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Decision-Making Mechanism in Sustainable Design: The Impact of Individual Values of Local Architects

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A B S T R A C T

The idea of the research crystallized with the increasing interest in sustainable design methodologies and strategies for applying its standards as a prevailing concept in the current time, adopting various terms such as green design, healthy design, and environmentally friendly design. These propositions have intertwined, and formed complex hybrid concepts in architecture. The decision-making process is a fundamental component of the design process and holds a crucial position along the design process trajectory. The research aims to achieve a precise and comprehensive definition of the stages of decision-making in sustainable design and the strategies for dealing with its many components. These previously considered non-imposed design goals but are now constraints and that define the desires of the designer, client, and user within regulated frameworks to achieve a sustainable building outcome. The decision-making process in sustainable design is characterized by ambiguity due to the cognitive and personal values of the stakeholders, these values may lean towards laws and frameworks that are clearer in the context of communication with others, neglecting the individual values of decision-makers. The research methodology relied on surveying architectural professionals' perspectives regarding their interaction level with sustainability standards and which values hold greater importance, to gain a clearer insight into the extent to which this category adopts sustainability standards and criteria and within what parameters. The research concluded that there is a difference in decision-making mechanisms for sustainable design compared to traditional design. Moreover, there is a variation in architects' perspectives on sustainable design resulting from differences in experiences, awareness, and academic content in the job market.

Keywords:Sustainable Design,Decision-Making,Values,Frames,The decision problem space.

آلية اتخاذ القرار في التصميم المستدام: تأثير القيم الفردية للمهندسين المعماريين المحليين

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خلاصة

وتبلورت فكرة البحث مع تزايد الاهتمام بمنهجيات واستراتيجيات التصميم المستدام لتطبيق معاييره كمفهوم سائد في الوقت الحالي، باعتماد مصطلحات مختلفة مثل التصميم الأخضر، والتصميم الصحي، والتصميم الصديق للبيئة. وقد تشابكت هذه المقترحات وشكلت مفاهيم هجينة معقدة في الهندسة المعمارية. تعد عملية اتخاذ القرار عنصرًا أساسيًا في عملية التصميم وتحتل موقعًا حاسمًا على طول مسار عملية التصميم. ويهدف البحث إلى التوصل إلى تعريف دقيق وشامل لمراحل اتخاذ القرار في التصميم المستدام واستراتيجيات التعامل مع مكوناته المتعددة. كانت هذه الأهداف التي تم اعتبارها سابقًا غير مفروضة ولكنها أصبحت الآن قيودًا وتحدد رغبات المصمم والعميل والمستخدم ضمن أطر منظمة لتحقيق نتيجة بناء مستدامة. تتميز عملية صنع القرار في التصميم المستدام بالغموض بسبب القيم المعرفية والشخصية لأصحاب المصلحة، وقد تميل هذه القيم نحو قوانين وأطر تكون أكثر وضوحا في سياق التواصل مع الآخرين، مع إهمال القيم الفردية لمتخذي القرار . اعتمدت منهجية البحث على استطلاع وجهات نظر العاملين في مجال الهندسة المعمارية فيما يتعلق بمستوى تفاعلهم مع معايير الاستدامة وأي القيم لها أهمية أكبر، للحصول على رؤية أوضح لمدى تبني هذه الفئة لمعايير ومعايير الاستدامة وضمن أي معايير. وخلص البحث إلى وجود اختلاف في آليات اتخاذ القرار للتصميم المستدام مقارنة بالتصميم التقليدي. علاوة

على ذلك، هناك تباين في وجهات نظر المهندسين المعماريين حول التصميم المستدام نتيجة لاختلاف الخبرات والوعي والمحتوى الأكاديمي في سوق العمل.
الكلمات المفتاحية: التصميم المستدام، اتخاذ القرار، القيم، الأطر، مساحة مشكلة القرار.

Introduction:

Many literatures have pointed out how the decision-making process in sustainable design takes shape, often characterized by ambiguity due to the contributors' personal and individual cognitive processes. Traditional rational models suggest that decision-makers constantly choose and act with detachment and based on self-interest. Such theories assume an unlimited and unrestricted processing ability independent of time and context. Rational judgment and decision-making are often fundamentally constrained by the nature of cognitive processing, time, and context. Our awareness of these fundamental limitations (boundaries) is primarily based on cognitive biases and heuristics (mental shortcuts) and shapes desires and the possibility of choice [1].

The mitigation of the environmental impacts of building designs on sustainability is achieved through comprehensive and ambitious legal tools and individual and unofficial collective commitments. This mitigation is gradually managed through changes in some planning legislations and building regulations. These tools and controls may be subject to various interpretations by authorities, project clients, and stakeholders. Decision-makers can view sustainability regulations as less common denominators and starting points [2].

The decision-making process in sustainable design is defined as choosing a course of action from available and competing alternatives across the problem space between real-world situations and designer-preferred scenarios. Identifying decision problems leads to establishing boundaries for the problem space, which can shape or enhance alternatives concerning project sustainability. Decision-making constitutes the central or pivotal aspect of any design work closely related to applying sustainability principles.

1. Research Objective:

The primary objective of the study is to investigate the decision-making strategies in sustainable design, identifying conceptual and procedural differences between conventional design processes and sustainable design processes. This aims to unravel the complexity and interplay arising from the competition between sustainability issues and standards and decision-maker's self-values in the design process, including professionals, stakeholders, and users. The research objective is achieved by adopting a theoretical framework for decision-making in sustainable design. Additionally, the study measures the levels of interaction among architects with the obstacles in the decision-making process for sustainable design, employing the Valued-Driven Design Process methodology to explore these dimensions.

2. Concept of Sustainable Design:

Sustainable design represents a new approach that tends to shift the ways of dealing with ideas and concepts towards less resource-intensive and complex methods [3]. It focuses on integrating natural resources as an integral part of the design and the relationship between buildings and the natural environment to achieve integration and harmony with the surrounding environment [4]. Sustainable design aims to improve the performance of construction in the three main domains: environment, society, and economy [5], achieving a lower level of cost and energy consumption compared to traditional design. The United Nations Conference in 1987 defined sustainable design as meeting current needs without compromising the ability of future generations to meet their own needs [3].

Sustainable design has adopted various labels, including green design, environmental design, basophilic design, and ecological design. The formulation of these labels dates back to the early 1970s due to the emergence of multiple terms related to energy, all used to express design orientations aimed at reducing reliance on fuel for building operations. These labels share a common fundamental goal: considering the environmental impact of buildings. The slight shifts and essential transformations in systems, ideas, and strategies resulting from technological advancements, scientific discoveries, and economic requirements have crystallized the concept of sustainable design. The idea of sustainability involves reevaluating architecture in response to numerous concepts regarding the human impact on the environment. The term "sustainability" distinguishes these ideas from others that do not directly respond to this goal [3]. The concept of adaptation can be a critical factor associated with sustainable architecture by using fractal geometry tools, which aims to achieve sustainable architectural design, there is a harmonious relationship between the concepts of fractal geometry, including mechanisms dynamic growth, repetition within graduated scales, symmetry, and others ,and the concepts of sustainable nature with its adaptive characteristics towards various changes over time.[6]

3.1 General Principles of Sustainable Design

Various literature on sustainable design has articulated numerous common, intersecting, or divergent principles. However, they generally share three fundamental principles, encompassing resource efficiency, life cycle design, and human-centric design [7].

- First Principle; Resource Efficiency: This principle focuses on the natural resources utilized in the building through reduction, conservation, reuse, recycling, and the preservation of water resources [8].

- Second Principle; Life Cycle of the Building: This principle provides a methodology for analyzing the construction process and its environmental impact. The life cycle of the building is categorized into three stages: pre-construction, construction, and post-construction. Analyzing the construction processes in each stage provides a better understanding of how the building's design, construction, and operation impact the environment. All these stages are interconnected [3].

- Third Principle; Human-Centric Design: This principle focuses on the interactions between humans and the natural world, arguably the most crucial aspect of sustainable design. It is concerned with the suitability of all components of the ecological system. The primary role of architectural engineering lies in enhancing the quality of life for humans, encompassing the provision of built environments that preserve safety, health, physical and mental comfort, psychological well-being, productivity, security, and improving working conditions while reducing stress [9].

3. The Decision-Making Process:

The decision-making or decision-making process is one of the fundamental components of the design process, and the literature has proposed various contrasting definitions within its cognitive, behavioral, and integrative perspectives. Swami defines the decision-making process as the mental or cognitive process of choosing a logical alternative from the available options after evaluating and selecting from numerous competing alternatives to make the appropriate decision. Therefore, the decision-maker must consider all alternatives, balance the pros and cons of each option, and be able to predict the outcome of each choice to determine the best option for the situation [10]. Volker emphasizes that it is an iterative process involving various judgments leading to different values. Identifying and elucidating these values as a single truth is challenging as they depend on stakeholders' opinions [11]. The final choice resulting from the decision-making process may be an action or an opinion.

Perry's perspective on the decision-making process aligns it with the design process, meaning the decision procedure is based on thought, creativity, and emotion. It involves identification, learning, representation, and decision-making [12].

According to the study by Al-Qaemaqji (2008), decision-making in any term within the design vocabulary relies significantly on the overall cognitive processes occurring in memory and imagination. The process of retrieval and visualization, starting from releasing the stock of experience and forming working mental schemata to create structures assembled in the imagination to present the design conception, is contingent on the designer's ability to interact positively with this process. This interaction occurs through the designer's capacity to organize the context of their cognitive actions within mental patterns and effective reasoning mechanisms to solve the design problem.

On the one hand, the mental capacity of the designer is governed by the volume of information they receive, as this information should not reach the level of confusion that the mind responds to through intentional neglect. In this context, the conceptual stage of the designer's work is closely linked to their ability to convey their perceptions and cognitive understanding into the schematics they produce. Subsequently, they liberate what is stored in their memory, releasing a portion of information to deal with the emerging knowledge, thus restructuring their mental schemata and reconstructing their conceptions based on what has been reported during this transfer [7].

The components of the decision-making process are broken down into several sequential stages, forming a workflow not only for the designer alone but also for the key contributors to the project. The fundamental components of the decision-making process include the following stages [12]:

- Definition of the decision problem.
- Identification of possible alternatives.
- Consideration of all possible alternatives.
- Evaluation of positive and negative weights for each alternative.
- Estimation of the outcomes of each alternative.
- Determination of the best alternative for the appropriate solution.
- Selection of the logical alternative for the solution.

4.1 Decision-Making Processes in Sustainable Design:

The decision-making process in sustainable design is defined as the selection of a working path among the available and potential alternatives across the problem space, which moves between realistic and preferred scenarios for design issues. Identifying decision problems leads to establishing boundaries for the problem space and shaping or enhancing alternatives related to the sustainability of the project. Decision-making constitutes the central or pivotal part of any design work closely associated with applying sustainability principles. Almendra indicated that various types of decisions can be classified into three categories:

- Decisions are formulated when the designer frames the problem/solution, creating a general picture of the situation. These decisions occur during the analysis stage of the design process.
- Key decisions stimulate the transition from the analysis stage to the synthesis stage, generating a new solution and serving as a turning point in the design process, creating a mental image of the solution.
- Empowering decisions take place during the synthesis stage. These are regular decisions aimed at facilitating the implementation of the critical decision in its operational and procedural aspects. This occurs when the design team understands what is expected to happen, as revealed through the decision-making process [13].

Typically, decisions in the construction and architecture sector are made without undergoing a detailed analysis through interviews and case studies. Moreover, decisions are seldom documented or made using a systematic method, and in many instances, the design team selects an alternative without a clear logical basis. The decision-making process often lacks transparency, failing to contribute to consensus building or continuous expertise. Additionally, sustainable design involves the participation of various stakeholders with differing perspectives and conflicting interests. The current practice of selecting among alternatives may be inadequate for sustainable design due to the absence of a clear and shared logical foundation.

4.2 Foundations of Decision-Making Process in Sustainable Design:

The decision-making process is grounded in fundamental cognitive and practical procedures that enable the control and management of the overall stages and complexities involved. It aims to unravel the intricacies of decisions based on values imposed by project contributors when attempting to adopt the principles and concepts of sustainability. These foundational aspects encompass [12]:

a. **Identifying the Decision Problem Space**: Defining decision problem issues leads to establishing boundaries around the problem space. These boundaries can constrain or enhance options regarding the sustainability of the project in the future. The delineation of boundaries shapes possible and preferred solutions throughout the framing process of sustainability issues. The significance of the decision problem space lies in how one defines the problem based on one's understanding, approach, and the ability to redefine or reframe it. Exploring the problem space aims to broaden the scope of alternatives and solutions that have been tested [1].

b. **Frames**: The framing process involves interpreting and selecting certain aspects of the perceived reality, making them more straightforward in communicating with others. This process aims to enhance the definition, causal interpretation, and ethical evaluation of selected values within the decision problem space. Framing consists of dynamic, socially dimensioned processes in constructing meaning for the issues presented in decision-making [14]. Frames are the framed alternatives that influence individuals' interpretations of the likelihood of outcomes and feasibility, consequently impacting sustainable alternatives. They play crucial roles in the decision-making process.

c. **Values Identification**: Values are defined as patterns of personal identities that express what individuals consider desirable and worth achieving. Values reflect the motives that govern the attitudes and behaviours of different aspects of human life. Therefore, values are essential in rational thinking to address environmental problems. Values are categorised into individual values, representing patterns of individual identities and societal values, indicating a set of communal customs and traditions that collectively judge what is more important and meaningful [12].

d. **Evaluation of the Mutual Relationship between Frames and Values**: The existence of ambiguity and dynamics in the relationship between the frames of issues required for sustainable design and the human values associated with sustainability meanings for contributors within the decision-making problem space necessitates the adoption of a scientific or logical approach to describe and crystallise this dynamic relationship with mutual influence throughout the sustainable design process. There is a need to crystallise the mutual relationship between them, and interactively, values may manifest through frames, and frames may place values in their context [15].

The ambiguity and dynamics in the relationship between the frames of issues required for sustainable design and the human values associated with sustainability meanings for contributors within the decision-making problem

space necessitate the adoption of a scientific or logical approach to describe and crystallise this dynamic relationship with mutual influence throughout the sustainable design process. Table (1) illustrates the vocabulary of the theoretical framework for the decision-making process in sustainable design.

Table 1. Vocabulary of the theoretical framework for the decision-making process in sustainable design

Main Vocabulary	Secondary vocabulary	Potential Values
Space of Decision-Making Problem	Description of the Decision Problem	Categorizing Decision-Making Problems
		Prioritising Decision-Making Problems
		Selecting the Problem Based on Alternatives
		Identifying Alternative Branches
		Designing the Problem According to the Best Alternative
	Constraints of the Decision Problem	Legal Tools (Sustainability Regulations)
		Individual Commitments
		Collective Commitments for Stakeholders
		Knowledge Boundaries for Stakeholders
	Levels of the Decision Problem	Fundamental Decision Problem
		Qualitative Branches of the Decision Problem (Alternatives and Solutions)
		Boundaries of Formulating Desired Solutions
		Stakeholder Problem Area
	Decision Maker	Work Teams (Design Team, Technical Team, Executive Team)
		Stakeholders and Shareholders
		Evaluation and Assessment Team
Framing Process	Definition of Framing	Cognitive Frameworks for Organizing Ideas
		Thinking and Communication Tools
		Speaker or Listener Influence Style
		Individual Interpretations of Sustainability Issues
	Tools of Framing	Discussion of Ideas, Concepts, and Objectives
		Words, Phrases, and Opinions
		Behaviors and Professional Ethics
		Consistencies in Describing Sustainability Issues
		Individual Interpretations of Sustainability Issues
	Levels of Framing	Level of Communication (Identifying and Conveying Sustainability Issues)
		Cognitive and Perceptual Level (Self-Perceived Perspectives)
		Collective Opinion Level (Reference Frameworks)
Crystallizing Values	Patterns of Values	Individual Patterns of Individual Values Identities

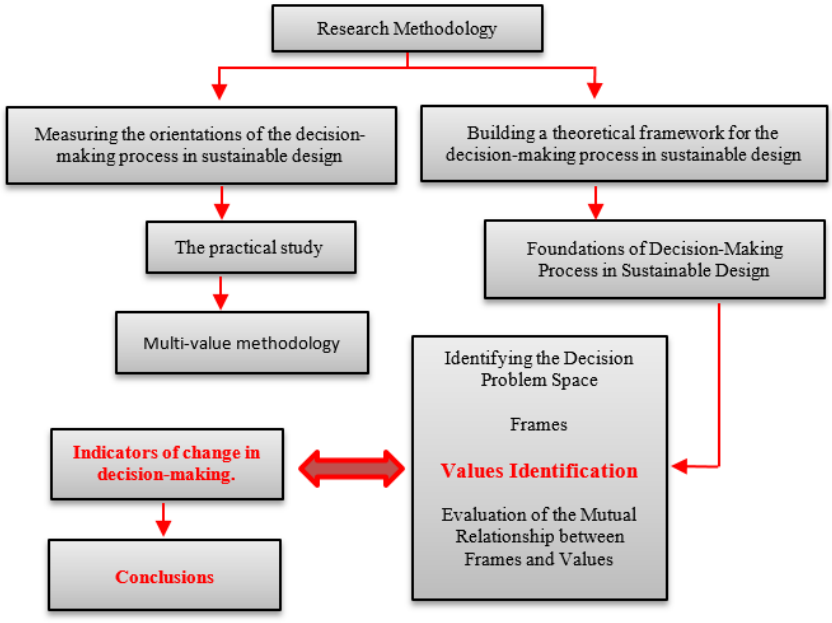
			Motivations Regulating Attitudes and Behaviors
			Preferred and Varied Importance of Goals
		Collective Values	Social Customs and Traditions
			Judgments of Importance and Meaning
	Characteristics of Values	Accessible and Meaningful Human Variables	
		Identifiable and Relatively Stable	
		Reflection of Cultures and Civilizational Values	
		Cognitive Contradictions and Disparities Among Stakeholders	
		Inherent Uncertainty	
		Transparency and Clarity in Agreements	
	Context of Values	Cognitive Context (Meaningful Context)	
		Material Context (Social, Ethical, Functional, Economic)	
		Temporal Context	
Relationship between Frames and Values	Pattern of the Relationship	The integration relationship of the emergence of values through frameworks or frameworks provides a clear context for values.	
		Reciprocal Procedural Relationship along the Work Path	
		Relational Connection (Mediating Frameworks between Sustainability Feasibility and Individual Values)	
	Aspects of the Relationship	Defining the Decision-Making Context	
		Determining the Level of Analysis for Alternative Solutions	

Research Methodology:

It is evident from the above that the traditional model of decision-making space in design has been characterised by ambiguity and lack of clarity, whether it is followed according to the linear design stages on the one hand or implicitly confined to the stage of composition and creativity on the other hand, and then evaluated by subsequent criteria that enhance the logic of the analysis stage. This means that evaluation criteria are always subsequent and not initial in the design process. However, the decision-making process for sustainable design acquires different characteristics in terms of challenges and accompanying obstacles. Therefore, the role of the design team here also differs, necessitating transparency, consensus management, and the ability to manage and share the necessary information to make design decisions among contributors. Studies have varied in describing the basic aspects of the decision-making process for sustainable design, between describing it as a continuous and recurring process throughout the design process, inherent in each step, or as occurring in the early stages of the design process to ensure the inclusion of sustainability principles as precise tools for the design decision. There is also a need for a computer software system to document

the basic and partial decisions and to adopt the processing of changes in the partial decisions that occur within the design process. All of this reflects the importance of formulating a working methodology that accommodates the complexity and interdependence between the reference frameworks for sustainability (such as laws, guidelines, or indicators) and the human values of the parties involved in formulating the design decision. Hence, the knowledge gap in related studies has emerged in the absence of formulating a framework and evaluation for the stages of decision-making in sustainable design and indicators of its difference from traditional design. This framework should take into account the referential characteristics of sustainability principles as fundamental guidelines that must be achieved as constraints, not as goals. It also emphasises the importance of adopting the human values of the contributors, which stem from their cognitive background about sustainability. As illustrated in Figure (1).

Figure (1) illustrates the structure of the research methodology



Practical Study:

Design is a continuous decision-making process in the context of architectural design. The role of decision-making can be defined in various ways. The decision-making process is influenced by sets of conditions or contexts, some of which can be controlled, such as the business context. In contrast, others are imposed and cannot be controlled, such as market demand and user preferences. In the case of designing/constructing a high-performance building, the owner has the choice to pursue sustainable design goals, such as obtaining Leadership in Energy and

Environmental Design (LEED) certification or ENERGY STAR certification. However, certain aspects of business contexts, such as market conditions influenced by competitive design products, are somewhat uncontrollable. Accurate assessment of the decision-making context is crucial as it determines the level of effort and the long-term impact of design decisions. Decisions with long-term effects are often irreversible after implementation. Therefore, decision-makers must thoroughly analyse the context of alternatives and their impacts before reaching a decision. In the case of sustainable design, decisions with long-term impacts are typically made in the early design stage by design teams led by architects, engineers, developers, or owners. Understanding and proposing a practical framework for design decision-making is crucial for achieving sustainability. Various methods are commonly used to assist designers in decision-making, such as using decision matrices or decision trees and deploying the quality function deployment. These methods are generally tailored and involve relatively high levels of autonomy, known as the designer's intuition. Therefore, the research methodology adopted a study of one of the pillars of the decision-making process in sustainable design, which is values, in both their individual and collective aspects. This is because values are the major variable among the pillars and have a significant impact on decision adoption, considering that frameworks are precise and structured for sustainability issues.

Indicator (Values) as an Influencer in Decision-Making:

The study adopted one of the pillars of the decision-making process in sustainable design by identifying and comparing different preferences of values among local architects and how this group attributes different weights to key sustainable design features. This was done by relying on new ideas proposed around the value-driven design process: Systematic Decision-Making, which is a design strategy that works on building a framework for decision-making based on the weights of values proposed by contributors in decision-making in relation to sustainability issues that must be adopted in sustainable design. The stages of the practical study are as follows:

–Building a validated questionnaire model based on the vocabulary of sustainable building evaluation according to our study of the sources [20.19.18.17.16] and its evaluation by specialists.

–Adopting sustainable criteria that are applicable and approved by the American Institute of Architects (AIA) (14), considering it the most credible entity, as it has developed the vocabulary for evaluating sustainable buildings to obtain LEED Platinum, Gold, or Silver certification, as shown in Table (2), which includes strategies and technologies for key sustainable design principles according to the official LEED rating system website | U.S. Green Building Council (usgbc.org) [20.19.18.17.16].

–Selecting a research sample from academic architects or local specialists in the private sector, totalling (30), to survey them about sustainability issues as a whole and to determine their level of preference in making design decisions.

–Analyzing the survey results and indicating the levels of interaction of the selected sample with sustainability issues according to the values of the decision-makers and reaching conclusions.

Table 2. illustrates the vocabulary and possible values for sustainable design (LEED) [19.18.17.16].

NO	Key sustainable design principles	Strategies and techniques
	Environmental sustainability	
1	Integrated design process	This is the design process where each element is optimal.
		The impact and interactions between elements and different systems within the building and site are reassessed, integrated, and improved as part of solving the entire building
2	Sustainable Site Design	Minimizing urban sprawl on valuable land and green spaces. Encouraging high-density urban development, urban redevelopment, and development as a means of preserving valuable green spaces.
		Preserving key environmental conditions through careful examination of each site.
		Engaging in the design and construction process that minimises site disruption and values, preserves and renews green spaces and environmental systems.
3	Water Quality and Conservation	Preserving the current natural water cycle and site improvements, focusing on retaining stormwater and site runoff and recharging groundwater using methods that closely mimic natural systems.
		Reducing unnecessary and inefficient use of potable water on-site while maximising water recycling and reuse
4	Energy & Environment	Reducing adverse environmental impacts (air, water, land, natural resources) by determining the optimal building location, optimal building design, material selection, and intensive use of energy conservation measures.
		The building's performance should exceed the minimum compliance level of the International Energy Conservation Code (IECC) by 30 to 40% or more.
		Maximizing the use of renewable energy and other low-impact energy sources
5	Indoor Environmental Quality	Providing a healthy, comfortable, and productive indoor environment for building occupants and visitors.
		Providing a building design that offers the best possible conditions in terms of indoor air quality, ventilation, thermal comfort, access to natural ventilation, daylighting, and effective control of the acoustic environment
6	Material & Resources	Reducing the use of non-renewable building materials and other resources such as energy and water through efficient engineering, design, planning, and construction, as well as effective recycling of construction debris.
		Maximizing the use of recyclable materials and modern, efficient engineering materials.
		Improving the use of construction materials and identifying ways to use high-content recyclable materials in the building structure and finishes

7	Pollution	Using recycled materials instead of new alternatives derived from the manufacturing process to create a reference list for landscape sustainability.
		Limiting stormwater runoff to reduce pollution and other environmental damage.
		Chemicals emitted from building materials can be a potential source of health problems if not properly treated.
		Ventilation is essential for maintaining and preserving indoor air quality for a healthier life.
		Encouraging the use of products and materials that reduce or eliminate indoor pollution sources
8	Societal Sustainability	Promoting social awareness and a sense of belonging.
		Encouraging new services, shared spaces, and meeting points.
		The ability to stimulate a sense of belonging (to a place or to a social group) enhances the quality of sustainable design and helps improve people's quality of life
9	Economic sustainability	Using a set of measures aimed at revitalising productive activities and job opportunities within the scope of planning, taking into account sustainable improvement, including promoting local historical heritage, with the consequent development of tourism in the context.
		Creating flexible production spaces that can accommodate self-organising activities and energy-efficient places is one of the challenges that we can all appreciate for years to come

Discussing the Results of the Practical Study:

The survey results measuring the value orientations of individuals contributing to decision-making indicated variation in the importance given to key sustainability issues (functional, social, economic) and, thus, design decision-making. Statistical analysis and data collection from specialists was conducted using Excel, showing in Tables (3-4-5) the relative importance of study variables related to sustainable design from the perspective of architects through mean values, standard deviations, and the relative importance of the three variables (environmental sustainability, social sustainability, economic sustainability). It was found that the most important variable of the sustainable design variables is the economic sustainability variable, while the social sustainability variable came in second in terms of importance, with the environmental sustainability variable ranking third and last. Table (6) includes the following results:

-The results regarding the relative importance of the dimensions of environmental sustainability indicated that the axis of design elements was identified as the foremost indicator in the preferences of decision-makers with a value of (77.83), while the urban site index was less favoured in decision-making preferences with a value of (70.31). This suggests a concentration of designers' attention on the building level in sustainable designs. (Table 3).

-The results regarding the relative importance of dimensions of social sustainability pointed towards an emphasis on improving the quality-of-life services, especially for vulnerable groups (such as the elderly and children), defined as the concept of accessibility, with a value of (80.67). Meanwhile, the indicator of individual safety and defence initiatives was less preferred by decision-makers, scoring (68.67). This indicates that designers focus more on the social dimensions for vulnerable groups rather than emphasising social

dimensions for communities. This orientation is linked to a local community vision. (Table 4).

-The results concerning the relative importance of dimensions of economic sustainability highlighted a preference among local architects for the axis of using alternative energy resources (resulting in reduced electricity bills) as the primary indicator, scoring (88.00) in decision-makers preferences. Conversely, the axis of employing specific activities to enhance sustainable employment opportunities for the community was considerably less favoured by decision-makers, scoring (75.33). This suggests that individuals prioritise enhancing the local reality by reducing the financial cost of energy sources without resorting to future plans that promote sustainable design. (Table 5).

Table 3. shows the relative importance of the dimensions of environmental sustainability. Source: The researcher prepared, based on the outputs of the SPSS program (V.26), n=30

Table 4. the relative importance of dimensions of social sustainability. Source: The researcher prepared, based on the outputs of the SPSS program (V.26), n=30

No	Dimensions	Mean	Standard Deviation	Relative Importance %	Order
1	Design Elements	3.89	0.96	77.83	First
2	Urban Site	3.52	0.98	70.31	Seventh
3	Water conservation	3.61	0.94	72.17	Sixth
4	Energy and Environment	3.87	0.94	77.47	Second
5	Quality of life in terms of health and comfort	3.71	0.97	74.17	Third
6	Materials and resources	3.62	0.91	72.38	Fifth
7	Pollution	3.68	0.88	73.5	Fourth

No	Variables of Social Sustainability	Mean	Standard Deviation	Relative Importance %	Order
1	The	3.77	0.82	75.33	Third

	Relationship Between Shared Spaces Usage				
2	Creating Distinctive Elements and Places for the Community and Sense of Place	4.00	0.69	80.00	Second
3	Community Services and Exchange Boundaries to Enhance Cooperation, Relationships, and Interactions Between Regions	3.53	0.82	70.67	Fifth
4	The Concept of Safety and Security Among Individuals and Defense Initiatives	3.43	0.94	68.67	Sixth
5	Improving Quality of Life Services, Especially for Vulnerable Groups	4.03	0.93	80.67	First

	(Elderly, Children), as Accessibility and Safety				
6	Providing Employment Opportunities and Enhancing Initiatives and Relationships to Support Youth	3.57	1.17	71.33	Fourth

Table 5. the relative importance of dimensions of economic . . Source: The researcher prepared, based on the outputs of the SPSS program (V.26), n=30

No	Variables of Economic Sustainability	Mean	Standard Deviation	Relative Importance %	Order
1	Use of Alternative Energy Resources (Reduction in Electricity Bills)	4.40	0.81	88.00	First
2	Use of Low-Flow Water Equipment and Optimal Water Usage	4.03	0.72	80.67	Second
3	Flexibility in Construction (Low-Cost Flexible Spaces)	3.53	0.82	70.67	Eighth
4	Employment-Boosting Activities for Sustainable Community Opportunities	3.77	0.94	75.33	Eleventh
5	Tourism Development in Urban Context by Enhancing	3.70	1.18	74.00	Sixth

	Local Historical Heritage				
6	Increasing Points of Attraction and Enhancing Quality of Natural Context	3.80	1.19	76.00	Fourth
7	Supporting the Local Vibrant Economy Industry	3.60	1.00	72.00	Seventh
8	Productive and Service Activities in Social Context and Natural Resources	3.37	1.07	67.33	Ninth
9	Reusing Urban Heritage by Renovating Functional and Spatial Treatments	4.00	1.02	80.00	Third
10	Utilising Production and Service Industries	3.33	1.03	66.67	Tenth
11	Creating and Enhancing Sustainable Employment	3.77	0.94	75.33	Fifth

	Opportunities through Specific Activities				

Table 6. shows the relative importance of the variables in sustainable design.

No	Dimensions	Mean	Standard Deviation	Relative Importance %	Order
1	environmental sustainability	3.71	0.94	73.98	Third
2	Social Sustainability	3.72	0.89	74.44	Second
3	Economic Sustainability	3.75	0.97	75.09	First

Conclusions:

The research concluded with specific conclusions regarding the theoretical framework of the decision-making process in sustainable design, highlighting the relationship between decision-making and sustainable design issues. Some sustainability goals are seen as constraints that restrict the decision-making process in the design process. The decision-making process is based on four key pillars: the decision problem space, the reference frameworks for sustainability issues, values (individual and collective), and the relationship between frameworks and values. There is a need for a new design process based on performance and sustainability features, in addition to involving decision-makers and specialised engineers. Additionally, sustainable design is seen as a new approach aimed at improving building performance in all three areas (environment, society, and economy).

The conclusions of the practical study indicate that the variation in individuals' self and collective values significantly influences the design decision-making process in sustainable design. This extends to establishing solid frameworks for sustainability issues through individuals' awareness of these frameworks and their ability to conceptually and practically convey them to contributing individuals. Therefore, the research concludes that it is necessary to study sustainable design standards based on the roles and importance of individual values for decision-makers (engineers, architects, stakeholders, and occupants). These values reflect individuals' identity patterns and motives that regulate their attitudes and behaviours. There is also a tendency for different values and perspectives towards sustainability variables among decision-making individuals in terms of their preferences over other variables. The study highlights the importance of economic sustainability in the local experience, indicating its significant importance in decision-making in the design process compared to other sustainability issues (environmental and social).

Recommendations:

–The research recommends the importance of raising awareness about sustainability standards, principles, and issues at the local level among local specialised architects.

–The necessity of developing curricula and programs to increase awareness among engineers in universities.

–Conducting training courses for professional staff on the importance of adopting sustainable design principles in design decision-making.

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The questionnaire form illustrates the survey items regarding the selected sample's preferences for sustainability issues according to LEED

University of Mosul
College of Engineering/ Architecture Department

Greetings,

The research study titled "Decision-Making Mechanism in Sustainable Design: The Impact of Individual Values of Local Architects" aimed to describe and measure the opinions of architecture professionals regarding the evaluation and adoption of sustainable design terms and their impact on the decision-making process in design. This reflects their individual values and their impact on their self-decision for sustainable design work. Please kindly provide your valuable feedback on the importance level of these terms according to the following classification:

Age:……. Gender:…….

Job Title:……. Years of Experience:…….

Affiliation:……..

Sustainable design vocabulary						
Environmental sustainability		The degree of importance is from 1 to 5				
In the integrated design process, what are your beliefs and the degree of importance of design elements?		1	2	3	4	5
V1	The mutual relationships between the Building location and its characteristics (sun path, building orientation)					
V2	The mutual relationships between the building site and facade elements					
V3	The mutual relationships between the building site and the quality of natural daylight effectiveness					
V4	The impact of building elements on direct solar loads					
V5	The impact of site planning on the design process					
V6	Design of the external envelope and facade details (external appearance)					
V7	The impact of natural ventilation of the building on the design process					
V8	The effect of natural ventilation of the building on the design process					
V9	All design professionals work collaboratively to achieve common goals from day one					
Urban site		The degree of importance is from 1 to 5				
When designing a sustainable site, what do you believe is the degree of importance of encouraging increased urban development?		1	2	3	4	5
V10	Infrastructure redevelopment, refurbishment and reuse of existing vacant buildings and sites					
V11	Approval of sites that play a key role in the local or regional ecosystem (identifying and protecting greenfield sites and valuable wetlands when developed).					

V12	Increasing population density in urban areas to avoid the expansion of buildings and their impact on the environment					
V13	Evaluation of the location and orientation of buildings (optimal use of passive solar energy, natural daylight, natural breezes and ventilation)					
V14	Use of mass transportation					
V15	Urban heat island effect (light-colored roofs, paving, walkways. Provide natural shading for buildings, tree-lined areas, and other landscape features)					
V16	On-site rainwater treatment and groundwater recharge					
V17	Landscape design to preserve the natural slopes and resources of the area					
V18	Reduce light pollution at night by avoiding excessive lighting of the site					
Water Conservation		The degree of importance is from 1 to 5				
What do you think is the degree of importance of maintaining water quality?		1	2	3	4	5
V19	The least expensive, least time consuming and most environmentally preferable design					
V20	Maintaining the nature of the site that acts as a natural detention for rainwater and groundwater infiltration systems					
V21	Use low environmental impact water equipment and techniques					
V22	Implement a design that reduces potable water use					
V23	On-site rainwater and stormwater treatment and recycling techniques					
V24	Use drought-resistant native trees, shrubs, plants and grasses					
Energy and environment		The degree of importance is from 1 to 5				
What do you believe is the degree of importance of the energy and environmental impacts on the building?		1	2	3	4	5
V25	Orientation of building mass and use of external shading equipment					
V26	Optimize the building's orientation, massing, shape, design, interior colors and finishes					
V27	Using high-performance Low-E glass material					
V28	Use indirect ambient lighting with direct task lighting					
V29	Use heat recovery ventilators and geothermal heat pump technology					
V30	Improving the use of natural ventilation and the use of evaporative or heat cooling					
V31	Efficient use of energy-saving devices					
V32	Consider energy generation, (wind, solar and/or fuel cells, certified renewable and sustainable sources)					
Indoor Environmental Quality		The degree of importance is from 1 to 5				
What do you believe is the degree of importance of influences on the indoor environment to provide a healthy, comfortable and productive indoor environment?		1	2	3	4	5
V33	Use of building materials, adhesives, sealants and finishes					
V34	Improving solar orientation and building design					
V35	Providing custom engineered ventilation systems that operate independently of the buildings heating and cooling system					
V36	Design of the building envelope and environmental systems					
V37	Individual control by occupants in terms of temperature, ventilation, cooling, daylight and artificial lighting					
V38	Take steps to reduce the formation and spread of construction dust and dirt					
V39	Use cleaning agents that are biodegradable and environmentally friendly and do not release VOCs or other harmful agents and residues					
V40	Employing fresh natural air to disinfect the building naturally or mechanically					
Materials and Resources		The degree of importance is from 1 to 5				
What do you believe is the degree of importance of using materials and resources in sustainable design?		1	2	3	4	5
V41	Use construction materials that take advantage of locally standardized engineering principles					
V42	Reducing the amount of materials used and reducing the amount of waste generated from construction waste					
V43	High recycled content materials in the building structure and finishes					
V44	Use biomaterials of a sustainable nature according to the characteristics of the site					
V45	Recycled materials are easy to use with minimal pollutants					

V46	Supporting the regional economy and reducing transportation distances, energy and emissions					
Pollution		The degree of importance is from 1 to 5				
	What do you believe is the degree of importance of the impact of pollution in sustainable design?	1	2	3	4	5
V47	Use and evaluate supportive landscapes for improvement					
V48	Use guidelines regarding the use of pesticides and chemicals					
V49	Using environmental impact assessment systems in landscape assessment					
V50	Use the percentage of green space measured in residential areas					
V51	Use coating materials with healthy, breathable properties					
V52	Operating air leakage systems, sealed combustion gas appliances, bathroom and kitchen fans, and a balanced pressure ventilation system					
Societal Sustainability		The degree of importance is from 1 to 5				
What do you believe is the degree of importance of societal sustainability in sustainable design?		1	2	3	4	5
V53	The relationship between collective use spaces					
V54	Create distinctive community elements and places and a sense of place					
V55	Community services, exchange boundaries, and enhancing cooperation, relations and exchanges between regions					
V56	The concept of safety among residents and defense initiatives					
V57	Improving the quality of services for the lives of vulnerable groups such as the elderly and children					
V58	Improving initiatives to help young people					
V59	Job business and housing opportunities for young people					
Economic sustainability		The degree of importance is from 1 to 5				
What do you believe is the degree of importance of economic sustainability in sustainable design?		1	2	3	4	5
V60	Reducing Monthly Electricity Bills through Alternative Energy Sources					
V61	Utilizing low-flow water equipment and judicious use of graywater					
V62	Flexibility in construction (creating flexible, productive spaces)					
V63	Utilizing specific activities to enhance sustainable employment opportunities for the community					
V64	Touristic development of the urban context by promoting local historical heritage					
V65	Increasing attractions and improving the quality of the natural context					
V67	Supporting the local bio economic industry					
V68	Productive activities aligned with social context and natural resources					
V69	Reusing urban heritage and renewing functional and spatial treatments, connecting them to the local economic system					