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Factors Affecting the Selection of Sustainable Construction Materials: A Study in New Zealand

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Abstract: The construction industry is increasingly prioritizing sustainability, with the selection of sustainable construction materials (SCMs) playing a crucial role in achieving environmental and regulatory objectives. However, New Zealand's construction codes and sustainability standards lack cohesive, region-specific guidance, posing challenges for industry professionals in selecting appropriate materials. This study aims to identify the key factors influencing SCM selection within the New Zealand construction sector. An online questionnaire was distributed to 115 industry professionals, and data were analyzed using a structural equation modeling (SEM) with confirmatory factor analysis (CFA) to examine the relationships among social, economic, environmental, and technical factors. The finding was that technical factors are vital in achieving sustainable construction. Additionally, the social, economic, environmental, and technical factors were strongly correlated, affecting the selection of SCMs. Based on this research, construction consultants should advise customers on materials and the long-term economic benefits of investing in sustainable materials, which will cut operating expenses and environmental effects.

Keywords: sustainable construction; sustainable materials; sustainability; construction industry

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1. Introduction

The 17 sustainability goals are designed to establish a balanced approach to development that addresses the requirements of the present without risking the capacity of future generations [1]. These goals emphasize the importance of environmental protection, resource conservation, and social equity. They include reducing carbon emissions, minimizing waste, promoting renewable energy, and ensuring fair access to resources and opportunities [2].

The construction sector plays a significant role in the natural environment, economy, and society. Previous studies have revealed that construction activities, directly and indirectly, affect the environment and sustainable construction. Lim et al. [3] pointed out that the construction industry is responsible for approximately 25% of global logging operations, 40% of raw material extraction, 49% of sulfur dioxide emissions, 39% of carbon dioxide emissions, 25% of nitrous oxide emissions, and 10% of matter emissions. Indeed, the construction industry is significant in global greenhouse gas emissions, with buildings responsible for about 40%. Embodied carbon, or emissions from material manufacturing and construction processes, constitutes 11% of this total [4]. As a practical approach to solving environmental issues, sustainable construction materials are unique materials adapted to achieve sustainable construction. They are environmentally friendly and can help reduce greenhouse gas emissions, pollution, ecosystem imbalances, and other problems associated with traditional material categories [5].

The increasing focus on sustainability in the building industry presents a significant problem in New Zealand, where selecting sustainable construction materials is critical for satisfying environmental and regulatory requirements [5]. Current sustainability frameworks, such as LEED and Green Star, provide significant information, but they frequently fail to address the specific needs of different climatic conditions in New Zealand, such as seismic activity and local resource availability [6]. Achieving a Green Star rating can be expensive due to documentation, compliance, and assessment fees, discouraging broader adoption [7]. Moreover, in New Zealand, where timber is a commonly used construction material, frameworks like LEED do not fully account for the benefits of locally sourced, sustainably managed wood compared to imported alternatives [8]. Another problem is that building codes and sustainability standards in New Zealand have often been dispersed and may not provide cohesive guidance on sustainable material choices [9].

To address these challenges, this research seeks a deeper understanding of SCMs specifically tailored to the New Zealand construction context. Thus, it aims to identify crucial factors and investigate their interrelationship in selecting SCMs in New Zealand.

2. Literature Review and Hypotheses

2.1. Sustainable Construction Materials

Sustainable construction is described as activities that minimize negative impacts, while maximizing positive benefits to balance environmental, economic, and social goals [10]. The path to achieving sustainable construction involves enhancing material manufacturing processes, implementing recycling practices, substituting resources, adopting novel construction methods, designing buildings for disassembly and deconstruction, using innovative materials, and incorporating eco-friendly materials [11,12]. According to Danso (2018) [13], SCMs are socially acceptable and cost-effective materials that minimize detrimental environmental impacts during the manufacturing and construction of structures for current and future use. In general, SCMs reduce environmental impact throughout their life cycle, from extraction to disposal [14,15]. These materials aim to reduce carbon emissions, conserve resources, and promote a healthier environment, while maintaining durability and functionality for construction projects.

2.2. Factors Influencing the Selection of SCMs

A logical approach to identifying crucial factors influencing the selection of SCMs with three pillars of sustainability development has been widely accepted [13,16,17]. The three-pillar concept of sustainability (social, economic, and environmental) was introduced in 1987 [18]. This concept is typically depicted as three intersecting circles, with overall sustainability at the center. Purvis et al. (2019) [1] supplied an explanation of the theoretically rigorous depiction of the three pillars in a comprehensive review, as shown in Figure 1. Therefore, the initial crucial factors influencing SCMs based on the three-pillar approach are economic, social, and environmental factors.

Apart from these factors, technical factors also significantly influence the selection of SCMs and are essential for their application and selection [19,20]. The construction industry has increasingly acknowledged the necessity of materials that balance technical performance and environmental, social, and economic sustainability for three primary reasons. First, it is essential to evaluate technical characteristics, including the ability to fulfill design and functional specifications, durability, and performance capacity, to ensure that the materials continue to meet the demands of construction and use over time [21]. Concrete, a standard construction material, is optimized for durability and environmental impact with performance-based technical criteria [22]. Second, taking advantage of cutting-edge technologies to enhance SCMs is inevitable. The Technology Acceptance Model is a theory in information systems that describes how people accept and use technology. The Technology Acceptance Model idea could successfully explain the evolution of technology and the adoption of SCMs. Stakeholders can better understand and use these materials, producing a more sustainable built environment. Third, the Fourth Industrial Revolution, which includes 3D printing and nanotechnology, has the potential to accelerate the development of construction materials, thereby fostering a more sustainable built environment [23]. In the aforementioned analysis, technical factors are one of the most critical aspects of selecting SCMs.

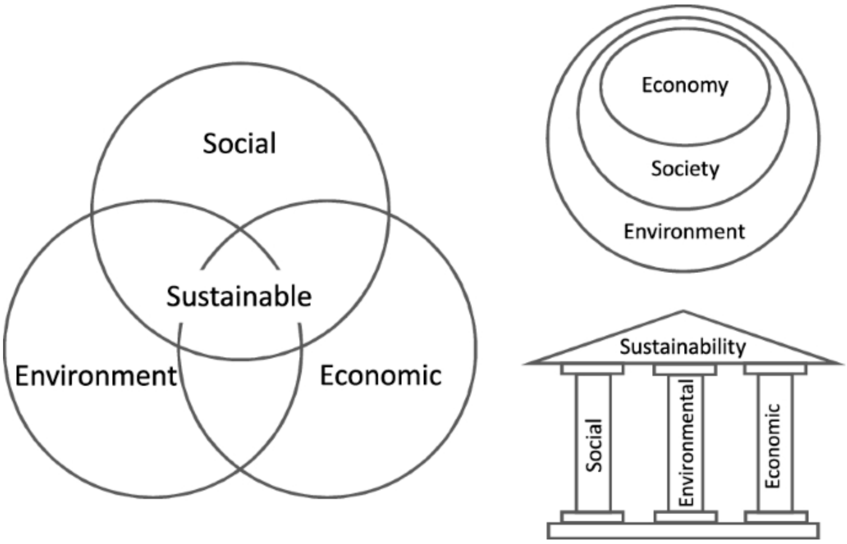

Figure 1. Three pillars of sustainability. Source: Purvis et al. (2019) [1].

2.3. Indicators of Crucial Factors

A literature review was conducted to determine the crucial factors impacting the selection of SCMs. Environmental, social, economic, and technical considerations are essential in achieving sustainability in construction projects. Table 1 lists four crucial factors with their indicators.

Table 1. List of four crucial factors with indicators.

Factors	Code	Indicators	References
Social factors	S1	Aesthetics quality	[24,25]
	S2	Use of local material	[26]
	S3	Health and safety	[27]
	S4	Accessibility (disability measure)	[28]
	S5	Living conditions	[14,29,30]
Economic factors	EC1	Initial cost	[31]
	EC2	Transportation cost	[32,33]
	EC3	Life cycle cost	[25,34]
	EC4	Installation cost	[35]
	EC5	Maintenance cost	[36]
	EC6	Profit and margin	[31]
	EC7	Tax contribution	[37]

Table 1. *Cont.*

Factors	Code	Indicators	References
Environmental factors	EN1	Anticipated energy effective level	[25]
	EN2	Pollution prevention	[25,38]
	EN3	Waste reduction	[39]
	EN4	Low habitat destruction	[40]
	EN5	Non-toxic/less toxic materials	[25]
	EN6	Biodegradability of material	[25,41]
	EN7	Reuse ability of material	[42]
	EN8	Climate stabilization	[37,43]
	EN9	Biodiversity protection	[25,37]
	EN10	Renewable material	[25,44]
	EN11	Recycled materials	[25,45]
	EN12	Water efficiency	[25,46]
Technical factors	T1	Maintainability	[19,47,48]
	T2	Buildability (ease of construction)	[19,49,50]
	T3	Resistance to decay	[51]
	T4	Fire resistance	[52,53]
	T5	Life expectancy of material	[54,55]
	T6	Energy saving and thermal insulation	[56]

2.4. Hypotheses

According to the aforementioned explanations, the factors influencing the selection of SCMs can be categorized as social, economic, environmental, and technical factors, as shown in Figure 2. These hypotheses suggest direct relationships, indicating that improvements in one factor correlate with improvements in the related factor, as detailed next:

H1: *Social factors are positively correlated with economic factors.*

H2: *Social factors are positively correlated with environmental factors.*

H3: *Social factors are positively correlated with technical factors.*

H4: *Economic factors are positively correlated with environmental factors.*

H5: *Economic factors are positively correlated with technical factors.*

H6: *Environmental factors are positively correlated with technical factors.*

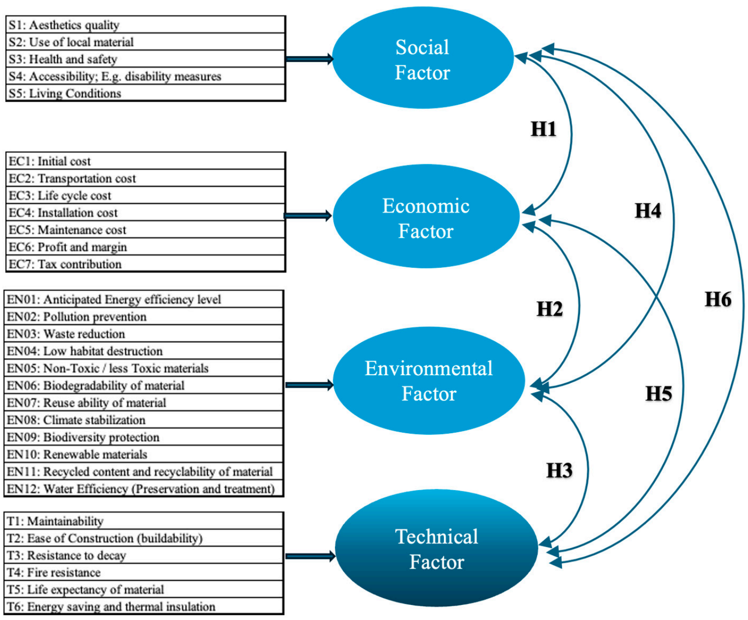

Figure 2. Hypotheses for factors affecting SCM selection.

3. Research Method

Developing a data collection instrument is crucial because further analysis and research findings rely on the gathered information, which is entirely based on the questions asked to the respondents [57]. The most suitable method for collecting quantitative data is through a questionnaire [58]. Thus, this study adopted this instrument to collect data. Moreover, the COVID-19 pandemic fostered the use of online questionnaires instead of conventional questionnaires as an effective way to collect data through an online network [59]. An online questionnaire was adopted in this study to gather information because it substantially benefits cost, efficiency, reach, and data quality. It is also adaptable and may be customized to suit different research contexts, which is why it is widely used in contemporary survey research. Therefore, an online questionnaire was used to collect data for this study.

3.1. Questionnaire Design

This study selected a five-point Likert scale over other scales because it provides a practical, reliable, and efficient method for collecting data. Its balanced structure, simplicity, and ease of use make it an excellent choice for various research applications, ensuring respondent comfort and data quality [60]. The questionnaire with a five-point Likert scale for this study consisted of two sections (Appendix A).

- Section A: This section sought to collect demographic details of the respondents, including their project job, corporate position, and construction work experience.
- Section B: This section sought to collect information regarding four critical elements influencing the choice of SCMs: social, economic, environmental, and technological aspects. All respondents were required to mark the importance based on their perspective for each statement in this section using a five-point Likert scale: 1—not important; 2—slightly important; 3—moderately important; 4—very important; and 5—extremely important.

3.2. Pilot Testing

Pilot testing is an essential step in research methodology. It involves conducting a small-scale version of the main study, which helps refine the research design, methodology, instruments, and procedures before launching the full-scale study [61,62]. In this study, the online questionnaire was tested by three experts: two academic researchers at Massey University and one construction professional in Auckland, New Zealand. They all are specialists in quantitative research and construction materials. The questionnaire was revised after the pilot study to enhance clarity and data quality. For example, questions about economic factors were refined to distinguish between “initial” and “life cycle costs”, while technical factors, like “material performance,” were specified as “life expectancy of material” or “resistance to decay” to ensure precise responses.

3.3. Data Collection Method

The online questionnaire included an explanation of the purpose of the research and the privacy and confidentiality policy. It also included a list of research teams to contact for further discussion about this research. The estimated time to complete the questionnaire was around 15 min. The online questionnaire was launched on 1 August 2024, via three popular platforms: Email, LinkedIn, and Google Forms. One day later, on 2 August 2024, a reminder notice was sent. The third reminder was on 5 August 2024. The questionnaire was officially closed on 7 August 2024, and the data were analyzed. The online survey allowed for efficient data collection through online networks, ensuring a higher response rate within the research time frame.

3.4. Sampling Techniques

Purposive sampling was chosen because it enables researchers to concentrate on specific individuals with the expertise needed to provide valuable data for the study. The target population comprised professionals actively engaged in construction material selection, sustainability assessment, and project decision making. These participants were selected from various sectors within the construction industry, ensuring a diverse and representative sample. To enhance sample selection, inclusion criteria were established, requiring that participants (1) have at least three years of experience in the construction industry; (2) be actively involved in projects that require material selection; and (3) work in roles such as architects, designers, quantity surveyors, construction consultants, or project principals. Purposive sampling was essential for this study to collect data from industry experts rather than a random population.

3.5. Data Analysis

Data filtering in research is a crucial process involving selecting relevant data and excluding irrelevant or erroneous data [63], as well as removing low-quality responses. For example, the questionnaire would be removed if it contains missing answers to key questions or the same option for every question, selecting the same response down a Likert scale. By carrying out the first step in the study, researchers can enhance the integrity and quality of the data collected through questionnaires, leading to more accurate and actionable insights. Of the 600 respondents contacted, 120 agreed to participate, indicating a response rate of 20%. The completed surveys were then subjected to a careful check to identify invalid and unreliable responses. As a result, information from 115 completed questionnaires was input into a database. Hair et al. (2019) [64] recommend a minimum of 100–150 for models with moderate complexity, while similar SEM studies in construction and sustainability have produced robust results with comparable samples, particularly when factor loadings exceed 0.5 and model fit indices are acceptable.

Basic descriptive statistics, including the mean, count, median, range, and rank order, were computed using Excel and SPSS V.30 software. Descriptive statistics offer a foundation for understanding the basic properties of a dataset, making them essential for data analysis in research. The researchers conducted content analysis to identify common themes, differences, patterns, and explanations that provided new opportunities for individual and collective data categorization [65].

There are two types of SEM, a covariance-based (CB-SEM) and a component-based (PLS-SEM) method. However, there are differences between covariance-based and component-based SEM approaches regarding their objectives, strategy, assumptions, parameter estimation, latent variable (construct) score, and sample size requirement. According to Rigdon et al. [66], CB-SEM is designed for theory testing and confirmation, ensuring that a hypothesized model fits the observed data. By contrast, PLS-SEM is more exploratory and is often criticized for being less rigorous when used for confirmatory purposes. Thus, CB-SEM was the better choice for this study for hypothesis-driven, confirmatory research with a relatively high level of complexity and patterns of relationships among four constructs. This study adopted CFA for further analysis using SEM. Indeed, CFA assesses the strength of evidence supporting a hypothesis. It determines whether new data confirm, contradict, or are neutral toward a hypothesis or theory.

3.6. Ethics Considerations

Ethical considerations are obligatory when conducting research. Research ethics are typically defined as the rules governing acts concerning the rights of subjects of a study. Ethics also enhance the scientific validity of the research [67]. The research obtained ethical approval from the Massey University Human Ethics Committee, which determined that the study presented a low risk.

4. Results

4.1. Sample Characteristics

Table 2 outlines the characteristics of the participant sample, categorized by work experience, roles, and involvement in current projects, providing a clear demographic and professional profile relevant to the study. A significant portion of the sample had 5 to 10 years of work experience (38.3%), followed by those with less than 5 years (34.8%), while smaller groups included those with 11 to 15 years (14.8%), 16 to 20 years (7.0%), and over 20 years (5.2%). In terms of roles, the largest group consisted of construction consultants (26.1%), followed by quantity surveyors (22.6%), architects (21.7%), designers (19.1%), and principals (10.4%). Regarding project involvement, participants were most engaged in residential projects (37.4%), followed by commercial projects (30.4%), civil projects (16.5%), industrial projects (7.0%), and other categories (8.7%). These findings highlight the diversity and expertise of the sample, ensuring that insights drawn from this research reflect a broad spectrum of industry professionals. The distribution of jobs and experiences implies a balanced and representative dataset, allowing the research conclusions to be applied to various construction sector areas.

Table 2. The characteristics of respondents.

Variable	Frequency	Percentage	Cumulative Percentage
Work experience			
<5 years	40	34.8	34.8
5–10 years	44	38.3	73.0
11–15 years	17	14.8	87.8
16–20 years	8	7.0	94.8
Over 20 years	6	5.2	100.0
Total	115	100.0	100.0
Working roles			
Architect	25	21.7	21.7
Designer	22	19.1	40.9
Quantity surveyor	26	22.6	63.5
Principal	12	10.4	73.9
Construction consultant	30	26.1	100.0
Total	115	100.0	100.0
Current projects			
Commercial	35	30.4	30.4
Residential	43	37.4	67.8
Industrial	8	7.0	74.8
Civil	19	16.5	91.3
Others	10	8.7	100.0
Total	115	100.0	100.0

4.2. Validity and Reliability Analysis

Validity and reliability are two aspects of research quality that must be reviewed in any study [62]. Both are crucial concepts in research that ensure the accuracy and consistency of the findings. While reliability refers to the consistency of a measure to ensure stable and consistent results over repeated applications, validity refers to the extent to which a research instrument measures what it is intended to measure to indicate the accuracy and truthfulness of the findings. These two concepts help enhance the credibility and utility of research findings [61,62]. As suggested by Hair et al. (2019) [64], indicators with low loadings (below 0.4) should always be removed from the construct. The items used in model testing after eliminating an inconsistent item, along with their individual loadings, are presented in Table 3. All loadings exceeding 0.4 were extracted, indicating acceptable indicator reliability. Additionally, the calculated Cronbach's alpha scores surpassed 0.7, implying satisfactory internal consistency reliability. Therefore, the measurement items are appropriate for their respective constructs and valid for assessing the structural model.

Table 3. The outcomes of validity and reliability analysis.

Construct	Code	Indicators	Loading	Cronbach's Alpha
Social	S4	Accessibility (disability measure)	0.723	0.768
	S5	Living conditions	0.497	
	S1	Aesthetics quality	0.407	
Economic	EC6	Profit and margin	0.658	0.757
	EC2	Transportation cost	0.615	
	EC1	Initial cost	0.564	
	EC4	Installation cost	0.532	
	EC7	Tax contribution	0.513	
Environmental	EN10	Renewable material	0.903	0.924
	EN11	Recycled materials	0.829	
	EN9	Biodiversity protection	0.826	
	EN7	Reuse ability of material	0.818	
	EN8	Climate stabilization	0.698	
	EN3	Waste reduction	0.598	
	EN4	Low habitat destruction	0.589	
	EN12	Water efficiency	0.555	
Technical	T2	Buildability (ease of construction)	0.693	0.812
	T3	Resistance to decay	0.689	
	T1	Maintainability	0.632	
	T5	Life expectancy of material	0.625	
	T4	Fire resistance	0.558	

4.3. Structural Model Analysis

In CFA, the primary purpose of hypothesis testing regarding relationships between variables is to validate the measurement model by examining the empirical data. The structural equation model (SEM) presented in Figure 3 evaluated the relationships among four latent constructs—social, economic, environmental, and technical factors—as measured by their respective observed variables. The model demonstrated an acceptable fit to the data, as indicated by several fit indices: chi-square/df = 1.512 (below the threshold of 3, suggesting a good fit [68]), CFI = 0.918 (exceeding the recommended minimum of 0.90 for model acceptability [69]), and RMSEA = 0.067, with PCLOSE = 0.066 (within the acceptable range of $\leq$0.08, indicating a reasonable approximation of the population [70]). Although the goodness-of-fit index (GFI = 0.841) is slightly below the preferred threshold of 0.90, it remains acceptable in exploratory research contexts or the sample size is small [71]. The factor loadings, predominantly above 0.5, indicate strong and meaningful relationships between the latent constructs and their respective indicators, supporting construct validity [64]. Additionally, the moderate correlations among the latent variables suggest a balanced interdependence, avoiding excessive multicollinearity. Thus, the SEM analysis provides a robust framework for exploring the interrelationships among the constructs, contributing to the understanding of multidimensional influences in this research context.

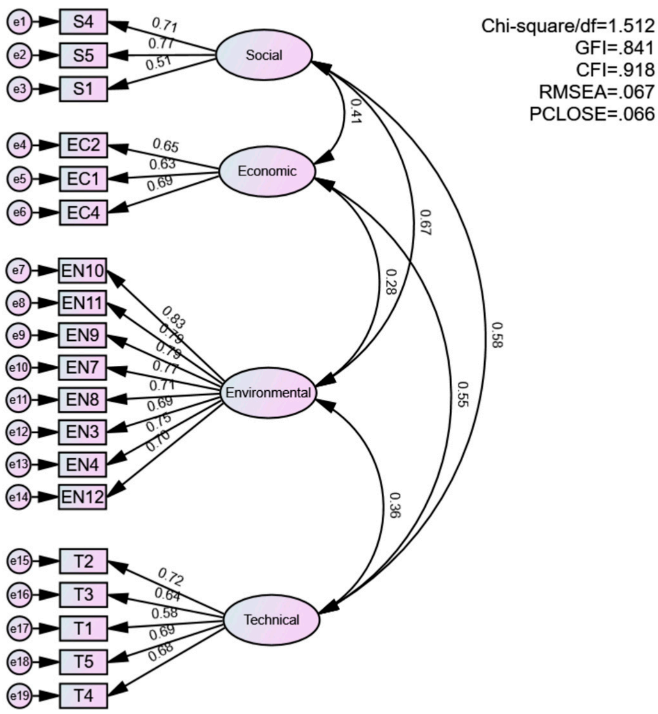

Figure 3. Confirmatory factor analysis result.

4.4. Hypothesis Testing

The statistical significance of the correlations observed between the four sustainability factors—economic, environmental, social, and technical—provides strong evidence for the interdependence of these dimensions in the context of sustainable construction material selection. All correlations reported in Table 4 are statistically significant, with *p*-values generally below the 0.05 threshold, indicating that the relationships are unlikely to be due to chance. Strong positive correlations were observed between environmental and social (r = 0.672, $p < 0.001$), technical and social (r = 0.582, $p = 0.001$), and technical and economic (r = 0.546, $p < 0.001$) factors, indicating that changes in one of these variables are likely to have a substantial impact on the others. Moderate positive relationships were identified between economic and social (r = 0.412, $p = 0.011$) and environmental and technical (r = 0.358, $p = 0.004$) factors, suggesting a meaningful, though less pronounced, connection. The weakest positive correlation was found between environmental and economic factors (r = 0.284, $p = 0.027$), which still indicates a statistically significant relationship. Overall, the statistical significance of these findings, with *p*-values ranging from $p < 0.001$ to $p = 0.027$, underscores the importance of considering multiple sustainability factors in material selection and provides valuable insights for practitioners in the construction industry seeking to integrate sustainability into their decision-making processes.

Table 4. The results of the hypotheses.

Hypothesis	Variable Pair	Estimated Correlation	*p*-Value	Interpretation
H1	Social ↔ economic	0.412	0.011	Significant—supported
H2	Economic ↔ environmental	0.284	0.027	Significant—supported
H3	Environmental ↔ technical	0.358	0.004	Significant—supported
H4	Social ↔ environmental	0.672	<0.001	Highly significant—supported
H5	Economic ↔ technical	0.546	<0.001	Highly significant—supported
H6	Social ↔ technical	0.582	0.001	Significant—supported

5. Discussion

5.1. Identifying of Factors Affecting the Selection of SCMs

This study identified four key factors—social, economic, environmental, and technical factors in Table 1—that all influence material selection. The findings of this study align with previous research on identifying environmental, economic, social, and technical factors as crucial in the selection of SCMs. Social factors, including local material use and health and safety, align with studies such as that by Calkins (2008) [26] but differ in the emphasis placed on cultural values and regional resource use. While economic factors, like initial and life cycle costs, are consistent with global findings, this study further underscores the importance of long-term financial benefits, reflecting a growing maturity in New Zealand's approach to SCMs. Environmental factors, such as renewability and biodiversity protection, mirror global trends seen in studies like that by Danso (2018) [34], while the emphasis on climate stabilization and low habitat destruction is particularly relevant to the distinctive ecosystem of New Zealand. Specifically, this study greatly enhances the understanding of SCM selection by adding technical factors. Indeed, this research uniquely incorporates technological concerns, whereas previous studies have examined the social, environmental, and economic dimensions of SCMs. Examining technical factors, including buildability, decay resistance, and maintainability, offers a novel perspective on SCM selection. Therefore, construction professionals must consider the technical characteristics of materials when making decisions about SCMs.

5.2. Interrelationships of Factors Affecting the Selection of SCMs

The concept of sustainability, often represented through the three pillars social, economic, and environmental, provides a comprehensive framework for understanding the interrelationships among these dimensions, especially in the context of selecting SCMs. The correlations between these factors offer valuable insights into how these dimensions interact and affect decision making in the construction industry. The positive correlations among these factors reinforce the need for an integrated approach to material selection that balances social, financial, and environmental objectives. One of the most prominent relationships is between social and environmental factors, with a high correlation (r = 0.672, $p < 0.001$), which suggests that societal considerations, such as accessibility and local material use, are closely linked to environmental sustainability. This aligns with previous studies, such as those by Danso (2018) [13] and Calkins (2008) [26], which have emphasized the importance of incorporating community and local resource values into material selection to enhance both social equity and ecological outcomes. The correlation between these two factors was found to be the weakest positive correlation (r = 0.284, $p = 0.027$), still statistically significant but relatively weak. This finding suggests that while there is some degree of alignment between economic efficiency and environmental sustainability, it is not as strong as expected. Previous research by Barrier (2017) [18] has often highlighted the close connection between economic and environmental considerations, particularly in the context of life cycle cost analyses and the adoption of green technologies. The weaker correlation observed in this study may suggest that in the New Zealand context, economic factors, such as cost savings and investment in sustainable materials, do not always align directly with environmental goals, possibly due to factors like market limitations or policy priorities in the construction industry. Additionally, a moderate correlation between social and economic factors (r = 0.412, $p = 0.011$) reflects how social objectives, including community well-being, are often aligned with economic strategies, such as reducing transportation costs through the use of locally sourced materials. This supports the findings by Lim et al. (2015) [3], which highlighted the growing importance of economic factors in the adoption of sustainable materials. In the New Zealand context, this holistic perspective is essential to ensure that construction practices promote not only environmental sustainability but also social equity and economic viability. Decision makers in the construction industry should leverage the relationships between these pillars to select materials that offer long-term benefits across all three dimensions, contributing to a more sustainable future for the construction sector and the broader community.

Technical factors play an essential role in shaping the selection of sustainable construction materials (SCMs), influencing how materials interact with social, economic, and environmental considerations. The correlation between technical and environmental factors (r = 0.358, $p = 0.004$) reveals that technical characteristics, such as durability and energy efficiency, contribute to the environmental sustainability of materials by extending their life cycle and reducing environmental impacts. This finding is consistent with that of Akadiri (2015) [19], who emphasized the importance of technical innovations, such as energy-efficient materials, in enhancing sustainability outcomes. The correlation between technical and economic factors (r = 0.546, $p < 0.001$) highlights how technical factors, including buildability and maintainability, contribute to cost savings, supporting the integration of technical attributes into economic planning. Lastly, the correlation between social and technical factors (r = 0.582, $p = 0.001$) suggests that technical aspects, such as ease of construction and resistance to decay, are aligned with social goals as they ensure the durability and safety of materials for communities. These findings underscore the interconnectedness of these factors and provide a framework for developing an integrated approach to selecting sustainable construction materials in New Zealand. By considering the correlations between these dimensions, stakeholders can prioritize materials that meet technical requirements and contribute to economic development, social equity, and environmental sustainability.

In conclusion, technical factors significantly influence the selection of SCMs by interacting with social, economic, and environmental factors. Therefore, construction professionals must consider the technical characteristics of materials when making decisions about SCMs, as they play a key role in achieving sustainability goals.

6. Conclusions

This study contributes significantly to the body of knowledge on sustainable construction materials by filling critical gaps in the literature. While previous research has focused on the social, environmental, and economic components of SCMs, this study is the first to incorporate technological factors, an innovative inclusion that has not been thoroughly examined in the New Zealand context. The study of the impact of technical variables, such as buildability, decay resistance, and maintainability, offers a new perspective on SCM selection. Moreover, the interrelationship among social, economic, environmental, and technical factors is critical in determining the successful selection and adoption of SCMs. The implications of these interrelated factors for selecting SCMs in New Zealand suggest that a holistic approach to sustainability is essential. Decision makers should consider not only the social, economic, and environmental benefits of materials but also their technical performance.

The generalizability of this study's findings is limited by its focus on certain geographic regions within New Zealand, which may not account for variations in environmental regulations, market conditions, and material availability in other contexts. Future research should expand data collection to include a more diverse sample across geographic and industry contexts to improve external validity. Additionally, while the sample size of 115 participants offers valuable insights, it may not comprehensively capture the diverse perspectives of industry professionals across various regions and construction disciplines.

Expanding the sample size to include more diverse and representative participants is recommended to enhance the robustness and generalizability of future research.

Author Contributions: Conceptualization, T.B. and N.D.; methodology, T.B. and N.D.; formal analysis, T.B. and N.D.; data collection, T.B., N.D. and A.L.; writing—original draft preparation, T.B.; writing—review and editing, T.B., N.D. and A.L. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study was conducted according to the guidelines of Massey University, New Zealand, and approved by the Massey University Human Ethics Committee (protocol code: 4000029130; date of approval: 01 June 2024).

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

Data Availability Statement: Research data are restricted in availability because researchers agreed with the study participants not to share their data. However, the summarized data presented in this study are available upon request from the corresponding author.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

SCMs	sustainable construction materials
SEM	structural equation model
CFA	confirmatory factor analysis
BRANZ	Building Research Association of New Zealand

Appendix A

Dear Sir/Madam,

This questionnaire gathers information for the study "Factors Affecting the Selection of Sustainable Construction Materials: A Study in New Zealand", which has an Ethics Notification Number of 4000029130.

The survey will take approximately 10–15 min to complete. By participating in this survey, you consent to engage in this questionnaire voluntarily. You acknowledge that you understand the purpose of the research, the time commitment required, the measures taken to ensure your anonymity and confidentiality, and your right to withdraw at any time. If you have any questions or concerns, do not hesitate to contact the research team.

Kien Tin Bui and Dr. Niluka Domingo, School of Built Environment, Massey University

Part A: General information

1. What is the title of your job?

   ☐ Architect ☐ Designer ☐ Quantity Surveyor ☐ Principal ☐ Others

2. How long have you been working in the construction industry?

   ☐ <5 years ☐ 5–10 years ☐ 11–15 years ☐ 16–20 years ☐ 20+ years

3. What type of current construction projects do you participate in? (You can choose multiple types.)

   ☐ Commercial ☐ Residential ☐ Industrial ☐ Civil ☐ Others

Part B: Identifying critical factors impacting the selection of sustainable construction materials

This section aims to identify the critical factors impacting the selection of materials in construction. How do you rate the following indicators for their significance in selecting materials for construction projects? Please select based on your experience and tick your responses using a scale of 1–5. (1—not important; 2—slightly important; 3—moderately important; 4—very important; and 5—extremely important).

FACTORS	**INDICATORS**	**Likert Scale 5-points**				
Technical Factor	T1: Maintainability	1	2	3	4	5
	T2: Ease of Construction (buildability)	1	2	3	4	5
	T3: Resistance to decay	1	2	3	4	5
	T4: Fire resistance	1	2	3	4	5
	T5: Life expectancy of material (e.g. strength, durability etc.)	1	2	3	4	5
	T6: Energy saving and thermal insulation	1	2	3	4	5
Economic Factor	EC1: Initial cost	1	2	3	4	5
	EC2: Transportation cost	1	2	3	4	5
	EC3: Life cycle cost	1	2	3	4	5
	EC4: Installation cost	1	2	3	4	5
	EC5: Maintenance cost	1	2	3	4	5
	EC6: Profit and margin	1	2	3	4	5
	EC7: Tax contribution	1	2	3	4	5
Social Factor	S1: Aesthetics quality	1	2	3	4	5
	S2: Use of local material	1	2	3	4	5
	S3: Health and safety	1	2	3	4	5
	S4: Accessibility; E.g. disability measures	1	2	3	4	5
	S5: Living Conditions	1	2	3	4	5
Environmental Factor	EN01: Anticipated Energy efficiency level	1	2	3	4	5
	EN02: Pollution prevention	1	2	3	4	5
	EN03: Waste reduction	1	2	3	4	5
	EN04: Low habitat destruction	1	2	3	4	5
	EN05: Non-Toxic / less Toxic materials	1	2	3	4	5
	EN06: Biodegradability of material	1	2	3	4	5
	EN07: Reuse ability of material	1	2	3	4	5
	EN08: Climate stabilization	1	2	3	4	5
	EN09: Biodiversity protection	1	2	3	4	5
	EN10: Renewable materials	1	2	3	4	5
	EN11: Recycled content and recyclability of material	1	2	3	4	5
	EN12: Water Efficiency (Preservation and treatment)	1	2	3	4	5

Your participation contributes significantly to our research, and we appreciate your input and support. Please add further concerns below.

Thank you very much!

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