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Predicting Maintenance Demand through Material Selection Criteria: Evidence from the Oman Construction Industry

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Abstract In Oman's fast-evolving construction industry, the demand for building maintenance is significantly influenced by the choice of materials, a decision primarily made by architects. This study investigates architects' priorities in selecting materials when predicting building maintenance demand, defined as the expected frequency, extent, and cost of interventions over a building's lifetime. A questionnaire survey of 78 architects was analyzed using descriptive statistics, one-way ANOVA, and multiple regression. Eleven technical, contextual, economic, and aesthetic factors were examined alongside professional characteristics. Results indicate that professional background significantly influenced the prioritization of material selection criteria such as climate compliance, durability, and environmental impact. Regression analysis identified material durability as the strongest predictor of anticipated maintenance demand, followed by climate compliance, client demand, and cost considerations. Although climate compliance was statistically significant, it received lower importance ratings in practice. These findings underscore the importance of performance-based material selection frameworks that integrate life-cycle thinking and climate adaptability to reduce long-term costs and maximize resilience in Oman's hot-arid climate. The results contribute to an existing body of knowledge on the fundamental understanding of the predictors of maintenance demand in the context of building management in the Oman construction Industry. The research will benefit industry stakeholders, especially architects, in improving their material selection practices in the face of performance demands associated with buildings.

Keywords Building Materials Selection, Architects, Maintenance Demand, Oman Construction Industry

1. Introduction

The construction sector in Oman is a key driver of the nation's socioeconomic transformation, particularly under the strategic goals of Oman Vision 2040 [1]. As the country modernizes its infrastructure and built environment, the vision emphasizes sustainable urban development, high-quality infrastructure, and innovation in construction practices as part of its transformation strategy. It prioritizes improving building quality, reducing life-cycle costs, and promoting environmentally responsible materials, which aligns with the aim of this study. Within this context, the selection of building materials has emerged as a pivotal factor influencing both initial construction quality and long-term building performance.

Globally, sustainable design principles are increasingly integrated into architectural practices. However, in many regions—especially hot-arid, rapidly urbanizing countries like Oman—the long-term performance of buildings, particularly with respect to maintenance demand, remains

insufficiently prioritized in material selection [2]. Maintenance demand, as used in this study, refers to the predicted frequency, scope, and cost of interventions required to sustain a building's usability, functionality, and structural integrity over its life-cycle [3, 4, 5].

In Oman's harsh desert climate—characterized by extreme temperatures, thermal expansion, saline coastal air, and dust—material degradation occurs rapidly, often leading to escalating maintenance costs, higher resource consumption, and increased environmental impact [6, 7]. While many of these effects can be mitigated through appropriate material choices at the design stage, material selection is often influenced by short-term priorities such as cost and client preference [8, 9, 10]. This is especially the case in Oman as recent studies indicate that despite global advancements in sustainable design, material selection practices still prioritize immediate costs and aesthetic preferences over durability and climate responsiveness [11, 12, 13].

According to Akadiri [10], architects are responsible for material selection, but they are often faced with making a decision under tight budgets and timelines [10], with limited access to performance data or standard evaluation tools [14]. Factors such as material familiarity, sensory perception (e.g., texture, color), and cultural symbolism may influence decisions, potentially at the expense of performance metrics like weather resistance and thermal efficiency [15, 16, 17]. Al Rubaiey et al. [2] observe that maintenance factors are seldom incorporated at the initial stages of the design process in Oman, resulting in premature degradation and reactive repair [14]. These issues are exacerbated by a lack of regional data as well as dependence on imported materials that have not been optimized for the climate in Oman [12, 14]. This, combined with the fact that there is no national material sustainability framework [14], further limits architects' ability to make life-cycle - conscious decisions.

Additionally, professional attributes like experience, education, and the type of firm could affect the way building material selection is tackled. Research suggests that experienced professionals would more likely emphasize durability and environmental performance, whereas less experienced or commercially-oriented practitioners would tend to prioritize upfront cost and regulatory compliance [18, 19, 20]. Although there is increasing global focus on life-cycle design, there are few Omani studies empirically investigating the connection between material selection criteria and expected maintenance demand. Current frameworks tend to tackle energy efficiency orestimating cost but overlook maintainability - a key consideration in building durability under harsh environmental conditions [21].

This study addresses that gap by investigating how architects in Oman prioritize material selection factors in relation to predicted maintenance demand. It explores which criteria—such as cost, client demand, durability, environmental impact, climate compliance, and aesthetics—serve as significant predictors of maintenance expectations. The study also examines whether professional characteristics influence these preferences. By applying a structured quantitative method, including one-way ANOVA and multiple regression analysis, the study offers data-driven insights into material selection behavior and its implications for building performance. The findings aim to support more informed, sustainability-oriented practices among architects and policymakers in Oman's construction sector.

2. Conceptual Framework

This study is guided by a framework that links architectural material selection decisions to anticipated maintenance demand in the built environment. The framework illustrates how multiple domains, such as technical performance, contextual suitability, economic drivers, aesthetic considerations, and professional characteristics, interact to influence the expected frequency, scope, and cost of building maintenance. It highlights the role of architects as critical decision-makers whose initial design decisions can have enduring consequences for building performance, particularly under Oman's extreme desert climate.

At the core of the framework is the understanding that material selection is not just a technical or economic choice, but rather a composite of professional judgment, client needs, regulatory constraints, resource availability, and environmental concerns [22]. These, in turn, contribute to how architects perceive the potential for future maintenance interventions over a building's lifespan. This approach aligns with the life-cycle thinking principles. These principles stress the importance of long-term performance, environmental effects, and resource efficiency as key factors in sustainable construction [21].

2.1. Key Variables in the Framework

2.1.1. Material Selection Criteria (Independent Variables)

These are the core factors that architects consider when choosing construction materials. They are categorized into four thematic groups and are drawn from empirical literature and professional practice. Each factor is measurable and was included in the study's questionnaire. These factors were selected based on empirical studies and professional practice guidelines in material selection and decision-making [8, 9, 10, 19, 20, 21]. Table 1 presents the definitions of these variables.

2.1.2. Professional Characteristics (Moderating Variables)

These are attributes of the architects themselves, such as years of experience, educational background, firm type, and their level of involvement in material decision-making. These characteristics are presumed to influence how material selection criteria are prioritized. For instance, experienced architects may place greater weight on durability and life-cycle performance, while those in cost-driven firms may favor affordability and availability.

Table 1. Material Selection Criterion

Factor Group	Factor Code	Variables	Definition/Description
Technical Performance	F5	Material Durability	The longevity and resistance of materials to wear and degradation under stress conditions.
	F3	Climate Compliance	The suitability of materials to withstand Oman's hot and arid climate conditions.
	F6	Environmental Impact	The impact of materials on the environment over their life cycle, including emissions and resource usage.
Contextual and Regulatory	F7	Availability and Local Sourcing	Ease of sourcing materials locally, which reduces logistics costs and improves contextual fit.
	F9	Building Function and Usage	The influence of building use intensity and type on material wear and tear.
	F 10	Regulatory Standard	The degree to which materials comply with legal and regulatory requirements for construction
Economic and Client-Driven	F1	Client Demand	The preferences and expectations of clients that influence material selection decisions.
	F2	Cost Consideration	The financial implications of using specific materials, including initial and lifecycle costs.
Design and Workforce	F 11	Aesthetic Preferences	The visual appeal and sensory characteristics of materials that influence design intent
	F12	Labor Availability	The availability of skilled labor to properly install and maintain selected materials.
	F8	Technological Advancements	Innovative materials and technologies that may improve performance but require special knowledge or tools.

Note: The factor codes (F1–F12) are grouped thematically rather than sequentially. Each code corresponds to a category of material selection criteria and follows the structure of the conceptual framework.

2.1.3. Maintenance Demand (Dependent Variable)

Serving as the outcome variable, maintenance demand in this framework refers to the architect's anticipated level of future upkeep that a building will require, based on the materials selected. It captures expected burdens in terms of intervention frequency, extent of repairs, and associated costs. While actual maintenance is carried out post-occupancy by facility managers or users, the perceived demand at the design stage reflects professional judgments on long-term performance risks. The framework assumes that materials lacking durability, climate responsiveness, or contextual fit are more likely to lead to increased maintenance needs over time.

2.1.4. Framework Logic and Application

The conceptual framework presented in this study reflects the dynamic and interconnected nature of material choice in the field of architectural practice. It illustrates that the decisions of architects are guided by a synthesis of technical, contextual, economic, aesthetic, and regulatory factors, which are further affected by individual professional characteristics. Together, these decisions form architects' expectations regarding the long-term needs for building maintenance.

At the core of the framework is the understanding that the material selection process is more than a technical or economic exercise. Instead, it involves navigating a set of trade-offs that include performance requirements, client aspirations, budget, available skill levels, and environmental suitability [23]. For example, architects must often balance durability with aesthetics, or cost with climate responsiveness, within the constraints of real-world project delivery.

The proposed framework posits that each factor influencing material selection plays a significant role in shaping the architect's understanding of maintenance requirements, which are characterized by the expected frequency, extent, and financial implications of subsequent maintenance tasks. Materials that exhibit deficiencies in durability, compatibility with environmental conditions, or availability of skilled labor are expected to result in increased long-term maintenance obligations. Consequently, architects' assessments of these associated risks are influenced by their prioritization of specific material attributes.

Professional characteristics such as years of experience, qualifications, and involvement in the material selection process are treated as moderating variables. These characteristics may influence how architects assign importance to each criterion. For example, more experienced architects might prioritize long-term performance, while those focused on commercial goals may concentrate more on short-term costs or client satisfaction.

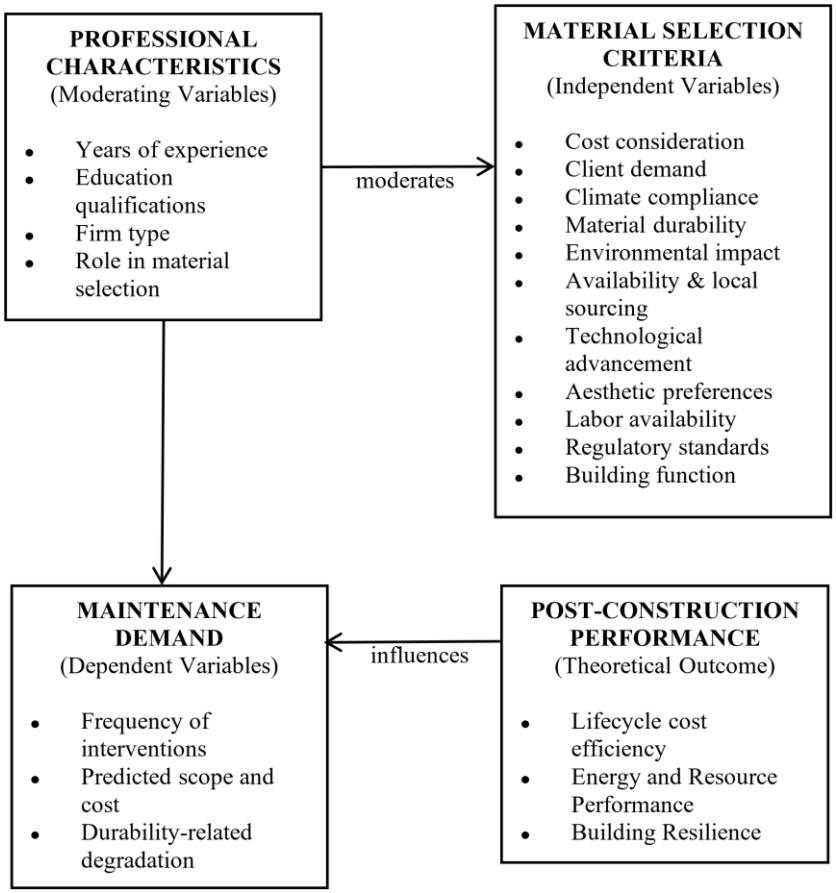

Figure 1. Conceptual Framework

The framework also guided the structure of the questionnaire and statistical analysis. It informed the selection of independent variables (material selection criteria), the dependent variable (maintenance demand), and moderating variables (professional characteristics). These relationships were examined using one-way ANOVA and multiple regression analysis to determine how professional profiles shape factor prioritization and how these priorities predict perceived maintenance demand (Figure 1).

Given Oman's harsh climate—marked by extreme heat, saline air, and dust exposure—the framework emphasizes the critical need for materials that are climate-adaptive, locally sourced, and resilient. Integrating life-cycle thinking at the design stage can significantly reduce downstream costs and environmental impacts. As such, the framework supports a shift toward performance-informed material selection strategies that align architectural intent with long-term building durability and efficiency.

3. Research Methodology

This study employed a quantitative research approach to systematically examine the relationship between material selection criteria and predicted maintenance demand in Oman's construction industry. The objective was to identify which factors most significantly influence the anticipated frequency, scope, and cost of maintenance interventions over a building's life-cycle. A structured online questionnaire served as the primary data collection tool. The survey targeted practicing architects in Oman, particularly those affiliated with the Oman Society of Engineers (OSE). Participants were recruited through professional networks, referrals, and mailing lists facilitated by industry contacts and institutional affiliations. A total of 93 questionnaires were distributed during March 2025. Since no official public registry of architects was available, the target number was informed by consultations with professionals and designed to ensure representation across different firm types, experience levels, and involvement in material selection. The online format was selected to enhance accessibility and participation, while also reducing logistical barriers and enhancing respondent accessibility.

Following a four-week data collection window, 78 completed and valid responses were received, yielding a high response rate of 83.9%. This sample size is appropriate for the multiple regression analysis conducted. General statistical guidelines recommend at least 10 respondents per predictor variable, suggesting that a minimum of 70–80 cases is sufficient for models with 11 predictors, which was met in this study. The data collection instrument was divided into two key sections. The first

section captured demographic and professional characteristics of respondents, including years of experience, educational qualifications, firm type, and level of involvement in material selection. These variables were essential for analyzing how professional background moderates decision-making behavior.

The second section formed the analytical core of the study, focusing on respondents' evaluation of 11 critical material selection factors—such as cost, climate compliance, durability, and environmental impact—using a 5-point Likert scale ranging from "1 = Least Important" to "5 = Extremely Important." Each factor was clearly defined to ensure consistent interpretation. This section was designed to examine how these selection priorities relate to expected maintenance demand. This demand served as the dependent variable in the statistical analysis. While participants rated the overall importance of each factor, the regression analysis investigated how well these ratings predicted perceived long-term maintenance needs.

Data was analyzed using SPSS version 30.0.0, following a structured three-stage approach. First, descriptive statistics were used to outline the demographic and professional characteristics of the respondents. This included years of experience, educational qualifications, firm type, and role in material selection. This initial analysis provided context for the sample and highlighted the diversity and relevance of the participant group within Oman's architectural practice. Next, a series of one-way ANOVA tests was performed to see if these professional attributes significantly influenced how respondents prioritized the eleven material selection criteria. This helped identify statistically significant differences in factor importance across professional subgroups.

In the final phase, multiple regression analysis determined how well the material selection criteria predicted perceived maintenance demand. This step addressed the study's core research objective by examining the relationship between architects' prioritization of specific material attributes and their expectations of long-term maintenance implications. Collectively, this analytical sequence offered a robust empirical framework for understanding how professional background, design priorities, and contextual awareness interact to shape material selection practices and anticipated building performance in Oman's challenging climate.

4. Results and Discussion

The respondent characteristics reflect a highly experienced group within the Omani construction industry as seen in Table 2. Most respondents (45%) have over 10 years of experience, with 30% having 5-10 years, providing a mix of deep expertise and newer insights into material selection processes. The majority (40%) work in architectural consultancies, highlighting architects' key role in material selection. Other firm types include general contracting firms (25%), construction management firms (15%), engineering consultancies (10%), and material suppliers (10%). This shows the collaborative nature of material decision-making in the industry.

Table 2. Demographic and Professional Characteristics of Respondents

Characteristic	Category	Percentage
Years of Experience	Less than 5 years	25%
	5-10 years	30%
	More than 10 years	45%
Firm Type	Architectural Consultancy	40%
	General Contracting Firm	25%
	Construction Management Firm	15%
	Engineering Consultancy	10%
	Specialized Building Material Supplier	10%
Qualifications	Undergraduate Degree	70%
	Postgraduate Degree	20%
	Professional Certification/Other	10%
Role in Material Selection	Primary Decision Maker	55%
	Collaborative Role with Engineers/Contractors	30%
	Minimal Involvement	15%
Professional Development & Continuing Education	Regularly Engaged in Professional Development	80%
	No Participation in Professional Development	20%

Educationally, 70% of respondents hold an undergraduate degree, and 20% have a postgraduate degree, indicating a well-educated sample. In material selection, 55% are primary decision-makers, with 30% working collaboratively with other professionals. Finally, 80% are engaged in professional development, ensuring their material selection practices are up to date with industry standards. This diversity in experience, firm type, and education provides valuable insights into material selection in Oman.

4.1. Analysis of One-Way ANOVA Results

A series of one-way ANOVA tests was conducted to examine whether architects' professional characteristics—specifically years of experience, firm type, educational qualifications, and role in material selection—significantly influenced the importance they assigned to each of the eleven material selection criteria. These tests aimed to identify statistically significant differences in factor prioritization across professional subgroups. The F-values and corresponding p-values in Table 3 were calculated using one-way ANOVA in SPSS (v30), based on the standard formula F = MSB/MSW, where MSB is the mean square between groups and MSW is the mean square within groups.

As shown in Table 3, years of experience had a statistically significant effect on the perceived importance of several key factors, including client demand (F1, p = 0.045), climate compliance (F3, p = 0.049), environmental impact (F6, p = 0.047), and regulatory standards (F10, p=0.043). More experienced architects tended to assign higher importance to long-term and sustainability-oriented criteria, supporting prior findings that professional maturity encourages life-cycle awareness and environmental sensitivity [24, 25].

Firm type also showed significant effects on material durability (F5, p = 0.033), environmental impact (F6, p = 0.041), and regulatory standards (F10, p=0.030). Architects working in consultancy and design-focused firms were more likely to prioritize durability and compliance than those in contractor-led organizations, aligning with findings by Marisa and Yusof [26], who highlighted the influence of organizational context on material priorities.

Educational qualifications significantly influenced the prioritization of environmental impact (F6, p = 0.045) and technological advancements (F8, p = 0.048). Postgraduate-qualified respondents gave greater weight to sustainability and innovation—an association supported by studies linking higher education with stronger environmental literacy [27, 28]. Role in material selection showed statistically significant effects on material durability (F5, p = 0.038) and aesthetic preferences (F11, p=0.042). Architects who identified as primary decision-makers rated these factors more highly, suggesting that those at the forefront of selection decisions are especially conscious of balancing long-term performance with design intent [10].

Table 3. ANOVA Results: Professional Influence on Material Selection Priorities

Source of Variation	Dependent Variable (Factor)	*F-value*	*p-value*
Years of Experience	Client Demand (F1)	2.84	0.045
	Cost Consideration (F2)	2.67	0.065
	Climate Compliance (F3)	3.21	0.049
	Material Durability (F5)	3.05	0.051
	Environmental Impact (F6)	3.00	0.047
	Availability and Local Sourcing (F7)	2.61	0.068
	Technological Advancements (F8)	2.41	0.072
	Building Function and Usage (F9)	2.15	0.089
	Regulatory Standards (F 10)	3.06	0.043
	Aesthetic Preferences (F 11)	2.82	0.050
	Labor Availability (F12)	2.19	0.088
Firm Type	Material Durability (F5)	3.55	0.033
	Environmental Impact (F6)	2.98	0.041
	Regulatory Standards (F 10)	3.61	0.030
Qualifications	Environmental Impact (F6)	3.22	0.045
	Technological Advancements (F8)	3.09	0.048
	Regulatory Standards (F 10)	2.66	0.068
Role in Material Selection	Material Durability (F5)	3.61	0.038
	Aesthetic Preferences (F 11)	2.96	0.042

For some factors—such as cost consideration (F2), availability and local sourcing (F7), building function and usage (F9), and labor availability (F12)—the ANOVA results did not yield statistically significant differences ($p > 0.05$). This indicates that professional background characteristics had limited or no measurable effect on how respondents prioritized these criteria. Although trends in mean scores suggested some variation, these were not strong enough to confirm with statistical certainty.

Overall, the ANOVA results indicate that professional background—particularly experience, firm type, and qualification—does influence the way architects prioritize key sustainability-related and performance-oriented criteria. However, other material factors appear to be more uniformly valued across the profession, suggesting shared industry-wide recognition of their relevance regardless of individual background.

Overall, the results confirm that professional background influences how architects prioritize material attributes, particularly those linked to sustainability, innovation, and long-term performance.

4.2. Regression Analysis: Predicting Maintenance Demand

The multiple regression analysis yielded a statistically significant model, confirming that architects' prioritization of material selection criteria significantly predicts their expectations of building maintenance demand. As presented in Table 4, the overall regression model was significant, $F(11, 66) = 230.999$, $p < 0.001$, indicating that the collective influence of the eleven independent variables was not due to random variation. The F-statistic validates the model's explanatory power and justifies further interpretation of individual predictor coefficients.

As shown in Table 5, the model achieved a high coefficient of determination ($R^2 = 0.810$), indicating that approximately 81% of the variance in perceived maintenance demand could be explained by the predictors. The adjusted R^2 value of 0.800 further supports the robustness of the model, accounting for the number of variables and minimizing the likelihood of over-fitting. The standard error of the estimate (0.350) reflects low residual variance, demonstrating the model's reliability in predicting long-term maintenance expectations based on material selection priorities.

Table 4. ANOVA Summary for Regression Model

Source	Sum of Squares	df	Mean Square	F	Sig. (p-value)
Regression	85.432	11	7.767	230.999	0.000
Residual	21.556	66	0.327	–	–
Total	107.988	77	–	–	–

Table 5. Model Summary of Multiple Regression Analysis

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	F Change	df 1	df2	Sig. F Change
1	0.900	0.810	0.800	0.350	234.578	11	66	0.000

Table 6. Regression Coefficients: Effects of Material Selection Factors on Maintenance Demand

Predictor (Material Selection Factor)	Unstandardized Coefficient (β)	Standardized Coefficient (β)	t-value	Significance (p-value)
(Constant)	0.922	–	7.720	0.000
Client Demand (F1)	0.288	0.060	4.779	0.000
Cost Consideration (F2)	0.250	0.080	3.099	0.004
Climate Compliance (F3)	0.309	0.069	4.696	0.000
Material Durability (F5)	0.400	0.110	5.000	0.000
Environmental Impact (F6)	0.280	0.075	3.500	0.002
Availability and Local Sourcing (F7)	0.370	0.090	4.000	0.000
Technological Advancements (F8)	0.210	0.060	2.800	0.007
Building Function and Usage (F9)	0.320	0.080	3.500	0.001
Regulatory Standards (F 10)	0.240	0.060	4.000	0.000
Aesthetic Preferences (F 11)	0.330	0.065	4.200	0.000
Labor Availability and Expertise (F12)	0.190	0.050	3.800	0.000

The strength and stability of the model support its practical utility in informing early design-stage decisions. The next section (Table 6) examines the relative contribution of each predictor using standardized regression coefficients (β values), which provide insights into the most influential material selection factors. Although Variance Inflation Factors (VIF) were not computed, the predictors originated from distinct conceptual domains, reducing the risk of multicollinearity. The stability of coefficients and the absence of sign reversals, along with a high adjusted R^2 (0.800) and significant F-statistic ($p < 0.001$), further support the model's validity.

4.3. Regression Coefficients: Influence of Individual Material Factors

Regression analysis revealed that all eleven material selection factors (F1–F3, F5–F12) significantly predicted maintenance demand (F4), with p-values ranging from <0.001 to 0.007 (see Table 6). This confirms that each factor—whether technical, economic, contextual, or aesthetic—has a statistically significant role in shaping architects' expectations of long-term maintenance needs. The relative strength of these predictors, however, varies considerably, as reflected in their standardized beta coefficients, which are discussed below.

4.4. Technical Performance Factors: Durability, Climate, and Environmental Impact

Material Durability (F5) emerged as the strongest predictor of maintenance demand (standardized $\beta = 0.400$, $p < 0.001$), underscoring its foundational role in architects' evaluation of long-term building performance. This aligns with the highest mean score (3.82) among the eleven selection factors (Table 7) and a strong consensus among respondents, with 94% rating it as at least "Important" and 54% as either "Very Important" or "Extremely Important" (Table 8). The strong association suggests growing awareness among Omani architects of the life-cycle and financial implications of material degradation, particularly under conditions of extreme heat, salinity, and dust. Durability in this context reflects resistance to corrosion, UV breakdown, thermal stress, and other forms of premature material failure. These findings validate previous work by de Brito and Silva [3] and Birge et al. [29], who argued that resilience to environmental conditions should be central to design specifications in arid regions.

Climate Compliance (F3) was also a significant predictor of maintenance demand ($\beta = 0.309$, $p < 0.001$). It had a slightly lower mean score (3.73), but was still rated as at least "Important" by 87.5% of respondents, and by 52.5% as "Very Important" or above. These figures suggest that while climate responsiveness is recognized, it is still not prioritized at the level its statistical relevance would suggest. This moderate gap between perceived importance and predictive strength may reflect a lack of standardized climate adaptation frameworks, limited performance data on materials in Oman's conditions, and availability constraints on regionally optimized products. As highlighted by Almheiri et al. [30], similar challenges are observed across the Gulf, where climate-adaptive design remains under-emphasized in material decisions despite significant environmental pressures.

Environmental Impact (F6), another technical factor, significantly predicted maintenance demand ($\beta = 0.280$, $p = 0.002$). It had a mean importance rating of 3.65 and was considered at least "Important" by 85% of respondents, though fewer (50%) rated it "Very Important" or higher. This indicates moderate-to-strong support, but also a potential undervaluation of the sustainability link to performance. Materials with low environmental impact often include recycled content, emit fewer pollutants, and degrade more slowly, all of which contribute indirectly to reducing maintenance burdens. The result supports arguments by Firoozi et al. [31] and Hariyani et al. [32] that environmentally responsible materials deliver tangible operational benefits beyond environmental compliance.

Table 7. Mean and Mode of F1–F3, F5–F12

Factors (Variable)	N	Valid	Missing	Mean	Mode
Client Demand (F1)	78	78	0	3.550	3.0
Cost Consideration (F2)	78	78	0	3.750	3.0
Climate Compliance (F3)	78	78	0	3.730	3.0
Material Durability (F5)	78	78	0	3.820	4.0
Environmental Impact (F6)	78	78	0	3.650	4.0
Availability and Local Sourcing (F7)	78	78	0	3.660	4.0
Technological Advancements (F8)	78	78	0	3.700	4.0
Building Function and Usage (F9)	78	78	0	3.690	4.0
Regulatory Standards (F 10)	78	78	0	3.670	4.0
Aesthetic Preferences (F 11)	78	78	0	3.580	4.0
Labor Availability and Expertise (F12)	78	78	0	3.550	4.0

Table 8. Importance Distribution

Factors (Variable)	Least Important (%)	Fairly Important (%)	Important (%)	Very Important (%)	Extremely Important (%)
Client Demand (F1)	4.0	5.0	57.5	14.3	19.0
Cost Consideration (F2)	7.0	5.5	35.0	34.5	23.0
Climate Compliance (F3)	16.0	10.5	35.0	38.0	14.5
Material Durability (F5)	2.0	4.0	40.0	36.0	18.0
Environmental Impact (F6)	8.0	7.0	35.0	38.0	12.0
Availability and Local Sourcing (F7)	5.0	6.0	45.0	30.0	14.0
Technological Advancements (F8)	9.0	10.0	35.0	34.0	12.0
Building Function and Usage (F9)	6.0	9.0	44.0	28.0	13.0
Regulatory Standards (F 10)	4.0	6.0	45.0	32.0	13.0
Aesthetic Preferences (F 11)	7.0	8.5	42.0	32.5	10.0
Labor Availability and Expertise (F12)	10.0	9.5	40.0	30.0	10.5

4.5. Contextual and Regulatory Factors: Local Sourcing, Building Function, and Codes

Availability and Local Sourcing (F7) was a strong and significant predictor of maintenance demand ($\beta = 0.370$, $p < 0.001$), with a mean importance score of 3.66. It was rated as at least "Important" by 89% of respondents, and 44% identified it as "Very Important" or higher. This shows broad support for the practical and contextual advantages of sourcing materials locally. Locally sourced materials are generally better adapted to the environment and offer logistical advantages that reduce handling damage and embodied energy. These results align with Akadiri [19], who emphasized that local sourcing enhances both economic feasibility and life-cycle reliability, particularly in regions with distinct climatic pressures.

Building Function and Usage (F9) also emerged as a significant predictor ($\beta = 0.320$, $p = 0.001$). With a mean score of 3.69 and 85% of respondents rating it at least "Important," the data underscores the influence of functional programming on material choice. For example, high-traffic areas (e.g., schools, hospitals) may require highly durable finishes, while spaces with intermittent use may permit more aesthetic-driven materials. This reflects the importance of use-specific material planning, supporting Au-Yong et al. [5], who highlighted how performance mismatches often arise from underestimating building function during the specification stage.

Regulatory Standards (F10) also significantly predicted maintenance demand ($\beta = 0.240$, $p < 0.001$), with a mean score of 3.67. A total of 90% of respondents rated it at least "Important," while 45% marked it "Very Important" or higher. Although regulation is not always seen as a driver of innovation, this finding suggests that architects increasingly view compliance not only as a legal necessity but also as a mechanism for long-term quality assurance. These results reinforce earlier calls by Saleh and Alalouch [12] for stronger enforcement of climate- and performance-based codes in the Gulf region.

4.6. Economic and Client-Driven Factors: Cost and Demand

Client Demand (F1) and Cost Consideration (F2) were both statistically significant predictors of maintenance demand, with $\beta = 0.288$ ($p < 0.001$) and $\beta = 0.250$ ($p = 0.004$), respectively. Client Demand had a mean importance score of 3.55 and was considered at least "Important" by 90.8% of respondents, though only 33.3% rated it as "Very Important" or above. Cost Consideration had a slightly higher mean (3.75) and 93% rated it at least "Important," with 57.5% rating it "Very Important" or higher. These figures illustrate a familiar pattern in architectural decision-making: cost and client preference dominate early design discussions and exert a strong influence on material selection, even when architects are aware of longer-term performance implications. As noted by Al-Ghamdi and Al-Gahtani [33], Emmitt [34] and Marisa and Yusof [26], this dynamic often results in value-engineering decisions that prioritize short-term affordability at the expense of life-cycle efficiency. The findings suggest an opportunity to improve outcomes by integrating life-cycle costing tools and stronger client education at the early stages of the design process.

4.7. Design and Workforce Considerations: Aesthetics, Labor, and Technology

Aesthetic Preferences (F11) was a significant predictor of maintenance demand ($\beta = 0.330$, $p < 0.001$), with a mean score of 3.58. About 84.5% of respondents rated aesthetics as at least "Important," but only 42.5% rated it "Very Important" or higher. This reflects the dual influence of

design intent and material performance: while aesthetics enhance user satisfaction and architectural expression, they can sometimes introduce fragility or complexity that increases maintenance needs. This supports earlier observations by Wastiels et al. [35] and Spence [17], who noted that visual priorities must be tempered by technical constraints to ensure long-term viability.

Labor Availability and Expertise (F12) also showed a statistically significant relationship ($\beta = 0.190$, $p < 0.001$), with a mean score of 3.55. Around 80.5% of respondents considered it at least "Important," although only 40.5% rated it "Very Important" or higher. This suggests that architects recognize the challenges posed by limited availability of skilled trades in Oman's construction workforce. Poor workmanship and inadequate installation can lead to early material failure, as highlighted by Tayeh et al. [36]. Aligning specifications with available technical expertise is thus essential to reduce downstream maintenance risks.

Technological Advancements (F8), though the weakest predictor in the model, was still statistically significant ($\beta = 0.210$, $p = 0.007$). It had a mean importance score of 3.70 and was rated at least "Important" by 87% of respondents, with 46% rating it "Very Important" or higher. This reflects cautious optimism: architects are aware of the potential of innovations like self-healing concrete, nano-coatings, and thermal-reactive systems, but adoption may be constrained by cost, unfamiliarity, or limited local demonstration [7, 20]. The findings align with Firoozi et al. [31] and Le et al. [37], who emphasized that the integration of high-performance materials depends on both technical capacity and practitioner confidence.

4.8. Summary of Predictors

As summarized in Table 9, all eleven material selection factors significantly predicted perceived maintenance demand. While technical factors such as material durability, local sourcing, and climate compliance demonstrated the strongest statistical influence (based on standardized beta values), the combined analysis of mean importance ratings (Table 7) and Likert-scale distributions (Table 8) reveals a more nuanced view of architects' actual prioritization in practice.

For instance, while climate compliance was the third most influential predictor ($\beta = 0.309$), it was rated as "Important and above" by 87.5% of respondents—slightly behind material durability (94%) and cost considerations (93%). Meanwhile, local sourcing, which ranked second in statistical strength ($\beta = 0.370$), had lower top-tier perceived importance, with only 44% rating it "Very Important" or "Extremely Important." These contrasts highlight a gap between statistical influence and professional emphasis, suggesting that while architects are aware of certain long-term performance drivers, their real-world decision-making may still be shaped by immediate project constraints and client preferences.

Broadly, over 80% of respondents rated each factor as at least "Important," indicating widespread acknowledgment of their relevance in the material selection process. However, the variation in perceived intensity (from "Important" to "Extremely Important") points to the influence of practical trade-offs. These findings support the need for an integrated, performance-informed material selection approach that balances durability, contextual fit, client and regulatory pressures, design goals, and workforce realities.

Tools such as life-cycle cost models, material performance dashboards, and regional adaptation guidelines could help close the gap between professional judgment and statistical performance, aligning material choices more closely with long-term maintenance expectations.

Table 9. Combined Summary of Predictors by Statistical and Perceived Importance

Rank	Material Criterion	β (Standardized)	% Rated Important+	Mean Score	p-value
1	Material Durability (F5)	0.400	94%	3.82	<0.001
2	Availability and Local Sourcing (F7)	0.370	89%	3.66	<0.001
3	Climate Compliance (F3)	0.309	87.5%	3.73	<0.001
4	Aesthetic Preferences (F 11)	0.330	84.5%	3.58	<0.001
5	Building Function and Usage (F9)	0.320	85%	3.69	0.001
6	Environmental Impact (F6)	0.280	85%	3.65	0.002
7	Client Demand (F1)	0.288	90.8%	3.55	<0.001
8	Cost Consideration (F2)	0.250	93%	3.75	0.004
9	Regulatory Standards (F 10)	0.240	90%	3.67	<0.001
10	Technological Advancements (F8)	0.210	87%	3.70	0.007
11	Labor Availability and Expertise (F12)	0.190	80.5%	3.55	<0.001

Note: β values are derived from standardized regression coefficients (Table 6). Likert importance ratings reflect the percentage of respondents who rated each factor as "Important," "Very Important," or "Extremely Important" (Table 8). Mean scores are from Table 7.

5. Conclusions

This study provides robust empirical evidence on the relationship between architects' material selection decisions and their expectations of long-term maintenance demand in Oman's construction sector. By combining statistical analysis with professional perception data, the research highlights how technical, contextual, economic, regulatory, aesthetic, and labor-related factors collectively shape anticipated maintenance outcomes. All eleven material selection criteria tested were found to be statistically significant predictors, with material durability, local sourcing, and climate compliance having the strongest influence.

The findings show a clear gap between architects' awareness of key factors, such as climate compliance and environmental impact, and how these factors are prioritized in material selection. Although most respondents acknowledged their importance, sustainability considerations were often ranked lower than immediate concerns like cost and client preferences. This disconnect highlights broader challenges, including the limited availability of climate-adapted materials, a lack of region-specific data, and weak regulatory enforcement.

Overall, the study emphasizes the need for better-informed and context-sensitive approaches to material selection in Oman's construction industry. Architects work within complex environments where technical knowledge, institutional pressures, and economic realities intersect. In a climate marked by extreme heat, salinity, and dust exposure, early design choices significantly influence long-term building resilience, operational costs, and environmental performance. While this study is based in Oman's unique construction context, characterized by severe desert conditions, saline exposure, and dependence on imported materials, the methods and key relationships identified may apply to other hot-arid regions. Still, the importance of factors like climate compliance and durability is especially critical in Oman, where environmental conditions speed up material degradation and increase maintenance risks. These contextual challenges highlight the need for region-specific strategies in material selection.

By pinpointing the main predictors of maintenance demand and examining the factors that influence architects' choices, this research adds valuable insights into the discussion on sustainable building practices in arid areas. It helps to understand how the criteria for material selection can forecast maintenance needs in buildings. Using multiple regression analysis, the research found that material durability, local sourcing, and climate compliance are the key predictors. These results show that emphasizing these factors during the design phase can lead to more accurate predictions of long-term maintenance needs. Future research should build on this work by including the views of contractors, facility managers, and end users, and by validating predicted outcomes through post-occupancy evaluations and field studies.

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