current study addresses the lack of prior literature by compiling a thorough inventory of obstacles to environmentally friendly interior architecture and design, lays the framework for more in-depth future studies, and uses a unique PLS-SEM that has not been used previously.

Keywords: PLS-SEM; structural equation modeling; sustainable success

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1. Introduction

Approximately 40% of all energy used, 30% of all greenhouse gas emissions, and approximately 40% of all trash are generated by the building sector worldwide [1–3]. Implementing sustainability and sustainable development has gained more traction as the world's population rapidly urbanizes and the building industry booms [4–6]. The World Commission on Environment and Development [7] defines "sustainability" as "filling the demands of the present without compromising future generations' ability to fulfil their own needs".

To reduce gas emissions of the building sector, the cement-based products should be developed sustainably by taking into account the life cycle and according to guidelines such as enhancing durability and making economical use of raw resources. Improved cementitious composites' fracture qualities can aid in achieving this aim by allowing them to use less cement, perform better overall, and further cut greenhouse gas emissions globally (carbon dioxide) [8]. Researchers from all around the world have given rubberized concrete a lot of attention since it is environmentally beneficial. However, the use of crumb rubber

can make concrete less mechanically strong, especially when exposed to high temperatures. By incorporating calcium carbonate whiskers, polyvinyl alcohol (PVA) fibers, and steel fibers, a novel multi-scale fiber-reinforced rubberized concrete (MSFRRC) is created to enhance the residual compressive performance of rubberized concrete [9]. Since its inception, the concept of sustainability has permeated nearly every area of human existence, most noticeably the built environment and the discipline of interior design (ID) [10].

There are several terms used to describe the integration of sustainability with ID. These include environmentally sustainable interior design [11], green interior design [12,13], sustainable interior design [14], and sustainable interior architectural design [15,16]. It is worth noting that the official title held by those working in this industry differs from one country to the next. Since the term "architect" is legally protected in Australia, the term "interior designer" is used instead [17]. Interior designer is a general term in the United States. In Turkey, the term "interior architect" is more common [18]. Thus, the current literature frequently uses both words interchangeably. Sustainable interior design (SID) is used throughout this study to encompass all the approaches to interior design that were taken to achieve this goal.

Different authors in the current literature [14,19] have offered their definitions of SID. However, a broader definition (following the triple bottom line) describes SID as a method that considers the system as a whole (including the users' emotional and physical well-being) in addition to the immediate environment and economy [16,20]. The literature has shown that the interior environment's qualities significantly affect occupants' performance, behavior, comfort, emotions, and general physical and psychological well-being [21–24]. In other words, SID is concerned with more than just the global environmental impact of a project; it also prioritizes the comfort and safety of building occupants and the interests of other stakeholders [19,25].

ID focuses on refurbishment and additions rather than structural work. The potential for such initiatives to lower the energy consumption of the existing building stock and the enormous savings in comparison to constructing brand-new buildings have given them renewed prominence in recent years [26–28]. Since the number of interior restoration projects has been growing steadily over the past decade, widespread adoption of SID is crucial to achieving the Sustainable Development Goals (SDGs). However, interior architects and designers still have difficulty putting sustainability into reality, even though the sustainability movement has been going strong for quite some time. Stieg [29] was one of the first academics to raise issues regarding the disconnect between theory and practise in SID, which she termed "the sustainability gap". While SID has been an essential topic in architecture for over a decade, the literature reveals that interior architects and designers are still not making enough sustainable decisions in their work [16,19,30]. The Green Building Index (GBI), Malaysia's national green building evaluation methodology, suggests that the ID industry is not making good strides toward sustainable behavior. This is evidenced by the fact that, between 2013 and 2020, just three interior projects were approved. There is a need for a comprehensive examination of impediments to SID practice, with an emphasis on interior restoration projects, because there is a paucity of research on the subject.

In the research that is now accessible, a number of barriers have been identified, including practitioners' resistance to adopting and embracing sustainable practises, consumers' interest, and increased cost and effort. However, very little study has occurred to list and rank all potential barriers to using SID. Further, the breadth, geographic scope, and/or examination of obstacles in the available research may not be generalizable to the setting of other nations. As a result of this context, the following research question was posed: Is SID facing any major roadblocks, and if so, what are they?

Therefore, this study's objective is to catalogue and analyze the obstacles that prevent SID from being implemented in interior restoration projects and to provide approaches for overcoming them. To achieve this goal and answer the research questions, this study first conducts a comprehensive literature analysis to identify the obstacles to implementing SID. This study's contributions are two goals: first, it fills a gap in the literature by naming

and ranking obstacles to the implementation of SID; and second, it introduces the novel PLS-SEM, which not only streamlines the data-gathering and analysis process but also improves the reliability of the findings. The remaining sections of this document are as follows: Section 2 provides a literature review; Section 3 provides a detailed description of the methodology used in this study; Section 4 presents and discusses the results of this research; and Section 5 offers implications, limits, and future efforts.

2. Sustainable Interior Design Implementation

Sustainable interior design (SID) is a complex and evolving field that requires a holistic approach to design [31]. It involves an understanding of the impact of design on the environment, as well as on human health and well-being [32–34]. SID requires designers to be knowledgeable about sustainable materials, building systems, and energy-efficient technologies [10]. One of the critical aspects of SID is the use of sustainable materials. Sustainable materials are those that are renewable, recyclable, and have a low environmental impact [35]. Designers can use materials such as bamboo, cork, and recycled metal and glass to reduce the environmental impact of interior design [36]. Using sustainable materials can also promote local economies and reduce the carbon footprint associated with transportation. Another essential aspect of SID is the integration of energy-efficient lighting and mechanical systems [37]. Designers can incorporate energy-efficient lighting systems such as LED or CFL bulbs, and incorporate passive solar design principles to reduce the need for artificial lighting [38]. The use of energy-efficient heating, ventilation, and air conditioning (HVAC) systems can also help reduce energy consumption and carbon emissions. Water conservation is another critical consideration in SID [39]. Designers can incorporate low-flow fixtures, rainwater harvesting systems, and graywater reuse systems to reduce water consumption [40]. In addition, designers can promote the use of drought-resistant plants and xeriscaping techniques to reduce the need for irrigation [41]. SID also focuses on waste reduction [42]. Designing for disassembly and promoting the reuse of materials can reduce the amount of waste generated during construction and demolition. Designers can also promote the use of recyclable and compostable materials to reduce the environmental impact of waste [43]. SID is a critical practice that can help reduce the negative impact of interior design on the environment and promote occupant health and well-being. By incorporating SID into the creation of indoor spaces, designers can create healthier, more sustainable environments for people to live and work in [44]. It is essential for designers to stay up to date with the latest sustainable design practices and technologies to ensure that they are designing spaces that are both beautiful and sustainable. SID is an emerging concept that aims to reduce the negative impact of interior design on the environment while promoting the health and well-being of occupants. The implementation of sustainable design principles, such as the use of sustainable materials, energy efficiency, indoor air quality, water conservation, and waste reduction, can significantly reduce the environmental impact of interior design and promote sustainability. Further research is needed to investigate the long-term impact of sustainable interior design on the environment and occupants' health and well-being.

3. Barriers to the Practice of SID

SID is a subset of sustainable architecture that prioritizes IEQ as much as energy efficiency, site sustainability, water savings, and material choice do. Material choice and indoor environmental quality, which immediately affect building inhabitants' emotional and physical health, are essential concerns in sustainable interior design, as noted by Kang and Guerin [14]. When the average person spends 88% of their time inside [45], adopting and applying SID becomes more pressing. While there has been an uptick in ID research as of late, few studies have looked at the obstacles to SID in depth. Barriers are obstacles that practitioners must overcome before fully accepting and implementing SID in their initiatives. Because of the paucity of research on the topic, Palm and Reindl [46] widened the scope of their literature evaluation to include construction industry roadblocks to

eco-friendly home improvements. In the same vein, papers, books, symposia, dissertations, and reports about the obstacles linked with sustainability in the construction sector were evaluated to establish a comprehensive grasp of general difficulties that might potentially apply to the subject of this study. Based on these and other research [47], we have compiled the following five broad categories of potential obstacles to the implementation of SID: first, there are monetary obstacles; second, there are market and mentality hurdles; third, there are data and knowledge gaps; fourth, there are governmental roadblocks; fifth, there are gaps in skills and training.

According to the parameters of this study, more research is needed to enhance and explore the studies' reports of hurdles in various construction industry sectors and contexts. In addition, the authors are unaware of any extensive studies examining the obstacles to implementing SID in the context of interior restoration projects. Furthermore, earlier research on the implementation of SID relied on simplistic qualitative (e.g., interviews and observations) and quantitative (e.g., surveys with fundamental statistical analysis) methods that inaccurately portrayed the prioritization of the identified hurdles. Therefore, the following gaps in the literature are what this research hopes to address:

- There is a lack of in-depth studies examining the obstacles to SID implementation.
- Too few studies have been conducted to identify the most significant obstacles to using SID in interior restoration projects.
- Using cutting-edge prioritization methods improves the reliability of findings and streamlines information gathering.

Consequently, a conceptual model for the study was proposed. It includes the five hypotheses given below:

H1: *Economic barriers positively influence sustainable interior design implementation adoption barriers.*

H2: *Attitude and market barriers positively influence sustainable interior design implementation adoption barriers.*

H3: *Information, knowledge, and awareness barriers positively influence sustainable interior design implementation adoption barriers.*

H4: *Governmental barriers positively influence sustainable interior design implementation adoption barriers.*

H5: *Technology and training barriers positively influence sustainable interior design implementation adoption barriers.*

4. Research Method and Model Development

The detailed framework of this research design is shown in Figure 1. After a thorough literature search, a list of 30 (Table 1) obstacles to adopting sustainable interior design was compiled and deemed adequate. After compiling a list of obstacles to adopting sustainable interior design, questionnaires were distributed to specialists in the interior design sector who also had relevant industrial expertise (Supplementary Materials). This was done in tandem with a PLS-SEM analysis of these factors and their respective categories to ensure that our list of obstacles to implementing sustainable interior design was exhaustive and precise.

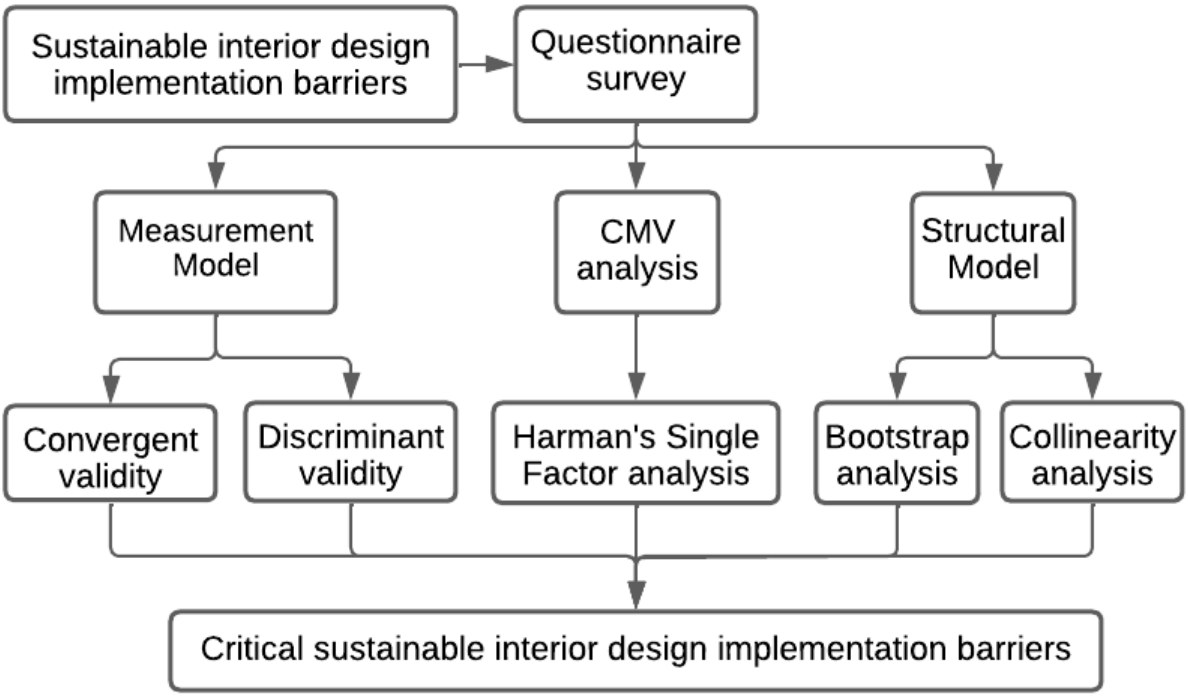

Figure 1. Research design.

Table 1. Identified potential barriers to the practice of SID.

Category	ID	Barrier Description	References
Economic	B1	Increased expenses caused by eco-friendly building methods.	[31–34]
	B2	Sustainable project research and development expenditures.	[31,48]
	B3	Costs associated with the upkeep of sustainable technology integrated into sustainable projects.	[31,49]
	B4	Sustainable projects have a high environmental evaluation rating and certification cost.	[12,48,50,51]
	B5	Long investment return for sustainable initiatives.	[33,34,52,53]
	B6	The increased price of eco-friendly materials.	[12,33]
	B7	Sustainable initiatives require more time (extended construction duration).	[11,12,48]
Attitude and Market	B8	The reluctance of designers to change.	[33,34,48,51,54]
	B9	Lack of faith in sustainability and its sound effects.	[48,49,51]
	B10	The local market lacks dependable, sustainable materials and components.	[12,31,50]
	B11	The local market's restricted availability of sustainable materials and components.	[12,31,33]
	B12	Conflict of interest between construction parties.	[31,46,55]
	B13	Indifference from the client.	[12,55,56]
	B14	Designers lack the motivation to practise responsibly and convince customers to embrace sustainable strategies.	[48,56]

Table 1. *Cont.*

Category	ID	Barrier Description	References
Information, Knowledge, and Awareness	B15	Insufficient information and genuine research on sustainable materials and components.	[11,49,56,57]
	B16	Lack of designers' expertise and awareness	[51,56,58]
	B17	Lack of expertise by the contractor/subcontractors.	[52,59]
	B18	Unawareness on the part of the client.	[54,60]
	B19	The idea that sustainable design would forfeit aesthetic values.	[51]
	B20	Lack of client understanding of the economic and environmental advantages of sustainable techniques.	[51,57,60]
	B21	The belief that sustainable practices do not raise the property's worth.	[57,60]
Governmental	B22	Lack of environmental assessment tools adaptable to many project types.	[31,49,56,61]
	B23	Absence of laws, regulations, and a legal framework tailored to certain sorts of undertakings.	[56,60]
	B24	Absence of government support and incentives to encourage sustainable behavior.	[12,31,49,62]
	B25	Lack of government encouragement of sustainable practices.	[49,52,62]
	B26	Absence of strict regulations enforcing sustainable behavior.	[12,56,60]
Technology and Training	B27	The absence of training for designers, such as seminars and conferences given by representative organizations.	[48–50,52]
	B28	Lack of dependable and appropriate technology.	[31,56,63]
	B29	Lack of expertise and technical knowledge among designers.	[31,56]
	B30	Insufficient experienced labor.	[31,52,64]

4.1. Model Development

The disciplines of business research and the social sciences, in general, have taken a keen interest in partial least square structural equation modeling (PLS-SEM) [65]. PLS-SEM has been the subject of recent studies published in high-impact SSCI journals [66–68]. The newest version of SMART-PLS was used to analyze the gathered data for a SEM model of the most pressing obstacles to implementing sustainable interior design. Although the differences between PLS-SEM and covariance-based structural equation modeling (CB-SEM) are minor, PLS-SEM has been well acknowledged for its superior forecasting objectives [69,70]. The measurement and structural model assessment strategy constituted the statistical analysis in this investigation.

4.1.1. Common Method Variance

Using the standard methods variance (CMV), the common methods bias (CMB) was calculated. Differences (or errors) in analysis results may often be explained by the CMB, which focuses on the measuring procedure rather than the measured constructs [71]. Furthermore, CMV might be defined as a variance overlap attributable to both constructs and measurement instruments [71]. Particularly problematic is the use of CMV if data are obtained from a specific source, such as a self-administered questionnaire [72,73]. Problems may arise when self-report data overstate or understate the scope of linkages that have been explored [73,74]. This research relied entirely on self-reported, subjective information from a single source, which may be particularly salient. As a result, fixing these issues is essential for spotting widespread approach shifts. Harman's experiment (1976) describes a formal, methodical one-factor test, so we decided to try it [75]. The factor analysis yielded a single component explaining most variation [73].

4.1.2. Measurement Model

The measuring model reveals the link between the items and their hidden structure [76]. The following sections meticulously discuss the measurement model's convergent and discriminant validity.

Convergent Validity

When two or more measures (barriers) of the same concept (group) agree with one another, we say that they have convergent validity [77]. A portion of the construct's validity, as is well-known, falls within this category. Cronbach's alpha (α), composite reliability scores (ρ_c), and average variance extracted (AVE) derived from the PLS could be used to ascertain the convergent validity of the generated constructs [78]. The threshold of modest dependability of the composite was proposed by Nunnally and Bernstein [79] to be a value of 0.7. Values above 0.70 were deemed appropriate for all studies, whereas values over 0.60 were deemed acceptable for exploratory studies [80]. The AVE test was the last one. This common statistic was calculated to evaluate the convergent validity of a model's constructs, with values over 0.50 indicating adequate convergent validity [80].

Discriminant Validity

If a phenomenon is empirically distinct, as shown by discriminant validity, then it is unlikely that any existing measures will be able to be used to identify it reliably in a SEM analysis [81]. Campbell and Fiske [82] argued that the degree to which different measures are alike should not be too great to demonstrate discriminating validity.

4.1.3. Structural Model Analysis

This research aimed to use SEM to model the priority of the hurdles to implementing sustainable interior design. This may be achieved by determining the coefficients of the observed paths between variables. As can be seen in Figure 2, it was expected that £ (barriers to the application of sustainable interior design) was involved in a five-way causal connection (path relation) with (sustainable interior design implementation). The linear equation that represents the inner relation between the £, μ, and €1 formula in the structural model is as follows [83]:

$$\mu = \beta\ £ + €1 \quad (1)$$

The expected value of the residual variance at this structural level is (€1), where (β) is the route coefficient between the sustainable interior design implementation obstacles' constructions. In this case, the standardized regression weight corresponds to the weight in a multiple regression model. Its statistical significance hinges on whether its sign matches the model's predictions. The current issue concerns determining the relevance of the route coefficient. The standard errors of the route coefficients were assessed using a bootstrapping method, also used for CFA. Based on a recommendation by Henseler, et al. [65], the t-statistics for hypothesis testing were calculated with 5000 subsamples. Five structural equations were developed for the PLS model, each expressing an inner relation between a build and Equation (1), to characterize the challenges inherent in implementing sustainable interior design.

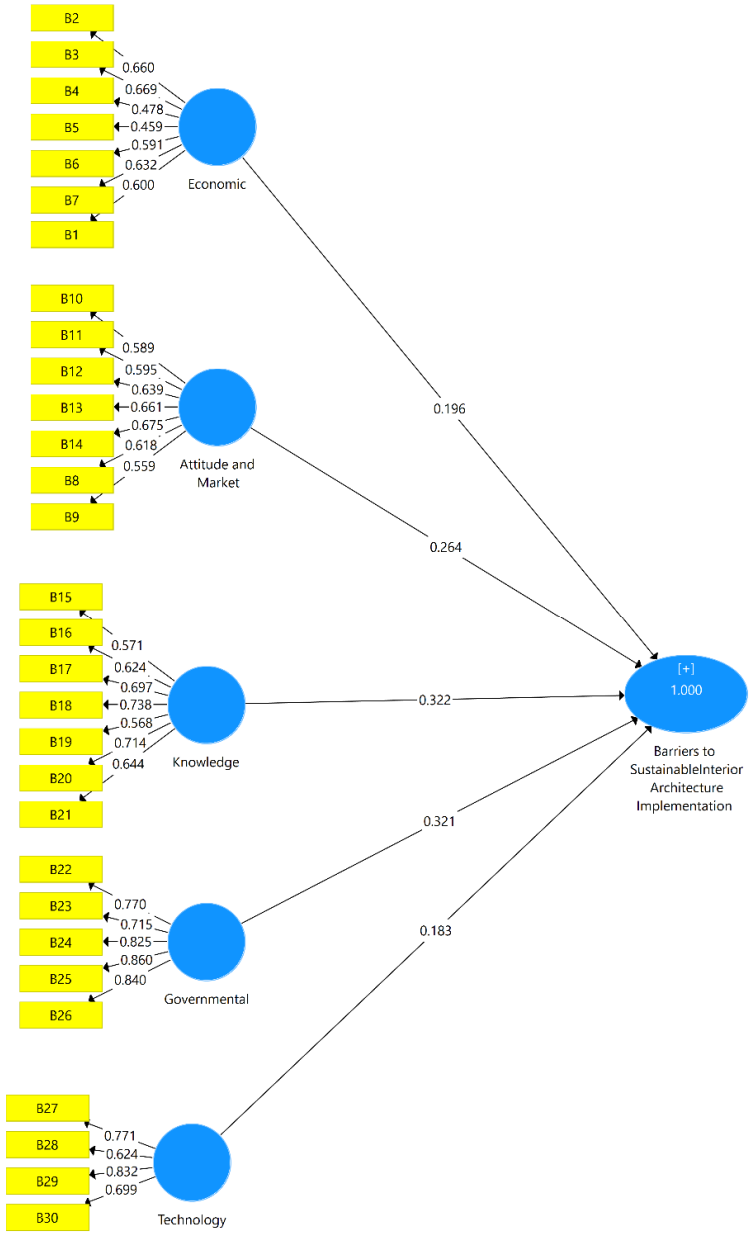

Figure 2. The PLS-SEM structural model.

5. Data Collection

A broader spectrum of prospective interior design industry actors in Egypt was addressed for questionnaire assets to explore the hurdles to implementing sustainable interior design. This survey has three primary sections: questions on the respondent's demographic information, obstacles to implementing sustainable interior design (Table 1), and free-form questions (to add any barriers that the participants considered essential to be identified).

With a Likert scale ranging from 5 (very high) to 1 (no or very minor), respondents rated the information and experience gaps that prevent the widespread adoption of sustainable interior design. Some earlier research employed this scale [84–90]. Due to the topic's relative novelty, the target population's stratified selection was examined. For example, the challenges associated with implementing sustainable interior design are now being explored in Egypt. In addition, the sample size in this study was determined by a purpose analysis of the methodology [91–93]. Sample sizes larger than 100 were recommended by Yin [94] for SEM. The SEM method utilized in this study resulted in a 73.85% response rate

from 100 of the 150 people polled. It was agreed that these rates of return were reasonable for this kind of research [95–97].

6. Data Analysis and Results

6.1. Demographic Analysis

According to the respondents' years of experience, professionalism, present positions, education, and organizational function, the authors have categorized the respondents in this study. For a Bachelor's, Master's, and Ph.D., the respondent's credentials were evaluated (at 80%, 54%, and 35%, respectively). As the highest percentage among the other work experience categories, the results also reveal that 8.5% of respondents had a work history of one to five years or fewer. The percentage of respondents who had worked for five to ten years, fifteen to twenty years, or more was roughly twenty-one percent, twenty-two percent, and thirteen percent, respectively. The largest percentage of respondents, at 33.2%, had worked for ten to fifteen years. This suggests that the study's participants were knowledgeable and capable of learning from it. The fact that the majority of respondents in the study held professional positions and had significant work experience suggests that they were likely to have a deep understanding of the subject matter and a high level of expertise. This, in turn, increases the credibility of the study's findings and the potential impact it may have on the field. Additionally, the respondents' educational qualifications further added to their credibility as experts in their respective fields. With 80% of respondents holding a Bachelor's degree or higher, the study's results are likely to be well-informed and supported by a solid theoretical and practical foundation. Moreover, the distribution of respondents across different organizational functions and present positions adds to the study's generalizability. By including respondents from different areas of the organization and at different levels, the study is more likely to provide insights that are relevant and applicable to a broad range of individuals and organizations. Overall, the study's sample appears to be well-represented and diverse, which increases the potential impact and relevance of its findings. This, in turn, enhances the study's value and contribution to the field of research.

6.2. Common Method Bias

A measurement error (variance) due to common procedure bias might cast doubt on the results of a study. This is a form of error variance that is systematically linked to the variables being measured and estimated [98]. Harman's single-factor assessment of models reveals different structural metrics [75] that can be used to evaluate this. The conventional method's variability was evaluated using a single-factor test [99]. The data will be unaffected by the standard method bias if the overall variance of the components is less than 50% [75]. Since the first set of components accounted for 42.75 percent of the overall variance, it is clear that the results cannot be influenced by the standard method variance, which was less than 50 percent [75].

6.3. Measurement Model

Internal reliability, convergent validity, and discriminative validity must be assessed while evaluating reflective measurement models (barriers) in PLS-SEM. The structural model will be assessed [100] when the measurement model's dependability and validity have been established. Table 2 shows that the model's constructs were all good enough according to the criteria (α and $\rho_c > 0.70$) [101].

In addition, as shown in Table 2, all structures were AVE-compliant. The AVE must be more than 0.5 to be considered acceptable [78]. All the estimated AVE values (Table 2) for the components in this investigation were over 50% when using the PLS algorithm 3.0. These results demonstrate the internal consistency and convergence of the measurement model. This means that within the study model, each construct (group) was adequately assessed by the measurement components, and no other construct was measured. When

the outer loads of many constructs are high, it suggests that their relevant components are somehow interconnected.

Items with extremely low outer loadings (below 0.6) are typically disregarded [70]. External loadings for both the original and revised measurement methods for each item are in Figures 1 and 2. Therefore, the first measurement model did not include external loads other than those labeled "B4, B5, B6, B8, B9, B10, B11, B15, B16, and B19". A loading factor below 0.6 suggested a minor contribution to the theoretical framework, which is why they were left out.

Table 2. The result of convergent validity.

Constructs	Cronbach's Alpha	Composite Reliability	AVE
Attitude and Market	0.653	0.812	0.59
Economic	0.632	0.781	0.512
Governmental	0.861	0.901	0.646
Knowledge	0.754	0.844	0.577
Technology	0.713	0.823	0.541

6.4. Discriminant Validity

Once the construct varies sufficiently from other constructs according to the criteria used, it has established its discriminant validity. Because of this, we may infer from the construct's initial discriminatory validity that it was unique and could capture occurrences not adequately captured by other constructs in the model [102]. Fornell and Larcker's (1981) criteria and HTMT (heterotrait–monotrait ratio of correlations) criterion are two ways to assess discriminant validity.

Discriminating validity may be assessed by comparing the square root of the AVE for each construct to the correlations between the same construct and all other constructs. Following the guidelines of Fornell and Larcker [78], the square root of the AVE must be greater than the correlation between the latent variables. According to Table 3, this finding provides further evidence that the measurement model had discriminant validity [103].

Table 3. Fornell and Larcker's analysis.

Constructs	Attitude and Market	Economic	Governmental	Knowledge	Technology
Attitude and Market	0.768				
Economic	0.471	0.687			
Governmental	0.496	0.327	0.804		
Knowledge	0.575	0.396	0.65	0.76	
Technology	0.342	0.388	0.46	0.439	0.735

On the other hand, many academics criticized the Fornell and Larcker [78] criteria of distinctive discriminating validity. Therefore, Henseler, et al. [104] suggested a different way of evaluating discriminatory validity: the heterotrait–monotrait criterion ratio (HTMT). As a novel method for evaluating the discriminative validity of variance-based SEMs, the HTMT predicts how closely two constructs would be related if they were evaluated precisely once (i.e., if they are unfailingly reliable without error). In addition to using the HTMT model to evaluate the discriminant, it was employed in this investigation. To indicate that the two constructions were distinct, Hair, et al. [81] suggested that the HTMT value should be below 0.85 and 0.90. If the model's constructs are conceptually comparable, the HTMT value should be less than 0.90, and if they are conceptually distinct, the number should be less than 0.85. The HTMT values for all investigated structures are presented in Table 4. Therefore, there was adequate discriminating validity for the conceptions.

Table 4. HTMT analysis.

Constructs	Attitude and Market	Economic	Governmental	Knowledge	Technology
Attitude and Market					
Economic	0.719				
Governmental	0.653	0.438			
Knowledge	0.821	0.566	0.8		
Technology	0.51	0.547	0.585	0.58	

6.5. Path Model Validation

After concluding that the SI barriers constituted a formative construct, we investigated collinearity among the construct's formative objects by calculating the inflation factor's relative worth (VIF). Because none of the VIF values was over 3.5, it may be inferred that each subdomain made a unique contribution to the higher-order structures. In addition, a bootstrapping method was employed to make predictions about the relevance of the route coefficients. Both Table 5 and Figure 3 show that all pathways significantly differed from zero at the 0.05 levels of significance [77].

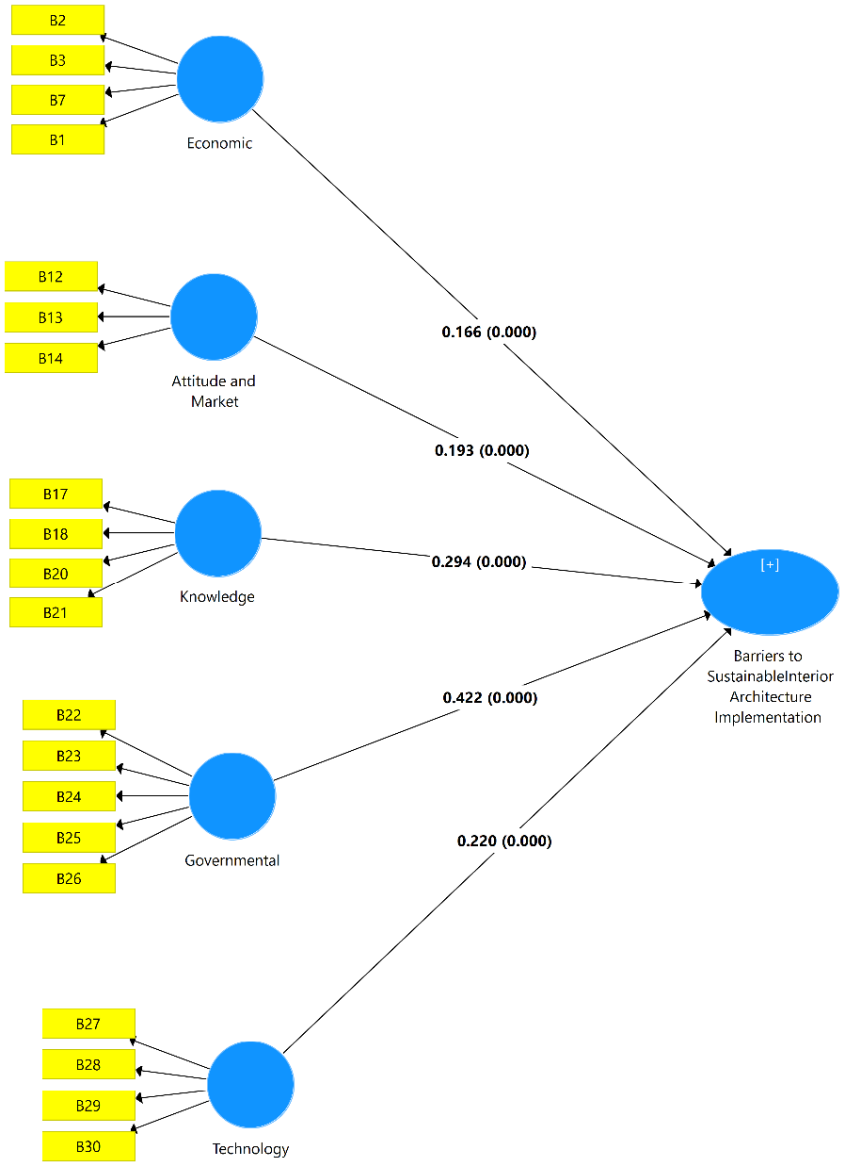

Figure 3. Path model.

Table 5. Path results.

Paths	B	SD	*p* Values
Attitude and Market → Barriers to Sustainable Interior Architecture Implementation	0.193	0.024	0
Economic → Barriers to Sustainable Interior Architecture Implementation	0.166	0.031	0
Governmental → Barriers to Sustainable Interior Architecture Implementation	0.422	0.046	0
Knowledge → Barriers to Sustainable Interior Architecture Implementation	0.294	0.028	0
Technology → Barriers to Sustainable Interior Architecture Implementation	0.22	0.026	0

7. Discussion

Sustainable interior design is essential in the building industry in many industrialized countries, yet it is barely present in poor ones. Like many other emerging countries, Egypt has had issues and conflicts with the quality of construction. This highlights the necessity to use sustainable interior design ideas to help with these difficulties. The choice of upper management to adopt sustainable interior design as an essential platform/element in their projects would greatly aid practitioners' identification of sustainable interior design and its principal building activities.

The suggested approach highlights these sustainable interior design implementation hurdles [1]. Sustainability in home construction may be improved in this way. Consequently, businesses in the construction industry may save money and time without sacrificing the quality or usefulness of their projects by embracing sustainable interior design [105]. In the following sections, you may see examples of the framework components derived from the proposed model and verified by subject matter experts.

7.1. Governmental Barriers

The lack of government incentives that motivate industry participants to embrace sustainable practices may lead to a dearth of sustainable initiatives [49]. Though research in wealthy nations has not uncovered any problems [33], a lack of government incentives is seen as one of the biggest obstacles in developing nations [12,49,52]. While introducing such incentives is seen as a positive step toward more sustainable development, the actual relevance resides in the incentives' flexibility and suitability for various projects and stakeholders. Although the Singaporean government has offered several incentives, Hwang et al. [34] argued that these incentives mostly favor architects, developers, and owners, preventing other stakeholders from reaping any rewards from adopting sustainable practices. Another obstacle to sustainable practice often cited in the literature is the lack of project-specific laws, regulations, and legal frameworks [56]. According to Baek and Park [60], a robust legislative structure is in place to govern the construction of new buildings well before the construction phase begins, but there is no similarly robust regulatory mechanism to be applied to rehabilitation projects. Kamaruzzaman, et al. [61] argued that existing evaluation techniques, such as the GBI, are insufficient since they were not developed with refurbishing projects in mind.

7.2. Information, Knowledge, and Awareness Barriers

According to reports, significant obstacles to implementing SID include a lack of training, expertise, and understanding [51,106]. According to several studies, slow development and an unwillingness to engage in green initiatives have been attributed to a lack of understanding on the part of stakeholders and clients [46,56]. As Hayles [11] suggested, it can be time-consuming for interior architects and designers to source materials due to a lack of information regarding sustainable options. Customers also feel that the financial benefits of a sustainable strategy, measured by increases in property value, are insufficient [60]. In a similar vein, Olanrewaju, et al. [31] noted that homebuyers in Malaysia lacked understanding, thus underscoring the importance of advising consumers on the advantages of sustainability to pique their interest. According to Aydin, et al. [107], homebuyers place a high value on aesthetics, making it the second most influential aspect. This is especially

true for individuals who believe that environmentally friendly features detract from the building's visual appeal. Others, however, point to increased market competition as the reason this problem is almost non-existent in the SID industry today; therefore, they say, manufacturers have introduced new, more visually attractive products, materials, and finishes to meet consumers' demands [51]. It is worth noting that this perspective originated in a developed nation; many developing nations lack access to the same breadth, depth, and quality of market-provided goods.

7.3. Technology and Training Barriers

Tabassi [108] emphasized the significance of training and how it would result in a more productive workforce and, thus, an increase in sustainability-related innovations. One of the most significant obstacles in Malaysia, Singapore, and Thailand is the practitioners' lack of training and technical expertise [52,56,64]. As a result, the design and building process may take longer than expected, driving up prices and decreasing the likelihood that customers would choose environmentally friendly options. Consultants are not the only ones lacking in knowledge and experience; builders, subcontractors, and the general labor force are just as guilty [34]. According to Olanrewaju, et al. [31], practitioners' lack of access to relevant and dependable technology in the local market is a significant obstacle to the widespread implementation of sustainable building practices. Because most of the necessary technology, components, and materials are imported, this problem is exacerbated in developing nations just starting on the path to sustainable development. According to the authors, the abovementioned could cost more than initially planned due to the extensive training needed for design, installation, and assembly [31].

7.4. Attitude and Market Barriers

Attitude-related hurdles to adopting green buildings were regarded as some of the most crucial in the United States, Canada, and Australia, according to research by Chan, et al. [109]. It is within the purview of consultants to encourage their customers to implement environmentally friendly solutions [110]. However, research suggests that not all consultants are enthusiastic about this responsibility [48,56]. According to Bonda and Sosnowchik [51], interior architects and designers prefer to stick to established practices rather than explore new areas because doing so will save them time and energy. In places where SID is still relatively unrecognized, the concept of "uncharted territory" may be more appropriate. According to research by Lee and Hallak [67], practitioners' beliefs about the benefits of SID are significantly related to their stances in implementing the practice. This is consistent with the findings of Máté [111], who found that proactive SID practitioners cited cost as not a substantial barrier to entry, but reactive practitioners cited it as a significant barrier to entry. Similarly, the client's function as a stakeholder in the market is impacted by the client's values. Some research has shown that consumers exhibit scepticism regarding the concept of sustainability, and many question whether it would improve their health, comfort, or quality of life in any way [57,64,112]. According to Hwang and Tan [55], a lack of interest on the client's part is a significant hurdle, and implementing sustainable construction methods is unrealistic. However, a major hindrance to the widespread use of sustainable construction methods is the prevalence of conflicts of interest among project stakeholders and the scarcity of sustainably sourced building materials in the local economy [31,50].

7.5. Economic Barriers

Clients often prefer instant rather than long-term savings; the higher upfront cost of sustainable projects [109,113,114] and the more extended return on investment [33,34] compared to conventional types have been cited as some of the most significant obstacles. According to Dwaikat and Ali [32], the premium for eco-friendly structures might be up to 21% more than traditional structures. In addition, due to the increased research time needed for sustainable design, the design process may take longer than usual, leading

to higher consulting costs [48]. According to the SmartMarket Report published by the World Green Building in 2018, although the cost is seen as the primary obstacle to sustainable building, its influence varies significantly by nation. This discrepancy necessitates country-specific investigations. According to Kamg and Guerin [115], the likelihood of using SID on a given project is correlated with its magnitude. The literature frequently discusses the higher cost of sustainable materials and the costs involved with certifying sustainable projects [50,51,116]. Higher initial costs, maintenance expenses, research and development costs, and investment risk have all been identified as significant obstacles in studies concentrating on the Malaysian setting [31,54,117].

8. Conclusions

Recently, the construction industry's focus on incorporating environmental practices has increased. On the other hand, sustainability in the SID area has been overlooked for far too long. People spend so much time inside that it is crucial to include SID concepts in any restoration projects that take place there. Practitioners of SID in Egypt must contend with a wide range of difficulties due to the novelty of the idea. Considering this, this research aimed to identify and prioritize factors that prevent the use of SID in Egyptian home remodeling projects. There are two ways in which this research is original. Firstly, the study addresses a vacuum in the literature by giving a thorough list of barriers to the practice of SID and prioritizing them; researchers in the field of SID may use this information. Furthermore, to the authors' knowledge, no prior research has analyzed challenges to implementing SID in a low-resource setting. This research lays the framework by analyzing the challenges encountered by Egyptian interior architects and designers. Step one of this study involved categorizing 30 possible obstacles to implementing SID across five broad categories.

According to the results of the study, the top five obstacles to the implementation of SID in residential remodeling projects are as follows: (1) governmental barriers; (2) information, knowledge, and awareness barriers; (3) technology and training barriers; (4) attitude and market barriers; (5) economic barriers. The overall outcome is that monetary concerns are not regarded as significant roadblocks, which contradicts conventional wisdom in the built environment. This is not to say that price should not be considered when planning an interior remodel; nevertheless, given the restricted scope of SID in Egypt, it is understandable that other obstacles are given more weight. Given the preceding, there is a pressing need to significantly and fundamentally enhance the training of interior architects and designers. To further raise awareness among designers, clients, and the public, government and statutory authorities need to take a more active role in promoting, supporting, and regulating the practice of SID.

9. Limitations

Although the study's goals were met, several restrictions must be acknowledged in order to plan future research and to take them into account when interpreting the findings. First and foremost, it is crucial to remember that the results are biased toward the viewpoint of specialists in the Egyptian setting. As a consequence, even if the authors anticipate similar outcomes in comparable contexts, it is not possible to generalize the current research's findings due to a recognized disadvantage of utilizing non-probability sampling techniques.

However, there is a demand for specialists in the subject to carry out comparison studies in different nations and locations because obstacles are so context-dependent. Future studies might examine the acceptance and hurdles of SID in developed and developing nations. This would make it easier to build a complete picture from which to study how obstacles relate to other factors at play. In order to offer real answers for the SID industry, maybe future research might concentrate on key obstacles (category or individual) mentioned in the current study and analyze effective policies, educational standards, and laws with regard to sustainable restorations.

The absence of consistent data on the quantity and nature of renovation projects in Egypt, along with a general lack of knowledge about working interior architects and designers (partly because the profession is not completely controlled and enforced), are also seen as important roadblocks to creating a thorough picture of the country's current situation. The lack of related literature on the subject of the inquiry is also regarded as a significant constraint. For this reason, the authors widened the scope of their literature review to include challenges to sustainable practice that are frequently encountered in the construction sector and further filtered them in light of the context of this study. Finally, yet importantly, it is advised that future research enlists the assistance of specialists who are involved in policymaking as well as those who represent organizations that have the power to decide the direction of the SID field. This is because experts with different perspectives on this issue may have different perspectives on it.

10. Implications

Following what has been said above, the present research suggests a variety of theoretical and practical applications for academia and business. As a result of this research, the most critical obstacles to using SID in interior restoration projects have been identified for the first time in the academic literature. The findings contradict previous research by demonstrating that financial obstacles are not among the top concerns. Instead, hurdles related to education, training, laws, and policies are high on the list. Considering there is a lack of similar studies in Egypt, this investigation fills a knowledge vacuum and paves the way for more studies. This research presents a unique quantitative technique that streamlines data gathering and analysis while maintaining high-quality outcomes. In addition to these benefits, the study's findings can guide construction industry players toward the most pressing challenges in the SID sector. Results suggest a pressing need for comprehensive reform, including but not limited to changes in educational standards, legislation, regulations, and practitioner attitudes. The specifics of these changes are as follows:

1. The certification requirements for SID programs need to include a sufficient number of sustainability modules, including those that address the triple bottom lines.
2. Only trained professionals are allowed to work on interior rehabilitation projects, so the qualification test of interior architects/designers must incorporate SID principles and strictly control the practice.
3. Workshops and training courses for working professionals must be regularly offered by representative bodies, organizations, and institutions.
4. Fourth, the government has to become more involved in encouraging the use of SID and creating useful incentive programs for home improvement initiatives.
5. Legislators and politicians should propose and vigorously enforce a comprehensive set of required norms, laws, and legal frameworks tailored to these initiatives.
6. Interior designers and architects in practice should warmly welcome SID; joyfully inform, inspire, and persuade customers; and work tirelessly to find methods to incorporate the concept into projects without jeopardizing their clients' desired aesthetics or financial stability.

The framework so laid would pave the way for future, more all-encompassing plans. Educators, statutory authorities, local and federal governments, politicians, and lawmakers may all learn from the results, not only from practicing interior architects and designers. As a result, this has the potential to stimulate local economies, increase demand for local renewable resources, and cut energy use overall.

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References

1. Ashour, M.; Mahdiyar, A.; Haron, S.H.; Hanafi, M.H. Barriers to the practice of sustainable interior architecture and design for interior renovations: A Parsimonious-Cybernetic Fuzzy AHP approach. *J. Clean. Prod.* **2022**, *366*, 132958. [CrossRef]
2. Durdyev, S.; Ashour, M.; Connelly, S.; Mahdiyar, A. Barriers to the implementation of Building Information Modelling (BIM) for facility management. *J. Build. Eng.* **2022**, *46*, 103736. [CrossRef]
3. Kineber, A.F.; Hamed, M.M. Exploring the Sustainable Delivery of Building Projects in Developing Countries: A PLS-SEM Approach. *Sustainability* **2022**, *14*, 15460. [CrossRef]
4. Rady, M.; Mahfouz, S.Y. Effects of Concrete Grades and Column Spacings on the Optimal Design of Reinforced Concrete Buildings. *Materials* **2022**, *15*, 4290. [CrossRef] [PubMed]
5. Doan, D.T.; Ghaffarianhoseini, A.; Naismith, N.; Zhang, T.; Ghaffarianhoseini, A.; Tookey, J. A critical comparison of green building rating systems. *Build. Environ.* **2017**, *123*, 243–260. [CrossRef]
6. Lima, L.; Trindade, E.; Alencar, L.; Alencar, M.; Silva, L. Sustainability in the construction industry: A systematic review of the literature. *J. Clean. Prod.* **2021**, *289*, 125730. [CrossRef]
7. World Commission On Environment and Development. *Our Common Future*; Oxford University Press: Oxford, UK, 1987.
8. Zhang, Y.; Zhang, S.; Jiang, X.; Chen, Q.; Jiang, Z.; Ju, J.W.; Bauchy, M. Insights into the thermal effect on the fracture toughness of calcium silicate hydrate grains: A reactive molecular dynamics study. *Cem. Concr. Compos.* **2022**, *134*, 104824. [CrossRef]
9. Zhang, Y.; Zhang, S.; Zhao, W.; Jiang, X.; Chen, Y.; Hou, J.; Wang, Y.; Yan, Z.; Zhu, H. Influence of multi-scale fiber on residual compressive properties of a novel rubberized concrete subjected to elevated temperatures. *J. Build. Eng.* **2023**, *65*, 105750. [CrossRef]
10. Winchip, S.M. *Sustainable Design for Interior Environments*, 2nd ed.; A&C Black: New York, NY, USA, 2011.
11. Hayles, C.S. Environmentally sustainable interior design: A snapshot of current supply of and demand for green, sustainable or Fair Trade products for interior design practice. *Int. J. Sustain. Built Environ.* **2015**, *4*, 100–108. [CrossRef]
12. Deng, W.; Yang, T.; Tang, L.; Tang, Y.T. Barriers and policy recommendations for developing green buildings from local government perspective: A case study of Ningbo China. *Intell. Build. Int.* **2018**, *10*, 61–77. [CrossRef]
13. Tabatabaee, S.; Ashour, M.; Sadeghi, H.; Hoseini, S.A.; Mohandes, S.R.; Mahdiyar, A.; Ismail, S.; Hosseini, M.R. Towards the adoption of most suitable green walls within sustainable buildings using interval type-2 fuzzy best-worst method and TOPSIS technique. *Eng. Constr. Archit. Manag.* **2022**. *ahead-of-print*. [CrossRef]
14. Kang, M.; Guerin, D.A. The state of environmentally sustainable interior design practice. *Am. J. Environ. Sci.* **2009**, *5*, 179–186. [CrossRef]
15. Aidy, A.; Rady, M.; Mashhour, I.M.; Mahfouz, S.Y. Structural Design Optimization of Flat Slab Hospital Buildings Using Genetic Algorithms. *Buildings* **2022**, *12*, 2195. [CrossRef]
16. Celadyn, M. Integrative design classes for environmental sustainability of interior architectural design. *Sustainability* **2020**, *12*, 7383. [CrossRef]
17. Smith, D.; Lommerse, M.; Metcalfe, P. *Perspectives on Social Sustainability and Interior Architecture: Life from the Inside*; Springer Science & Business: Berlin/Heidelberg, Germany, 2014.
18. Taşoz, Ş.M.; Afacan, Y. Simulated physical ageing: A prioritized persona-based model for accessible interiors in senior housing environments. *Indoor Built Environ.* **2020**, *31*, 2115–2133. [CrossRef]
19. Pilatowicz, G. Sustainability in interior design. *Sustain. J. Rec.* **2015**, *8*, 101–104. [CrossRef]

20. Tabatabaee, S.; Ashour, M.; Mohandes, S.R.; Sadeghi, H.; Mahdiyar, A.; Hosseini, M.R.; Ismail, S. Deterrents to the adoption of green walls: A hybrid fuzzy-based approach. *Eng. Constr. Archit. Manag.* **2022**, *29*, 3460–3479. [CrossRef]
21. Azzazy, S.; Ghaffarianhoseini, A.; GhaffarianHoseini, A.; Naismith, N.; Doborjeh, Z. A critical review on the impact of built environment on users' measured brain activity. *Archit. Sci. Rev.* **2021**, *64*, 319–335. [CrossRef]
22. Attaianese, E. Environmental Design and Human Performance. A Literature Review. In *Advances in Intelligent Systems and Computing*; Springer International Publishing: Cham, Switzerland, 2019; Volume 825, pp. 486–495.
23. Chowdhury, S.; Noguchi, M.; Doloi, H. Defining domestic environmental experience for occupants' mental health and wellbeing. *Designs* **2020**, *4*, 26. [CrossRef]
24. Bower, I.; Tucker, R.; Enticott, P.G. Impact of built environment design on emotion measured via neurophysiological correlates and subjective indicators: A systematic review. *J. Environ. Psychol.* **2019**, *66*, 101344. [CrossRef]
25. Rady, M.; Mahfouz, S.Y.; Taher, S.E.-D.F. Optimal Design of Reinforced Concrete Materials in Construction. *Materials* **2022**, *15*, 2625. [CrossRef]
26. Passoni, C.; Marini, A.; Belleri, A.; Menna, C. Redefining the concept of sustainable renovation of buildings: State of the art and an LCT-based design framework. *Sustain. Cities Soc.* **2021**, *64*, 102519. [CrossRef]
27. Edwards, R.E.; Lou, E.; Bataw, A.; Kamaruzzaman, S.N.; Johnson, C. Sustainability-led design: Feasibility of incorporating whole-life cycle energy assessment into BIM for refurbishment projects. *J. Build. Eng.* **2019**, *24*, 100697. [CrossRef]
28. Jagarajan, R.; Abdullah Mohd Asmoni, M.N.; Mohammed, A.H.; Jaafar, M.N.; Lee Yim Mei, J.; Baba, M. Green retrofitting—A review of current status, implementations and challenges. *Renew. Sustain. Energy Rev.* **2017**, *67*, 1360–1368. [CrossRef]
29. Stieg, C. The Sustainability Gap. *J. Inter. Des.* **2006**, *32*, vii–xxi. [CrossRef]
30. Lee, E.; Allen, A.; Kim, B. Interior Design Practitioner Motivations for Specifying Sustainable Materials: Applying the Theory of Planned Behavior to Residential Design. *J. Inter. Des.* **2013**, *38*, 1–16. [CrossRef]
31. Olanrewaju, A.L.; Min, C.S.; Sanmargaraja, S.; Ponniah, V. What is Stopping the Adoption of Sustainable Residential Buildings in Malaysia? In *Green Energy and Technology*; Springer International Publishing: Cham, Switzerland, 2020; pp. 181–198. [CrossRef]
32. Dwaikat, L.N.; Ali, K.N. Green buildings cost premium: A review of empirical evidence. *Energy Build.* **2016**, *110*, 396–403. [CrossRef]
33. Ahn, Y.H.; Pearce, A.R.; Wang, Y.; Wang, G. Drivers and barriers of sustainable design and construction: The perception of green building experience. *Int. J. Sustain. Build. Technol. Urban Dev.* **2013**, *4*, 35–45. [CrossRef]
34. Hwang, B.G.; Shan, M.; Lye, J.M. Adoption of sustainable construction for small contractors: Major barriers and best solutions. *Clean Technol. Environ. Policy* **2018**, *20*, 2223–2237. [CrossRef]
35. Kwok, A.G.; Grondzik, W. *The Green Studio Handbook: Environmental Strategies for Schematic Design*; Routledge: New York, NY, USA, 2018.
36. Foster, K.; Stelmack, A.; Hindman, D. *Sustainable Residential Interiors*; John Wiley & Sons: Hoboken, NJ, USA, 2012.
37. Charnofsky, L.W. The Interrelationship between Human Behavior and Sustainability in the Built Environment. Doctoral Dissertation, Kent State University, Kent, OH, USA, 2012.
38. Braungart, M.; McDonough, W. *The Upcycle. Beyond Sustainability-Designing for Abundance*; Macmillan: New York, NY, USA, 2013.
39. James, S.; Lahti, T. *The Natural Step for Communities: How Cities and Towns Can Change to Sustainable Practices*; New Society Publishers: Gabriola Island, BC, Canada, 2004.
40. Benyus, J.M. *Biomimicry: Innovation Inspired by Nature*; Harper Perennial: New York, NY, USA, 1997.
41. Beeks, J.; Ziko, A. Internalizing economic externalities on the macroeconomic stage. Exploring and expanding Paul Hawken's the ecology of commerce: A declaration of sustainability for globalized solutions. *Eur. J. Sustain. Dev. Res.* **2018**, *2*, 03. [CrossRef]
42. Michel, K. *Green Guide for Artists: Nontoxic Recipes, Green Art Ideas, & Resources for the Eco-Conscious Artist*; Quarry Books: Beverly, MA, USA, 2009.
43. O'Shea, L.; Grimley, C.; Love, M. *The Interior Design Reference & Specification Book: Everything Interior Designers Need to Know Every Day*; Rockport Publishers: Beverly, MA, USA, 2013.
44. Kocsis, A.B. *The Complete Guide to Eco-Friendly House Cleaning: Everything You Need to Know Explained Simply*; Atlantic Publishing Company: London, UK, 2010.
45. Al horr, Y.; Arif, M.; Katafygiotou, M.; Mazroei, A.; Kaushik, A.; Elsarrag, E. Impact of indoor environmental quality on occupant well-being and comfort: A review of the literature. *Int. J. Sustain. Built Environ.* **2016**, *5*, 1–11. [CrossRef]
46. Palm, J.; Reindl, K. Understanding barriers to energy-efficiency renovations of multifamily dwellings. *Energy Effic.* **2018**, *11*, 53–65. [CrossRef]
47. Lam, P.T.I.; Chan, E.H.W.; Chau, C.K.; Poon, C.S.; Chun, K.P. Integrating green specifications in construction and overcoming barriers in their use. *J. Prof. Issues Eng. Educ. Pract.* **2009**, *135*, 142–152. [CrossRef]
48. Hankinson, M.; Breytenbach, A. Barriers that impact on the implementation of sustainable design. In Proceedings of the Northern World Mandate Conference, Helsinki, Finland, 24–26 May 2012; pp. 24–26.
49. Chan, A.P.C.; Darko, A.; Olanipekun, A.O.; Ameyaw, E.E. Critical barriers to green building technologies adoption in developing countries: The case of Ghana. *J. Clean. Prod.* **2018**, *172*, 1067–1079. [CrossRef]
50. Shen, W.; Tang, W.; Siripanan, A.; Lei, Z.; Duffield, C.F.; Hui, F.K.P. Understanding the Green Technical Capabilities and Barriers to Green Buildings in Developing Countries: A Case Study of Thailand. *Sustainability* **2018**, *10*, 3585. [CrossRef]
51. Bonda, P.; Sosnowchik, K. *Sustainable Commercial Interiors*; John Wiley & Sons: Hoboken, NJ, USA, 2007.

52. Durdyev, S.; Ismail, S.; Ihtiyar, A.; Abu Bakar, N.F.S.; Darko, A. A partial least squares structural equation modeling (PLS-SEM) of barriers to sustainable construction in Malaysia. *J. Clean. Prod.* **2018**, *204*, 564–572. [CrossRef]
53. Jafari, A.; Valentin, V. An optimization framework for building energy retrofits decision-making. *Build. Environ.* **2017**, *115*, 118–129. [CrossRef]
54. Zainul Abidin Nazirah, N. Investigating the awareness and application of sustainable construction concept by Malaysian developers. *Habitat Int.* **2010**, *34*, 421–426. [CrossRef]
55. Hwang, B.G.; Tan, J.S. Green building project management: Obstacles and solutions for sustainable development. *Sustain. Dev.* **2012**, *20*, 335–349. [CrossRef]
56. Nguyen, H.T.; Skitmore, M.; Gray, M.; Zhang, X.; Olanipekun, A.O. Will green building development take off? An exploratory study of barriers to green building in Vietnam. *Resour. Conserv. Recycl.* **2017**, *127*, 8–20. [CrossRef]
57. Häkkinen, T.; Belloni, K. Barriers and drivers for sustainable building. *Build. Res. Inf.* **2011**, *39*, 239–255. [CrossRef]
58. bin Esa, M.R.; Marhani, M.A.; Yaman, R.; Rashid, A.A.H.N.H.N.; Adnan, H. Obstacles in implementing green building projects in Malaysia. *Aust. J. Basic Appl. Sci.* **2011**, *5*, 1806–1812.
59. Pham, D.H.; Lee, J.; Ahn, Y. Implementing LEED v4 BD+C projects in Vietnam: Contributions and challenges for general contractor. *Sustainability* **2019**, *11*, 5449. [CrossRef]
60. Baek, C.; Park, S. Policy measures to overcome barriers to energy renovation of existing buildings. *Renew. Sustain. Energy Rev.* **2012**, *16*, 3939–3947. [CrossRef]
61. Kamaruzzaman, S.N.; Lou, E.C.W.; Wong, P.F.; Edwards, R.; Hamzah, N.; Ghani, M.K. Development of a non-domestic building refurbishment scheme for Malaysia: A Delphi approach. *Energy* **2019**, *167*, 804–818. [CrossRef]
62. He, Q.; Zhao, H.; Shen, L.; Dong, L.; Cheng, Y.; Xu, K. Factors influencing residents' intention toward green retrofitting of existing residential buildings. *Sustainability* **2019**, *11*, 4246. [CrossRef]
63. Luthra, S.; Kumar, S.; Garg, D.; Haleem, A. Barriers to renewable/sustainable energy technologies adoption: Indian perspective. *Renew. Sustain. Energy Rev.* **2015**, *41*, 762–776. [CrossRef]
64. Hwang, B.G.; Zhao, X.; See, Y.L.; Zhong, Y. Addressing Risks in Green Retrofit Projects: The Case of Singapore. *Proj. Manag. J.* **2015**, *46*, 76–89. [CrossRef]
65. Henseler, J.; Hubona, G.; Ray, P.A. Using PLS path modeling in new technology research: Updated guidelines. *Ind. Manag. Data Syst.* **2016**, *116*, 2–20. [CrossRef]
66. Banihashemi, S.; Hosseini, M.R.; Golizadeh, H.; Sankaran, S. Critical success factors (CSFs) for integration of sustainability into construction project management practices in developing countries. *Int. J. Proj. Manag.* **2017**, *35*, 1103–1119. [CrossRef]
67. Lee, C.; Hallak, R. Investigating the moderating role of education on a structural model of restaurant performance using multi-group PLS-SEM analysis. *J. Bus. Res.* **2018**, *88*, 298–305. [CrossRef]
68. Hult, G.T.M.; Hair, J.F., Jr.; Proksch, D.; Sarstedt, M.; Pinkwart, A.; Ringle, C.M. Addressing endogeneity in international marketing applications of partial least squares structural equation modeling. *J. Int. Mark.* **2018**, *26*, 1–21. [CrossRef]
69. Hair, J.F., Jr.; Matthews, L.M.; Matthews, R.L.; Sarstedt, M. PLS-SEM or CB-SEM: Updated guidelines on which method to use. *Int. J. Multivar. Data Anal.* **2017**, *1*, 107–123. [CrossRef]
70. Hair, J.F.; Ringle, C.M.; Sarstedt, M. PLS-SEM: Indeed a silver bullet. *J. Mark. Theory Pract.* **2011**, *19*, 139–152. [CrossRef]
71. Podsakoff, P.M.; MacKenzie, S.B.; Lee, J.-Y.; Podsakoff, N.P. Common method biases in behavioral research: A critical review of the literature and recommended remedies. *J. Appl. Psychol.* **2003**, *88*, 879–903. [CrossRef] [PubMed]
72. Glick, W.H.; Jenkins, G.D., Jr.; Gupta, N. Method versus substance: How strong are underlying relationships between job characteristics and attitudinal outcomes? *Acad. Manag. J.* **1986**, *29*, 441–464. [CrossRef]
73. Strandholm, K.; Kumar, K.; Subramanian, R. Examining the interrelationships among perceived environmental change, strategic response, managerial characteristics, and organizational performance. *J. Bus. Res.* **2004**, *57*, 58–68. [CrossRef]
74. Williams, L.J.; Cote, J.A.; Buckley, M.R. Lack of method variance in self-reported affect and perceptions at work: Reality or artifact? *J. Appl. Psychol.* **1989**, *74*, 462–468. [CrossRef]
75. Podsakoff, P.M.; Organ, D.W. Self-reports in organizational research: Problems and prospects. *J. Manag.* **1986**, *12*, 531–544. [CrossRef]
76. Al-Ashmori, Y.Y.; Othman, I.; Rahmawati, Y.; Amran, Y.M.; Sabah, S.A.; Rafindadi, A.D.u.; Mikić, M. BIM benefits and its influence on the BIM implementation in Malaysia. *Ain Shams Eng. J.* **2020**, *11*, 1013–1019. [CrossRef]
77. Hulland, J. Use of partial least squares (PLS) in strategic management research: A review of four recent studies. *Strateg. Manag. J.* **1999**, *20*, 195–204. [CrossRef]
78. Fornell, C.; Larcker, D.F. Evaluating structural equation models with unobservable variables and measurement error. *J. Mark. Res.* **1981**, *18*, 39–50. [CrossRef]
79. Nunnally, J.C.; Bernstein, I. The role of university in the development of entrepreneurial vocations: A Spanish study. In *Psychometric Theory*; McGraw-Hill: New York, NY, USA, 1978.
80. Wong, K.K.-K. Partial least squares structural equation modeling (PLS-SEM) techniques using SmartPLS. *Mark. Bull.* **2013**, *24*, 1–32.
81. Hair, J.F.; Anderson, R.E.; Babin, B.J.; Black, W.C. *Multivariate Data Analysis: A Global Perspective*; Pearson: Upper Saddle River, NJ, USA, 2010; Volume 7.

82. Campbell, D.T.; Fiske, D.W. Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychol. Bull.* **1959**, *56*, 81–105. [CrossRef] [PubMed]
83. Alkilani, S.G.R.Z. Performance Measurement and Improvement Model for Small and Medium Contractors in Developing Countries. Doctoral Dissertation, UNSW Sydney, Kensington, Australia, 2018.
84. Al-Mekhlafi, A.-B.A.; Isha, A.S.N.; Chileshe, N.; Abdulrab, M.; Kineber, A.F.; Ajmal, M. Impact of Safety Culture Implementation on Driving Performance among Oil and Gas Tanker Drivers: A Partial Least Squares Structural Equation Modelling (PLS-SEM) Approach. *Sustainability* **2021**, *13*, 8886. [CrossRef]
85. Buniya, M.K.; Othman, I.; Sunindijo, R.Y.; Kineber, A.F.; Mussi, E.; Ahmad, H. Barriers to safety program implementation in the construction industry. *Ain Shams Eng. J.* **2020**, *12*, 65–72. [CrossRef]
86. Kineber, A.F.; Othman, I.; Oke, A.E.; Chileshe, N.; Alsolami, B. Critical Value Management Activities in Building Projects: A Case of Egypt. *Buildings* **2020**, *10*, 239. [CrossRef]
87. Olanrewaju, O.I.; Kineber, A.F.; Chileshe, N.; Edwards, D.J. Modelling the impact of Building Information Modelling (BIM) Implementation Drivers and Awareness on Project Lifecycle. *Sustainability* **2021**, *13*, 8887. [CrossRef]
88. Oke, A.E.; Kineber, A.F.; Al-Bukhari, I.; Famakin, I.; Kingsley, C. Exploring the benefits of cloud computing for sustainable construction in Nigeria. *J. Eng. Des. Technol. Soc.* **2021**. [CrossRef]
89. Othman, I.; Kineber, A.; Oke, A.; Zayed, T.; Buniya, M. Barriers of value management implementation for building projects in Egyptian construction industry. *Ain Shams Eng. J.* **2020**, *12*, 21–30. [CrossRef]
90. Kineber, A.F.; Massoud, M.M.; Hamed, M.M.; Alhammadi, Y.; Al-Mhdawi, M.K.S. Impact of Overcoming BIM Implementation Barriers on Sustainable Building Project Success: A PLS-SEM Approach. *Buildings* **2023**, *13*, 178. [CrossRef]
91. Kineber, A.F.; Othman, I.; Oke, A.E.; Chileshe, N.; Buniya, M.K. Impact of Value Management on Building Projects Success: Structural Equation Modeling Approach. *J. Constr. Eng. Manag.* **2021**, *147*, 04021011. [CrossRef]
92. Kineber, A.F.; Othman, I.; Oke, A.E.; Chileshe, N.; Zayed, T. Exploring the value management critical success factors for sustainable residential building—A structural equation modelling approach. *J. Clean. Prod.* **2021**, *293*, 126115. [CrossRef]
93. Kineber, A.F.; Oke, A.E.; Hamed, M.M.; Rached, E.F.; Elmansoury, A. Modeling the Impact of Overcoming the Green Walls Implementation Barriers on Sustainable Building Projects: A Novel Mathematical Partial Least Squares—SEM Method. *Mathematics* **2023**, *11*, 504. [CrossRef]
94. Yin, R.K. Applied social research methods series. In *Case Study Research: Design and Methods*, 4th ed.; Sage: Thousand Oaks, CA, USA, 2009; Volume 5.
95. Kothari, C. *Research Methodology Methods and Techniques*, 2nd ed.; Revised Edition; New Age International Publishers: New Delhi, India, 2009.
96. Wahyuni, D. The research design maze: Understanding paradigms, cases, methods and methodologies. *J. Appl. Manag. Account. Res.* **2012**, *10*, 69–80.
97. Kineber, A.F.; Oke, A.E.; Hamed, M.M.; Rached, E.F.; Elmansoury, A.; Alyanbaawi, A. A Partial Least Squares Structural Equation Modeling of Robotics Implementation for Sustainable Building Projects: A Case in Nigeria. *Sustainability* **2023**, *15*, 604. [CrossRef]
98. MacKenzie, S.B.; Podsakoff, P.M. Common method bias in marketing: Causes, mechanisms, and procedural remedies. *J. Retail.* **2012**, *88*, 542–555. [CrossRef]
99. Harman, H.H. *Modern Factor Analysis*; University of Chicago Press: Chicago, IL, USA, 1967.
100. Hair, J.F.; Black, W.C.; Babin, B.J.; Anderson, R.E.; Tatham, R.L. *Multivariate Data Analysis*; Pearson Prentice Hall: Upper Saddle River, NJ, USA, 2006; Volume 6.
101. Hair, J.F., Jr.; Hult, G.T.M.; Ringle, C.; Sarstedt, M. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*; Sage Publications: Thousand Oaks, CA, USA, 2016.
102. Hair, J.F.; Ringle, C.M.; Sarstedt, M. Partial least squares structural equation modeling: Rigorous applications, better results and higher acceptance. *Long Range Plan.* **2013**, *46*, 1–12. [CrossRef]
103. Chin, W.W.; Newsted, P.R. Structural equation modeling analysis with small samples using partial least squares. *Stat. Strateg. Small Sample Res.* **1999**, *1*, 307–341.
104. Henseler, J.; Ringle, C.M.; Sarstedt, M. A new criterion for assessing discriminant validity in variance-based structural equation modeling. *J. Acad. Mark. Sci.* **2015**, *43*, 115–135. [CrossRef]
105. Dallas, M.F. *Value and Risk Management: A Guide to Best Practice*; John Wiley & Sons: Hoboken, NJ, USA, 2008.
106. Piotrowski, C. *Professional Practice for Interior Designers*; John Wiley & Sons: Hoboken, NJ, USA, 2002.
107. Aydin, Y.C.; Mirzaei, P.A.; Akhavannasab, S. On the relationship between building energy efficiency, aesthetic features and marketability: Toward a novel policy for energy demand reduction. *Energy Policy* **2019**, *128*, 593–606. [CrossRef]
108. Tabassi, A.A.; Ramli, M.; Bakar, A.H.A. Effects of training and motivation practices on teamwork improvement and task efficiency: The case of construction firms. *Int. J. Proj. Manag.* **2012**, *30*, 213–224. [CrossRef]
109. Chan, A.P.C.; Darko, A.; Ameyaw, E.E.; Owusu-Manu, D.G. Barriers Affecting the Adoption of Green Building Technologies. *J. Manag. Eng.* **2017**, *33*, 04016057. [CrossRef]
110. Sorrento, L. A Natural Balance: Interior Design, Humans, and Sustainability. *J. Inter. Des.* **2012**, *37*, 9–24. [CrossRef]
111. Máté, K. Attitudes Versus Actions: Are Interior Designers Genuinely Embracing Sustainable Design through Material Selection? In Proceedings of the Fifth International Conference of the Association of Architecture Schools in Australasia (AASA), Brisbane, Australia, 28–30 September 2009.

112. Palm, J.; Reindl, K.; Ambrose, A. Understanding tenants' responses to energy efficiency renovations in public housing in Sweden: From the resigned to the demanding. *Energy Rep.* **2020**, *6*, 2619–2626. [CrossRef]
113. Österbring, M.; Mata, É.; Thuvander, L.; Wallbaum, H. Explorative life-cycle assessment of renovating existing urban housing-stocks. *Build. Environ.* **2019**, *165*, 106391. [CrossRef]
114. Rady, M.; Kineber, A.F.; Hamed, M.M.; Daoud, A.O. Partial Least Squares Structural Equation Modeling of Constraint Factors Affecting Project Performance in the Egyptian Building Industry. *Mathematics* **2023**, *11*, 497. [CrossRef]
115. Kamg, M.; Guerin, D.A. The characteristics of interior designers who practice environmentally sustainable interior design. *Environ. Behav.* **2009**, *41*, 170–184. [CrossRef]
116. Alfuraty, A.B. Sustainable Environment in Interior Design: Design by Choosing Sustainable Materials. In *IOP Conference Series: Materials Science and Engineering*; IOP Publishing: Bristol, UK, 2020.
117. Samari, M.; Godrati, N.; Esmaeilifar, R.; Olfat, P.; Shafiei, M.W.M. The investigation of the barriers in developing green building in Malaysia. *Mod. Appl. Sci.* **2013**, *7*, 1–10. [CrossRef]