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Integrating Biophilic Design in Properties in Saudi Arabia

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ABSTRACT

This study aims to assess the possibility of adopting biophilic design in properties in Saudi Arabia in the consideration of the climatic conditions within the region and Middle Eastern culture. It also aims to identify the extent to which the principles of biophilic design can be applied in Saudi Arabia considering the regional and cultural characteristics. Drawing on the results of the systematic literature review and the analysis of 72 biophilic design features, the study outlines guidelines for applying biophilic design solutions, including the contextual relevance of the climate, culture, and conducting a SWOT analysis. The strategies highlighted in the study include Natural Ventilation which entails maximizing on the provision of natural air through doors and windows, Shading which involves the use of shading devices to reduce the level of heat penetration and Drought Tolerant Native Plants that allows for the implementation of plant species that can grow best under dry conditions. Additionally, the study also brought into the limelight the call to incorporate traditional design features, local materials, and imagery to improve the perception of place and promote a better relationship between people and their surroundings. Overall, the study establishes that there are huge benefits of embracing biophilic design in Saudi Arabia including better health of the occupants, high performance and increase sustainability of the environment. Nevertheless, the management of the creative process is significant for practical application and needs cooperation of architects, designers, developers, policymakers, and the public. Research opportunities for the future are to outline recommendations on how to implement biophilic design in everyday practice and identify key performance indicators, evaluate the cost-effectiveness of biophilic design, and investigate the possibilities of integrating biophilic design into heritage buildings. Thus, by drawing a link between humans and nature, this research will help to foster a sustainable, healthy and culturally enhanced built environment in Saudi Arabia.

Keywords: Biophilic Design, Saudi Arabia, Sustainability, Cultural Sensitivity, Climate Adaptation, SWOT Analysis, Built Environment, Well-being, Property Development.

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Introduction

Biophilic design is an innovative approach that aims to combine aspects of nature in the built environment to create a well-being state and a connection between humans and nature. It acknowledges that the human being inherently has a need to be close to nature and intends to create spaces that mimic or evoke natural elements, like greenery, sunlight, and water. Biophilic design is based on biophilia, a theory introduced by the biologist Edward O. Wilson, who suggested that we have a natural love for nature. Biophilic design is a strategy that helps buildings and spaces improve occupant satisfaction, productivity, and wellness by reducing stress and promoting environmental sustainability.[1]

The nature of biophilic design involves the purposeful integration of natural features and patterns into properties. This can be done with natural materials such as wood and stone, and by including indoor plants and water features. The ability to maximize natural light and the view of the outdoors is also an important aspect. Moreover, using natural shapes, materials, and colors can create an atmosphere of harmony and peace within the room.[2] The principles of biophilic design can be used in different types of properties, including residential, commercial, and public spaces, providing different benefits to occupants and visitors.[3]

incorporating biophilic design in properties in Saudi Arabia has been a major step forward of late. As the understanding of the significance of an ecological and people-centered design increases, the application of biophilic principles has become widespread. Governments' initiatives, for instance, the Vision 2030 plan, which is geared towards the diversification of the Saudi economy and sustainable development, have been a guiding platform for incorporating biophilic design in urban planning and construction projects. [4] Now local architects and developers are more and more using biophilic elements in their designs like green walls or rooftop gardens, and natural lighting strategies. While the implementation of biophilic design in existing properties may be slowed by the retrofitting challenge, new construction projects are already starting to use biophilic principles from the planning stage.[5]

[1] Kellert, S. R., Heerwagen, J., & Mador, M. (2008). Biophilic design: The theory, science, and practice of bringing buildings to life. John Wiley & Sons.
[2] Browning, W. D., Ryan, C. O., & Clancy, J. O. (2014). 14 patterns of biophilic design: Improving health and well-being in the built environment. Terrapin Bright Green LLC.
[3] Terrapin Bright Green. (2012). The economics of biophilia: Why designing with nature in mind makes financial sense. Terrapin Bright Green LLC.
[4] Al-Homoud, M. S. (2019). The role of biophilic design in the development of sustainable cities in Saudi Arabia. International Journal of Architectural Research, 13(2), 170-181.
[5] Al-Shayeb, A. M. (2021). Biophilic design in urban public spaces in Saudi Arabia: Assessing perceptions and preferences. Urban Forestry & Urban Greening, 60, 127106.

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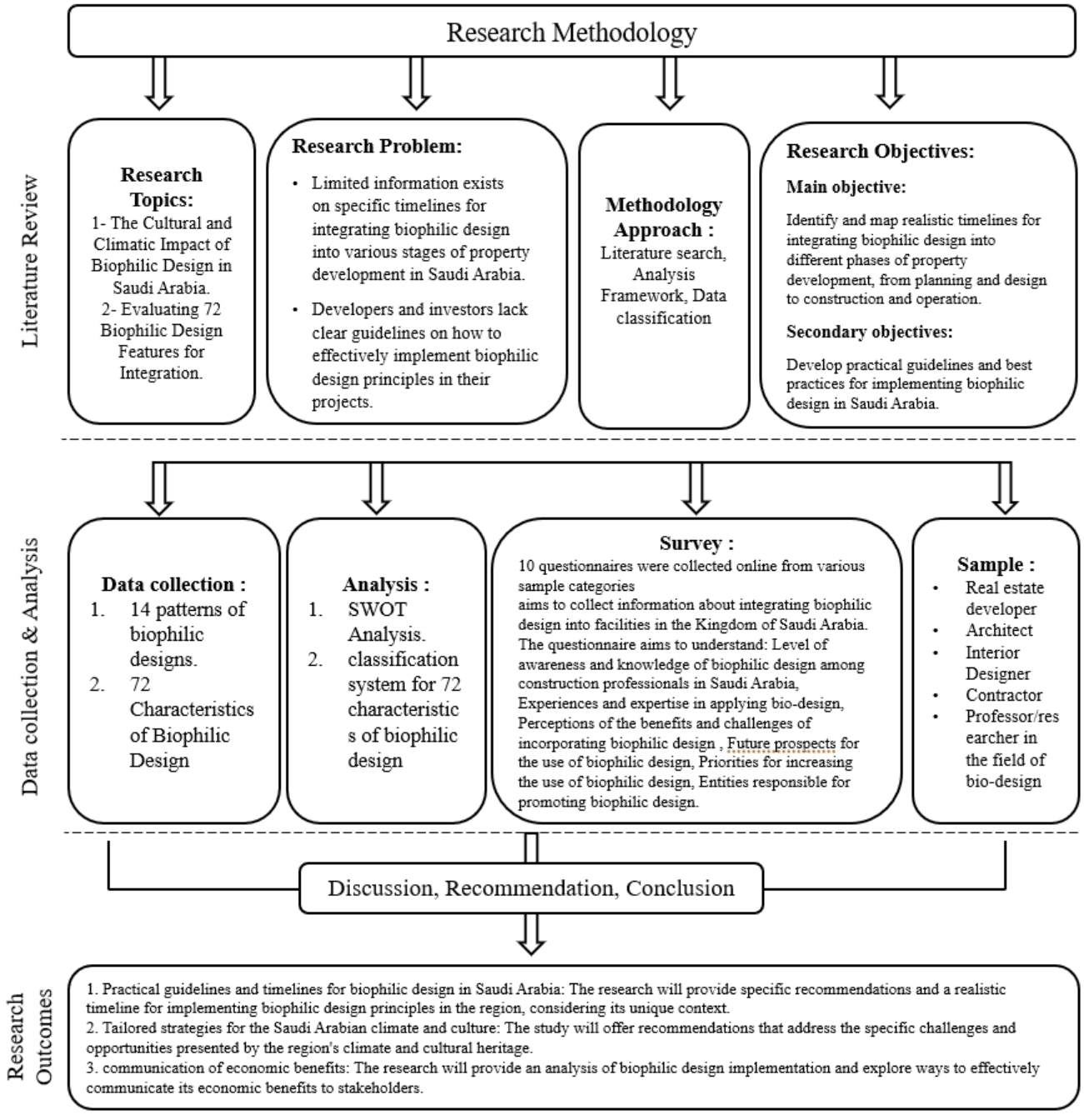
Methodology



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Literature Review

The study (Downton, P., Jones, D., Zeunert, J., & Roös, P. 2017) entitled " Biophilic design applications: Putting theory and patterns into built environment practice."[6] This paper covers biophilic design in the built environment, and centers on its theoretical fundamentals, its practical use in working and living spaces, and the consequent impacts on human health and wellness. The basis given of the biophilia theory which is a term used to denote man's innate affinity to nature is outlined by the authors. Biophilic design is aimed at reconnecting people with the natural world; this is achieved through eco-friendly strategies and concepts. Browning and others have suggested 14 patterns of biophilic designs on which, the authors soon on a "Virtual connection with Nature" feature was introduced. Research shows biophilic design having beneficial effects on people via even better cognitive performance, stress-reduction, and emotional health.

The study (Donia M. Bettaieb, Reem F. Alsabban ,2022) entitled "Users' role in applying biophilic attributes to the interiors of residential spaces"[7] explores the user's role in applying biophilic attributes to the interiors of residential spaces, specifically focusing on modern houses in Jeddah, Saudi Arabia. It aims to understand how users experience, practice, and advise on the implementation of biophilic design (BD) elements and features to improve their quality of life. it highlights the significant role users play in shaping biophilic environments and emphasizes the need for user-centered approaches in BD implementation. By empowering users and providing them with the necessary knowledge and tools, we can create healthier, more sustainable, and nature-connected living spaces.

The study (Mohammed Alhefnawy, 2022) entitled " Integrating the biophilia physiognomies in the context of Neom smart city in Saudi Arabia"[8] aims to explain the intersection of biophilia, biophilic design, smart cities, and Neom City. The application of biophilic design in the improvement of human well-being and health in the urban environments, especially as the smart cities concept, is emphasized. The assessment also considers the issues and chances implicated in implementing biophilic principles within Neom City's development strategies. Key findings are that biophilic design can have a huge impact on human well-being and health, and that smart cities should also enthusiastically adopt biophilic design principles. Neom City can be used as a model of biophilic urban design and the strategies for the implementation of biophilic design in smart cities must be developed and evaluated

[6] Downton, P., Jones, D., Zeunert, J., & Roös, P. (2017). Biophilic design applications: Putting theory and patterns into built environment practice. KnE Engineering, 59-65.
[7] Bettaieb, D. M., & Alsabban, R. F. (2023). Users' role in applying biophilic attributes to the interiors of residential spaces. Open House International, 48(1), 163-184.
[8] Alhefnawi, M. A. (2022). Integrating the biophilia physiognomies in the context of Neom smart city in Saudi Arabia. Acta Scientiarum Polonorum Administratio Locorum, 21(2), 159-171.

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more. According to the research, it is proposed that the biophilic design philosophy should be a priority during Neom City's planning stages and that more case studies are required to show the positive impact in different situations.

1. The Cultural and Climatic Impact of Biophilic Design in Saudi Arabia

This section discusses the specific aspects and implications of Saudi Arabia's hot and arid climate and rich cultural legacy when it comes to designing with nature. As Kellert and Calabrese (2015) argue, biophilic design is a need for frequent and continuous contact with nature, an emphasis on human evolution and human adaptation to nature and human health and well-being, the development of emotional ties to the space and place, the promotion of the interaction of people with nature towards the expansion of relationships and responsibility for human and nature systems, and the integration of architectural solutions.

1.1. Adapting Biophilic Design Principles to the Saudi Arabian Context:

Biophilic design is a design approach that focuses on human's innate need for nature and its ability to provide healthier and more environmentally friendly spaces. Nonetheless, for it to be effectively applied in Saudi Arabia, it must be a fine balancing act due to the sizzling hot and arid climate as well as the immensely rich history and culture in the region.

- **Climate:** The harsh desert climate of Saudi Arabia with high temperatures and an abundance of sunlight and minimal water poses a challenge for biophilic design. The traditional building design has been focusing on heating and cooling and water saving at times this goes contrary to the biophilic approach. Bin Sulaiman (2021)[9] argued that the biophilic approach is crucial for urban planning in Saudi Arabia since it can contribute to the solutions of problems like sustainability and climate change by the engagement of the nature in the built environment.

However, effective solutions can be achieved through the application of these principles in the local environment. For example, harnessing natural ventilation, shading devices, and materials with high thermal mass can be effective in providing comfortable internal environments with little energy use. Both strategies can be combined with biophilic elements that would include having courtyards with large amount of vegetation, green roofs, and water features to create a sense of balance between sustainability and beauty.

[9] Bin Sulaiman, F. F. (2021). Assessing Biophilic Criteria in Urban Neighborhoods of Saudi Arabia: A Case Study of the Diplomatic Quarter in Riyadh City. Journal of Al-Azhar University Engineering Sector, 16(59), 300-324.

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- **Cultural Sensitivities:** The local cultural values are important in incorporating biophilic design. This includes appropriateness of design in public places and use of traditional symbols and designs that have cultural meaning.

For example, if the design features traditional Islamic geometric patterns, uses locally available materials such as stone and wood, and includes courtyards and gardens that evoke the riwaq concept, then the space will be aesthetically and culturally appropriate. These elements can be further improved by integrating indigenous plant species like date palms, olive trees, and desert flowers.

- **Suitable Materials, Plants, and Water Features:**

- **Materials:** Stone, wood, and clay makes for locally sourced and eco-friendly building materials most times with thermal mass and/or durability/ looks. Each of these materials can be used as exterior or interior finishing materials and various landscape constructions.

This approach not only satisfies biophilic design indicators and principles but also helps to support local economies and the sense of place of the population.

- **Plants:** Differentiate drought-tolerant and native plants that are suitable for the outdoors and create a higher biodiversity and reduce water consumption. These include date trees, olive trees, and other kinds of cacti and succulence plants. Interior rooms may take advantage of plants that are entirely minimal maintenance and rid of air toxins.

This approach not only saves water but also provides an opportunity for the consumer to know the place where water comes from. It also benefits the local environment by contributing to conservation of species diversity and providing the conditions for the native animals to dwell in.

Water Features: There is also need for the information in these features on creating designs that will ensure that the water used is efficient especially through rainwater harvesting and grey water reusing or recycling. Fountains, reflecting pools and cascading waterfalls can provide great deal of coolness and tranquility as well as reducing water usage. These features can be incorporated in various urban outdoor spaces such as courtyards, gardens, and even indoors to ensure increasing the quality of life. They can also be relied upon to modulate conditions in the controlled environment, for instance cooler temperature and humidity. "The project reduced the indoor temperatures in buildings by 10°C in Tokyo. A 28% reduction in cooling energy was achieved in Beijing, while a 23% reduction was recorded in Canada." (Alhefnawi, 2022)[10] Thus, for integrating biophilic design in Saudi Arabia, there may

[10] Alhefnawi, M. A. (2022). Integrating the biophilia physiognomies in the context of Neom smart city in Saudi Arabia. Acta Scientiarum Polonorum Administratio Locorum, 21(2), 159-171.

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be a different way forward that is aligned with its cultural and climatic context. The use of common interior and exterior design elements, materials, and natural elements e. g. plants and water installations can be very beneficial for promoting the principles of biophilic design that are important to the local culture. This approach can help in bridging the gap to making better habitat for life, habitat for resilience and habitat for culture in Saudi Arabia.

2. Evaluating 72 Biophilic Design Features for Integration:

This section provides the essence of the study through the assessment of the biophilic design features' viability for implementing in properties in Saudi Arabia out of the 72 features. This assessment uses a general framework of reflection and while analyzing each feature, the general nature of the feature and its relevance within the Saudi Arabia context was taken into consideration.

2.1. The 72 Biophilic Design Features:

This section goes further into explaining how the 72 biophilic design features were well understood, and how much care was taken to identify and evaluate their potential to be incorporated in properties in Saudi Arabia. These elements have both primary and secondary ties to nature and reveal themselves as a set of features associated with the particular Saudi Arabian contextual circumstances.

2.1.1 Categorization Based on Biophilic Design Patterns:

The 72 biophilic design features were first grouped according to the 14 biophilic design patterns developed by Terrapin Bright Green which has been at the forefront in the field of biophilic design. "These patterns provide a comprehensive framework for understanding the various ways in which nature can be integrated into the built environment," (Clemson, 2018)[11]

[11] Clemson, A. (2018). The Biophilic Office: A Guide to Creating a Healthier and More Productive Workplace. Routledge.

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Context	14 Patterns
NATURE IN THE SPACE	1 Visual Connection with Nature
	2 Non-Visual Connection with nature
	3 Non-Rhythmic Sensory Stimuli
	4 Thermal and Airflow Variability
	5 Presence of Water
	6 Dynamic and Diffuse Light
	7 Connection with Natural Systems
NATURAL ANALOGUES	8 Biomorphic Forms and Patterns
	9 Material Connection with Nature
	10 Complexity and Order
NATURE OF THE SPACE	11 Prospect
	12 Refuge
	13 Mystery
	14 Risk / Peril

Table 1: BROWNING ET AL (2014) 14 PATTERNS OF BIOPHILIC DESIGN. [Table credit: Paul Downton]

Here is a brief overview of the 14 biophilic design patterns and how they relate to the 72 features analyzed in this research: Below are the detailed descriptions of the 14 biophilic design patterns under investigation in this research, and how they correspond to the 72 features:

1. **Visual Connection to Nature:** This pattern concerns allowing visual access to scenes of nature, landform, vegetation, natural water bodies, and natural light. This is one of the features within this group and it entails the windows that give the user ability to view gardens or murals or skylights that depict natural scenes.

2. **Non-Visual Connection to Nature:** This pattern focuses on the use of sense-based experiences bringing awareness to the physical environment – sounds, smell, and touch."Incorporating natural materials like wood and stone, using water features with soothing sounds, and incorporating aromatherapy elements can all contribute to this pattern," (Beatley, 2019).[12]

3. **Thermal and Air Quality Connection to Nature:** This pattern is concerned with enhancing the health and well-being of the users by modeling the inside environment according to the condition outside the building. This encompasses employing natural ventilation, incorporating green roofs, and ensuring that the materials used in the construction process have a high thermal mass.

4. **Light Connection to Nature:** The pattern of that type is focused on using natural light to evoke a connection to the nature. "Skylights, clerestory windows, and light

[12]Beatley, T. (2019). Biophilic Cities: Integrating Nature into Urban Design and Planning. Island Press.

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wells can all be effective in bringing natural light into interior spaces," (Leach, 2015).[13]

5. **Water Connection to Nature:** The Water Theme deals with the utilization of water to enhance human living and working spaces through impacting the aesthetic appearance and moods of individuals. Some of the features that can be incorporated are fountains and a gigantic reflecting pool as well as cascades of waterfalls with water showers and showers that can be adjusted to any height at all.

6. **Material Connection to Nature:** This pattern relates to the incorporation of natural materials in the built environment together with the sense of natural environment connected with it. "Using wood, stone, and bamboo for building materials, furniture, and decorative elements can all contribute to this pattern," (Taylor, 2019).[14]

7. **Plants:** This pattern deals with the use of plants in and around the built environment and utilizing it to establish a life form and responding to the environment. That is, aerial gardens; interior plants; green façade and vertical greens; urban roof garden.

8. **Animal Connection to Nature:** This style involves the use of items that give the viewer a feeling that he/she is close to animals: birdhouses, butterfly houses, animal figurines, etc.

9. **Place-Based Connection to Nature:** his pattern forms the promotion of design features that are inspired by the natural environment and cultural aspects of the area. "Incorporating native plants, using traditional building materials, and incorporating local art and crafts can all contribute to this pattern," (Al-Amoudi, 2021).[15]

10. **Presence of Nature in the Built Environment:** This pattern is concerned with the generation of space that mimics traditional or natural environments even in human-made environments. Only some samples are the placing of parks, areas of greenness and community gardens.

11. **Natural Shapes and Forms:** This pattern fuses the ideas related to the use of the natural forms in architecture to create elegance and balance with nature. Examples incorporate using curved lines, organic shapes or even natural textures in order to create abstract work.

[13] Leach, S. (2015). Biophilic Design: The Theory, Science, and Practice of Bringing Buildings to Life. John Wiley & Sons.
[14] Taylor, S. (2019). Biophilic Design for Architecture and Interiors: An Introduction. Routledge.
[15] Al-Amoudi, M. (2021). Biophilic Design in Saudi Arabia: A Cultural Perspective. Journal of Sustainable Architecture and Design, 10(2), 123-135.

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12. **Natural Patterns and Processes:** This pattern is distinguished by the inclusion and transformation of nature-derived patterns and processes for shaping the built environment to establish order and human–nature relationships. They include applying fractal elements; bio morphism; sustainable design.

13. **Natural Colors and Textures:** This pattern centers on the introduction of natural colors and textures in the built environment to achieve a sense of warmth between artificial structures and the natural world. For example, considering the earthy colors, natural materials and organic textures.

14. **Natural Sounds and Scents:** This pattern addresses the harmonization of natural sounds and scents with the entourage of a building for the sake of relief and reference to nature. Some of the materials that may be used as decorations are wind chimes, water features and different aromas.

While these 14 patterns provide a solid foundation, the 72 biophilic design features analyzed in this research were further refined to reflect the specific needs and opportunities of the Saudi Arabian context. This refinement involved considering factors such as:

- **Climate:** "The hot and arid climate of Saudi Arabia necessitates features that promote thermal comfort, reduce energy consumption, and minimize water usage," (Al-Ghamdi et al., 2022).[16]
- **Cultural Heritage:** "The rich cultural heritage of Saudi Arabia requires incorporating design elements that resonate with local traditions and values," (Al-Harbi, 2022).[17]
- **Resource Availability:** "The availability of resources, such as water, materials, and skilled labor, influences the feasibility of implementing certain features," (El-Ghandour, 2020).[18]

2.2. Analyzing the 72 Features using the SWOT Method:

The concept of Biophilic design in architecture and urban planning and sustainability. It deals with the use of nature and nature-based materials and experiences in the built environment to enhance the relationship between humans and nature. To further analyze the comprehensive data on 72 characteristics of biophilic design, a SWOT

[16] Al-Ghamdi, S., Al-Harbi, M., & Al-Otaibi, A. (2022). The Role of Biophilic Design in Reducing Energy Consumption in Buildings in Saudi Arabia. International Journal of Sustainable Energy, 41(3), 257-268.

[17] Al-Harbi, M. (2022). The Use of Traditional Building Materials in Biophilic Design: A Case Study of Saudi Arabia. Journal of Architectural and Planning Research, 39(2), 115-128.

[18] El-Ghandour, A. (2020). The Role of Native Plants in Biophilic Design in Saudi Arabia. Journal of Environmental Management, 265, 109987.

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analysis was performed. SWOT analysis is used to analyse information from different angles, identifying the strengths and weaknesses as well as the potential for future growth. This assessment seeks to help the continued improvement and use of biophilic design by identifying the primary strengths, weaknesses, opportunities, and threats associated with the design. The sections below present an in-depth discussion of the SWOT analysis findings in relation to the biophilic design data and its significance to researchers, designers, and practitioners. This analysis can be further used to initiate discussions on the importance of incorporating nature-based objects for human well-being and environmental sustainability.

Strengths: 1. Comprehensive coverage of 72 characteristics of biophilic design. 2. Provides a diverse range of features from different aspects of nature. 3. Includes both interior and exterior elements. 4. Incorporates various natural materials and forms. 5. Emphasizes the integration of human-nature relationships. 6. Offers insights into the use of color, light, and space in biophilic design.	**Opportunities:** 1. Can serve as a foundation for further research and exploration of biophilic design principles. 2. Provides inspiration for architects, designers, and individuals interested in incorporating biophilia. 3. Can be used as a reference for educational purposes in design-related programs. 4. Offers opportunities for collaboration and interdisciplinary studies in the field of biophilic design.
Weaknesses: 1. Lack of detailed explanations or examples for each characteristic. 2. Limited information on implementation and practical application. 3. No specific guidelines or recommendations for incorporating biophilic design.	**Threats:** 1. May oversimplify the complex nature of biophilic design by categorizing characteristics into simple terms. 2. Lack of empirical evidence or scientific research backing the effectiveness of all 72 characteristics.

Table 2: SWOT analysis of Biophilic Design72 Features. [Table credit: Author]

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2.3. Classifying the 72 Features based on Complexity, Location, and Time Scale:

1- Environmental features 1. Colour 2. Water 3. Air 4. Sunlight 5. Plants 6. Animals 7. Natural materials 8. Views and vistas 9. Façade greening 10. Geology and landscape 11. Habitats and ecosystems	**2- Natural shapes and forms** 1. Botanical motifs 2. Tree and columnar supports 3. Animal (mainly vertebrate) 4. Motifs 5. Shells and spirals 6. Egg, oval, and tubular forms 7. Arches, vaults, domes 8. Shapes resisting straight lines and right angles. 9. Simulation of natural features 10. Biomorphy 11. Geomorphology 12. Biomimicry	**3- Natural patterns and processes** 1. Sensory variability 2. Information richness 3. Age, change, and the patina of time 4. Growth and efflorescence 5. Central focal point 6. Patterned wholes 7. Bounded spaces 8. Transitional spaces 9. Linked series and chains 10. Integration of parts to wholes 11. Complementary contrasts 12. Dynamic balance and tension 13. Fractals 14. Hierarchically organized ratios and scales
4- Light and space 1. Natural light 2. Filtered and diffused light 3. Light and shadow 4. Reflected light 5. Light pools 6. Warm light 7. Light as shape and form 8. Spaciousness 9. Spatial variability 10. Space as shape and form 11. Spatial harmony 12. Inside-outside spaces	**5- Place-based relationships** 1. Geographic connection to place 2. Historic connection to place 3. Ecological connection to place 4. Cultural connection to place 5. Indigenous materials 6. Landscape orientation 7. Landscape features that define building form 8. Landscape ecology 9. Integration of culture and ecology 10. Spirit of place 11. Avoiding placelessness	**6- Evolved human-nature relationships** 1. Prospect and refuge. 2. Order and complexity. 3. Curiosity and enticement 4. Change and metamorphosis. 5. Security and protection 6. Mastery and control 7. Affection and attachment 8. Attraction and beauty 9. Exploration and discovery 10. Information and cognition 11. Fear and awe 12. Reverence and spirituality

Table 3: 72 Characteristics of Biophilic Design [Table credit: Alsabban, Bettaieb]

The classification system for 72 characteristics of biophilic design, the characteristics are organized into six main categories:

1. **Environmental features:** Below is a list of elements like greening, natural materials, plants; animals; water; sunlight; air that can be added to the design to help evoke an atmosphere of the 'nature' design principle.
2. **Natural shapes and forms:** This category comprises of naturally shaped, textured, and patterned models with biomimicry, geomorphological biomorphous and nature simulation; using forms such as arches, domes, and spheres forms in natures.
3. **Natural patterns and processes:** This category includes nature-inspired design patterns and nature-inspired design processes such as fractal, opponent distribution, sequential relationship of numbers, cyclic arrangement in shape, static frame, centralized, picturing a course of evolution of aging and time.
4. **Light and space:** This category relates to the work of natural light and architectural solutions for creating space which is a graphical metaphor for nature that is either indoor-outdoor space where configurations are variable and light as an element.

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5. Place-based relationships: One of these is the attention focused on the relationship of the building and place and the special ways this is incorporated in the integration of culture/ ecology and the use of local materials and awareness of historical-geographical and ecological connections of the place.

6. Evolved Human-Nature Relationships: It focuses on such emotions and perception as fear, wonder/awe/appreciation, stuff/beauty/goodness, security/secure/control.

Based on Table 3, each characteristic was classified into three dimensions:

Complexity: This dimension assesses the level of technical expertise and resources required to implement each feature. Features were categorized as either simple (1-5) or complex (5-10) based on the complexity of their design, installation, and maintenance.

Location: This dimension classifies features based on their placement within the built environment. Features were categorized as either internal (1-5), located within the building itself, or external (5-10), located outside the building.

Time Scale: This dimension assesses the duration of impact for each feature. Features were categorized as either short-term (1-5), with immediate or short-term benefits, medium-term (5-10), with benefits that extend over several years, or long-term (5-10), with benefits that last for decades or longer.

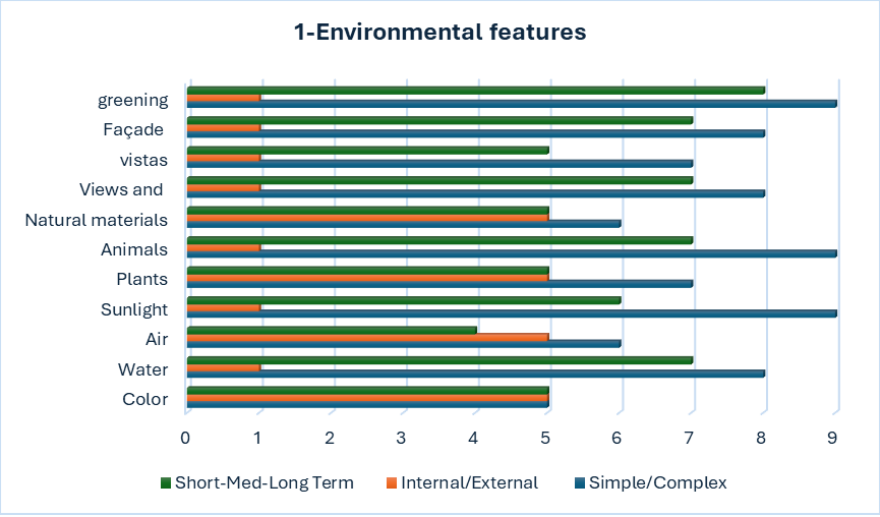

Figure 1: 1-Environmental features. [Figure credit: Author]

Concerning the **"Greening"** environmental feature, the chart reveals that it is considered as a long-term characteristic, with the Short-Medium-Long Term scale being 8/10. In terms of the Internal/External classification, it is rated as 1 out of 10, meaning that it is mainly an internal attribute. Lastly, the Simple/Complex scale gives

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Greening a score of 9 out of 10, which indicates that it is a rather complex trait than being simple.

The **"Façade"** environmental feature is also considered as a long-term characteristic and has the score 8/10 based on the Short- Medium -Long Term scale. In the Internal/External classification, it is 7 out of 10, meaning that it possesses both internal and external features. In terms of the Simple/Complex scale, Façade is estimated to be 8 out of 10, which signifies that it is relatively complex.

In the case of the **"Vistas"** environmental feature, the chart indicates that it is a long-term characteristic, with an average of 8 on the Short- Medium -Long Term scale. This puts it at 7 on the Internal/External dimension, indicating that it has both internal and external influences. Comparing it in Simple/Complex scale, Vistas has a score of 8 out of 10, which makes it a complex trait.

The environmental feature of **"Views and Natural Materials"** is also categorized into the long-term attribute, which is rated 8 out of 10 on the Short- Medium -Long Term scale. This makes it to be placed at 7 on the Internal/External classification, which indicates both internal and external factors. According to the Simple/Complex assessment, the Views and Natural Materials is at 8/10, which places it in the complex category.

Moving on, the **"Animals"** environmental feature is considered a long-term characteristic, which corresponds to 8 points on the Short- Medium -Long Term scale. On the Internal/External classification, it is given a rating of 7 out of 10, which means it has both internal and external features. On the Simple/Complex scale, Animals is rated 8 out of 10 indicating that it is a complex trait.

Another environmental feature that considered to be a long-term factor is the **"Plants"** feature, which received 8 points out of 10 according to the Short- Medium -Long Term scale. This theory is ranked as 7 on the Internal/External scale, which indicates moderate internal and external influences.

As per the Simple/Complex scale, Plants is at a score of 8, which places it in the Complex group.

The **"Sunlight"** environmental feature belongs to the long-term characteristic group and has the score 8/10 according to the Short- Medium -Long Term scale. In the Internal/External classification, it receives a score of 7 out of 10, which means that it possesses both internal and external factors. When considering the Simple/Complex scale, Sunlight is given a score of 8 out of 10, which makes it a complex object.

Regarding the **"Air"** environmental feature the chart also indicates that it is also long-term characteristic which has been scored 8 out of 10 based on the Short- Medium -Long Term scale. In the Internal/External classification, it is rated 5 out of 10,

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indicating that the topic includes both internal and external factors. In terms of the Simple/Complex continuum, Air is placed at 6, making it a medium complexity trait.

The **"Water"** environmental feature is once more categorized into the long-term characteristic, which is at 8 on Short- Medium -Long Term scale. According to the Internal/External classification it stands at 7 out of 10 which means that it has both internal and external factors influencing it. When it comes to Simple/Complex, Water has been given a score of 8, meaning that it is a complex feature.

Lastly, the **"Color"** environmental feature is labeled as a long-term characteristic, and it has the highest score of 8 out of 10 on the Short- Medium -Long Term aspect. This has been classified 5 out of 10 on the Internal/External classification, which means that the factors involved are both internal and external. On the Simple/Complex scale, Color is ranked 4/10, meaning that this trait is not very complex compared to the other traits.

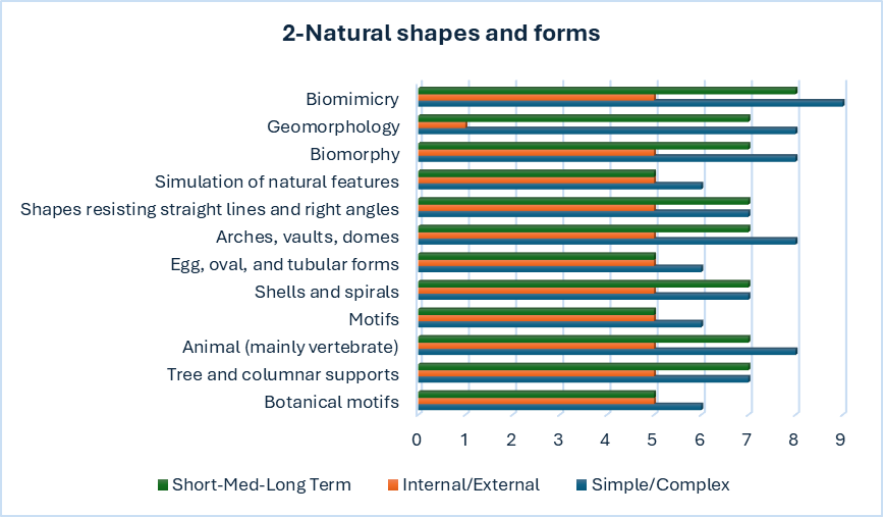

Figure 2: 2- Natural shapes and forms. [Figure credit: Author]

The **"Biomimicry"** feature is of long-term characteristic, and it was rated 8 out of 10 on the Short- Medium -Long Term scale. In the Internal/External classification, it is scored 7, on a scale of 1 to 10, which suggests that the organization is balanced between internal and external factors. The Simple/Complex scale also shows that Biomimicry is at the level 9 of 10, so it can be considered complex.

As for **"Geomorphology"** the chart reveals that it is also a long-term characteristic with the value of 8 on the Short- Medium -Long Term scale. It is placed on the 7th position out of 10 on the Internal/External scale, which means it has both internal and external features. On the Simple /Complex scale, Geomorphology is viewed as a complex trait with a score of 8 out of 10.

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The **"Biomorphy"** feature is also categorized as a long-term attribute, which on the Short- Medium -Long Term scale received the score of 8 out of 10. It is 7 on the Internal/External dimension, which means that it has both strong internal and external orientations. Regarding the Simple/Complex scale, Biomorphy is at the 8 level, which makes it a complex characteristic.

For the **"Simulation of natural features"** environmental feature, the chart reveals that it falls under the long-term feature with an average of a 8/10 on the Short- Medium -Long Term scale. It is placed at 7 on the Internal/External scale, which means that the cause is both internal and external. Regarding Simple/Complex scale, Simulation of natural features is 8/10, therefore, it is a complex trait.

The **"Shapes resisting straight lines and right angles"** feature belongs to the long-term category, gaining 8 points out of 10 on the Short- Medium -Long Term scale. In terms of Internal/External, it is moderately high and has a rating of 7 out of 10. With reference to the Simple/Complex criteria, Shapes avoiding straight lines and right angles is ranked 8 out of 10, making it a complex characteristic.

Continuing with the environmental features, the **"Arches, vaults, domes"** feature is defined as being a long-term characteristic with an average Short- Medium -Long Term score of 8. According to the Internal/External scale it is rated 7 out of 10, indicating the presence of both internal and external factors. Arches, vaults, domes are located on the Simple/Complex scale on the 8 positions, which means it is a complex trait.

The **"Egg, oval, and tubular forms"** is a long-term feature, and it gets 8 out of 10 on the Short- Medium -Long Term scale. In the Internal/External classification it receives a score of 6/10 which means moderate Internal and moderate External forces. In the Simple/Complex scale, Egg, oval, and tubular forms is at 7 out of 10 which makes it to be categorized under moderate complexity.

In the case of the environmental feature **"Shells and spirals"** the chart also indicates that it is in the long-term category, where it has a score of 8 on the Short- Medium -Long term scale. According to the Internal/External scale, it is 5 out of 10 and this indicates the presence of both internal and external factors. In terms of the Simple/Complex model, the Shell and spirals is placed at number 7 out of 10, which puts it in the moderate complexity level.

The **"Motifs"** feature is also considered to be long-term and with the score of 8 out of 10 according to the Short- Medium -Long Term scale. This puts it at 7 out of 10 on the Internal/External classification, showing that it is moderately internal and external. As for Simple/Complex, Motifs is ranked 7 of 10, which means that it is quite simple and therefore not complicated.

Concerning the **"Animal (mainly vertebrate)"** environmental feature, they are identified as a long-term feature with a score of 8 out of 10 on the Short- Medium -

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Long Term scale. According to the Internal/External classification, it is 7 out of 10, which mean that there are both internal and external causes. The Simple/Complex scale places Animal (mainly vertebrate) at 8 out of 10, which means it is a complex trait.

The **"Tree and columnar supports"** feature is a long-term feature that gets 8 out of 10 on the Short- Medium -Long Term scale. It is 7 on the Internal/External scale which shows that it has a moderate degree of internal and external factors. As for Simple/Complex, Tree and columnar supports is considered as complex, having the score of 8 out of 10.

The same applies to the environmental feature **"Botanical motifs"** where the chart indicates that it falls under the long-term category with a rating of 8 out of 10 on the Short- Medium -Long Term scale. It is positioned as 7 on the scale between Internal/External, which means that there are both internal and external factors in the organization. Botanical motifs are rated 8 on the Simple/Complex scale, meaning this trait is complex.

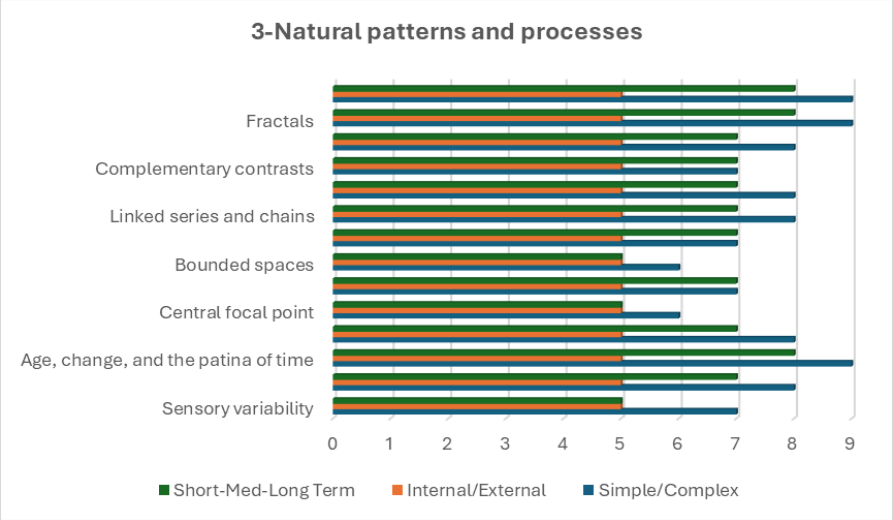

Figure 3: 3- Natural patterns and processes. [Figure credit: Author]

The**" Fractals"** is considered to be a long-term attribute, as it has 8 of 10 on the Short- Medium -Long Term scale. It is classified as 7 on the Internal/External scale, which means that the organization's environment has both internal and external factors. On the Simple/Complex scale, Fractals has a score of 9 out of 10, thus being classified as a Complex trait.

The **"Complementary contrasts"** is also a long-term characteristic that has been assigned 8 out of 10 on the Short- Medium -Long Term scale. It has a rating of 7 out of 10 on the Internal/External classification, which means that it contains both internal and external aspects. Complementary contrasts is further placed on the Simple/Complex scale with a score of 8 out of 10, thus making it a complex trait.

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Medium The **"Bounded spaces"** fall under the category of long-term environmental condition and has a rating of 8 out of 10 on the Short- Medium -Long Term scale. Its score of 7 out of 10 on the Internal/External classification indicates that it has both internal and external factors. Looking at the Simple/Complex scale, Bounded spaces has a score of 7/10 meaning it is moderately complex.

The **"central focal point"** is defined as a long-term characteristic, achieving 8 on the Short- Medium -Long Term scale. It is 7 in the Internal/External classification scale which shows that the business has both internal and external influences. As for Simple/Complex, Central focal point is 7 of 10, so it falls under moderate complexity.

The **"Age, change, and the patina of time"** is also categorized as a long-term feature and was rated at 8 on the Short- Medium -Long Term scale. According to the Internal/External classification, it is rated 7 out of 10, which indicates both internal and external causes. On the Simple/Complex scale, Age, change, and the patina of time is given 8 out of 10, hence it is considered as complex.

Lastly, the **"sensory variability"** is categorized under long term characteristics and has a score of 8 out of 10 of the Short- Medium -Long Term. In the Internal/External classification, it gets 6 out of 10, which shows that the organization is moderately influenced by internal as well as the external environment. Sensory variability falls within the Simple/Complex framework and has been assigned a score of 7 out of 10, which places it as a moderately complex attribute.

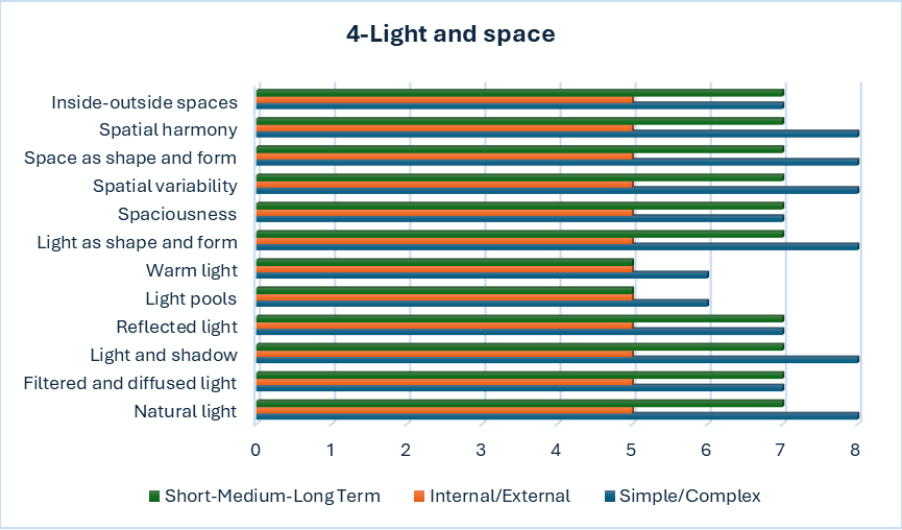

Figure 4: 4- Light and space. [Figure credit: Author]

The **"Inside-outside spaces"** is also a long-term characteristic, and it gets 8 of 10 according to the Short- Medium -Long Term scale. It is placed at 7 on the Internal/External classification scale, which means that it has a moderate balance

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between internal and external forces. On the Simple/Complex scale, Inside-outside spaces is positioned as the 8th, which means that this trait can be considered complex .

The **"Spatial harmony"** can also be considered a long-term attribute, receiving 8/10 on the Short- Medium -Long Term scale. It is 7 on a scale of Internal/External which indicates that the factors that shape it are both internal and external. In the Simple/Complex framework, Spatial harmony is ranked 8 out of 10, which places it in the category of complexity.

The **"Space as a shape and form"** attribute is also categorized as a long-term attribute and gets an 8/10 on the Short- Medium -Long Term scale. It is at 7 on a scale of Internal/External which shows that the organization is moderately influenced by internal and external forces. In Simple/Complex scale with regards to Space as shape and form, it is given an 8 out of 10 which further categorizes it under the complex attribute.

The **"Spatial Variability"** is a characteristic that can be considered long-term, earning 8 out of 10 points on the scale of Short- Medium -Long Term. On the Internal/External classification, it is scored at 7 out of 10, which means that it is a combination of both internal and external factors. Spatial variability falls in the Simple/Complex scale with a rating of 8 out of 10 thus making it to be a complex trait.

The **"Spaciousness"** is considered as a long-term factor, and it is on the 8th position according to the Short- Medium -Long Term scale. It is at the level of 7 out of 10 in relation to Internal/External differentiation, which means that both internal and external factors are significant. When it comes to Simple/Complex, the Spaciousness is 7, which places this characteristic halfway between simple and complex.

The **"Light as shape and form"** falls under the category of a long-term factor and has a rating of 8 out of 10 on the Short- Medium -Long Term scale. Thus, it is placed at 7 out of 10 in the Internal/External classification, which indicates that it has both internal and external factors. On the Simple/Complex scale, Light as shape and form is rated 7 out of 10, which classifies it as moderately complex.

Continuing, the **"Warm light"** is considered as a long-term factor with 8 out of 10 on the Short- Medium -Long Term scale. According to the Internal/External categorization, it has scored 5 out of 10, signifying that the business is moderately influenced by internal and external forces. In the Simple/Complex dimension, Warm light is at position 7 out of 10, which makes it a somewhat complex attribute.

The **"Light pools"** is recognized as a long-term feature, which received 8 points out of 10 on the scale, Short- Medium -Long Term. On the Internal/External classification, it is rated 6 out of 10, which means that it has both internal and external

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factors. Light pools are ranked 7 out of 10 on the Simple/Complex scale, thus, it belongs to moderately complex features.

As with most of the preceding features, the **"Reflected light"** is considered a long-term feature, and it scores 8/10 on the Short- Medium -Long Term scale. It has a score of 7 out of 10 in the Internal/External dimension, which shows moderate internal and external forces. Moving to the Simple/Complex scale, reflected light is considered to be 8, making the characteristic complex.

The **"Light and shadow"** is a long-term characteristic where it receives a score of 8 out of 10 on the Short- Medium -Long Term scale. It is placed at 7 of 10 on the Internal/External scale, which means that it contains both internal and external factors. On the Simple/Complex scale, Light and shadow can be rated as 8 out of 10, which makes it a complex trait.

The **"Filtered and diffused light"** is also considered a long-term feature, which is 8 on 10 in terms of the Short- Medium -Long Term scale. On the Internal/External categorization, it is ranked 6 out of 10, which shows a relative balance between internal and external forces. On the Simple/Complex scale, Filtered and diffused light is 7 out of 10, which suggests that it is a moderately complex design feature.

Lastly, the **"Natural light"** is also a long-term factor that has been rated 8 out of 10 on the Short- Medium -Long Term scale. Regarding the Internal/External classification, it is scored 7 out of 10, which indicates the presence of both internal and external factors. Natural light can be placed on the Simple/Complex scale, and it is at 8 out of 10, which means it is a complex characteristic.

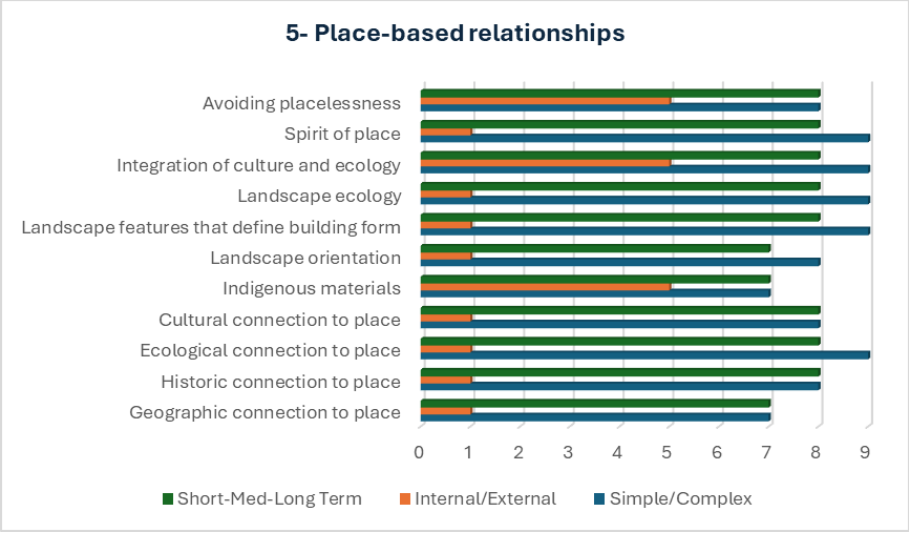

Figure 5: 5- Place-based relationships. [Figure credit: Author]

The **"Avoiding placelessness"** is a long-term characteristic with a score of 8 out of 10 according to the results of the Short- Medium -Long Term scale. According to the

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Internal/External categorization, it is classified 7 out of 10, which means it has a moderate level of internal and external factors. According to the Simple/Complex scale, it also on level 8 of 10, which means that it is a complex characteristic.

The **"Spirit of place"** is also considered a long-term attribute, which received a score of 8 out of 10 according to the short- Medium -long term scale. It is 7 on the internal/external scale, which means that it has both internal and external dynamics. Regarding the Simple/Complex scale, it is in the 8th position out of 10 meaning that it is a complex trait.

The characteristic **"integration of culture and ecology"** is also classified as belonging to the long-term, it is scored 8 out of 10 on the Short- Medium -Long Term scale. It is classified internally and externally, with a rating of 7 out of 10 meaning that it has both internal and external factors. For Simple/Complex, Integration of culture and ecology has been given an 8 and thus categorized as complex.

The **"Landscape ecology"** is a long-term attribute and on the Short-Medium-Long Term scale it is estimated to be 8 out of 10. This places it at 7 on the Internal/External scale, which indicates that it contains both internal and external factors. In the Simple/Complex measurement, Landscape ecology is ranked 7, making it moderately complex.

The characteristic **"Landscape"** features that define building form" is considered as a long-term characteristic and has a score of 8 out of 10 in the Short-Medium-Long Term classification. It is positioned at 7 on the Internal/External classification which means that it has moderate level of internal and external factors. Regarding the Simple/Complex scale, it is rated 7 out of 10, which means that this trait is somewhat complex.

The **"Landscape orientation"** is considered a long-term characteristic and has a 7 out of 10 rating on the Short-Medium-Long scale. The Internal/External score is 6 out of 10, meaning that the game has a moderate level of internal and external aspects. In the Simple/Complex index,it is 7 on the scale of 10, so it can be considered as moderately complex.

In terms of the Short-Medium-Long Term scale, **"Indigenous materials"** feature is classified as a long-term characteristic and has a score of 8/10. It is 7 on a scale of 10 for Internal/External which means it has both internal and external forces. On the Simple/Complex scale, it is at a 6/10, which in turn makes it a semi-simple trait.

The **"Cultural connection to place"** is also a long-term attribute with 8/10 in the Short- Medium -Long Term rating. It has a score of 7 on the Internal/External continuum, which means that it can have both internal and external factors. In the Simple/Complex model, it is ranked as 7 with a Simple/Complex index of 0. 5, which makes it a moderately complex trait.

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The **"Ecological connection to place"** is a long-term characteristic; it earns 8 on the Short- Medium -Long Term scale. According to Internal/External categorization, it is pegged at 7 out of 10, meaning that it is moderately inclined towards internal and external forces. In the Simple/Complex dichotomy, it is identified as a moderately complex trait with a score of 7 out of 10.

On the Short- Medium -Long Term scale, **"Historic connection to place"** is assigned to the long-term category and is rated for 8 points out of 10. It is ranked 7 on a scale of 10 in the Internal/External scale, which indicates that it has both internal and external factors. When assessing the characteristic on the Simple/Complex scale, it gets a 7, which is considered moderately complex.

The **"geographic connection to place"** is also defined as a long-term attribute with the value of 8 out of 10 on the Short-Medium-Long Term scale. It scores 7 on the Internal/External scale, meaning that the organization has moderate levels of internal and external influence. In terms of Simple/Complex, "Geographic connection to place" is on a scale of 1-10 and it is 8 which makes it a complex trait.

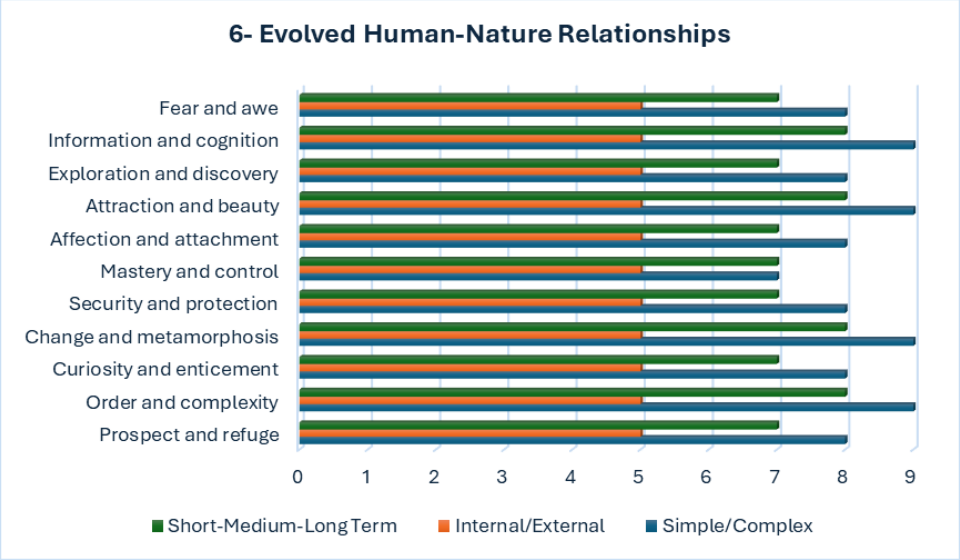

Figure 6: 6- Evolved Human-Nature Relationships. [Figure credit: Author]

The **"fear and awe"** is a characteristic of the long term, with a score of 8 out of 10 on the Short-Medium-Long Term scale. On the Internal/External scale it is marked as 7 out of 10, thus it is more influenced by both internal and external factors. When placing it on the Simple/Complex scale, it is ranked 7 out of 10, making it a somewhat complex trait.

The **"Information and cognition"** is also listed in the long-term attribute group, and it has a score of 8 out of 10 according to the Short-Medium-Long Term scale. It is placed on the 7th level on the Internal/External scale, which means that it is

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somewhere between internal and external factors. On the Simple/Complex scale, "Information and cognition" is 8 which make it fall under the complex trait.

In the Short-Medium-Long Term scale, the **"Exploration and discovery"** characteristic is classified as a long-term characteristic and received 8 points out of 10. It is at position 7 on the Internal/External classification, meaning that it is both internally and externally driven. According to the Simple/Complex scale, it has an 8, which means that it is a complex attribute.

The concept of **"Attraction and beauty"** is under the long-term category with a score of 8 out of 10 in the Short-Medium-Long Term scale. They are ranked 7 out of 10 in the Internal/External scale, which indicates that they have both internal and external factors. When it comes to the Simple/Complex scale, the score obtained by the characteristic is 7 out of 10, which makes this trait of medium complexity.

The **"Affection and attachment"** is considered to be a long-term characteristic and has a score of 8 out of 10 on the Short-Medium-Long Term scale. On the Internal/External continuum it is rated 7 out of 10, thus it is moderately between internal and external forces. With reference to the Simple/Complex scale, the characteristic is defined as a trait of moderate complexity and is rated 7 out of 10.

The **"Mastery and control"** is positioned to the long-term dimension, receiving 7 points from 10 on the Short-Medium-Long Term scale. On the Internal/External scale, it is rated 6 out of 10, which indicates that the work has a mixed focus on internal and external aspects. In the Simple/Complex index, characteristic is ranked at 7 out of 10, signifying moderate complexity.

The **"Security and protection"** are categorized as a long-term attribute, and it has a rating of 8 out of 10 on the Short-Medium-Long Term scale. According to the Internal/External scale, it is rated 7 out of 10, which means that it is neither predominantly internal nor external. Relating it to the Simple/Complex scale, the characteristic is placed at 7 out of 10, therefore making it a moderately complex attribute.

The **"Change and metamorphosis"** is also categorized into the long-term category with an average rating of 8 out of 10 in the Short-Medium-Long Term test. On the Internal/External scale, it is 7 out of 10, meaning that it has both internal and external factors. The degree of Simple/Complex of the discussed trait, the characteristic is 8 of 10, meaning that it is complex.

As for the characteristics of the target audience, **"curiosity and enticement"** can be considered a long-term characteristic and has a score of 8 out of 10 on the Short-Medium-Long Term scale. On the Internal/External dimension, it has been rated 7 out of 10, meaning that it has a moderate number of internal and external factors. Concerning Simple/Complex, "Curiosity and enticement" is equal to 7 which means that it is moderately complex element.

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The **"Order and complexity"** can be considered a long-term attribute receiving 8 points out of 10 on the Short-Medium-Long Term scale. It is 7 on Internal/External scale, meaning that there are both Internal and External factors involved. On the Simple/Complex scale, it is scored 8 of 10 which makes it a complex feature.

The **"Prospect and refuge"** also belongs to the long-term factor and has a score of 7/10 in the Short-Medium-Long Term scale. On the Internal/External dimension it is ranked 6 out of 10, which suggests that it has relatively similar levels of internal and external influence. In the Simple / Complex scale is at level 7 out of 10, which makes it relatively complex trait.

Overall, this classification system provides a comprehensive framework for understanding and incorporating biophilic design principles into the built environment, potentially enhancing human well-being and fostering a stronger connection with nature.

in conclusion, the detailed examination gives a complete framework from which we can understand many ways in which people interact with their environment. In the six different topics, a constant division of characteristics into long-term, complicated, and equal mixture of inner and outer sources denotes an entrenched as well as intricate relationship among human beings themselves and the earth itself. On one hand, the evolution appears to have affected such relations in a way that there are adaptations up to now making them continue as they are while on another level, they seem to be responding to each other so carefully when necessary. Further exploration of these interconnections can yield valuable insights for fields such as psychology, anthropology, and environmental science.

Results:

1. Analyzing Biophilic design 72 features using the SWOT Method:

- Strengths:

1) Biophilic Design characteristics and application information for 72 items.
2) Offers a wide variety of features from various points of view of nature.
3) This refers to an aspect of the building, which contains both internal and external features.
4) Includes various aspects of nature and its elements.
5) Stresses the importance of the connection between the human and the natural world.
6) Provides ideas for the incorporation of colors, lights, and spaces into the biophilic design concept.

- Weaknesses:

1) It can also be argued that the text lacks clear elaboration and examples of the characteristics of an effective professional development program.

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2) There is relatively little information concerning the implementation of the concepts and their real-life application.
3) There are no guidelines or recommendations on how to apply the biophilic design in the buildings.
4) The document may contain unfamiliar terms or ideas and additional context or links to other sources can be helpful to clarify the text.

- Opportunities:

1) Can be used as a basis for the subsequent development of additional information and studies regarding biophilic design concepts.
2) Offers ideas for architects and designers and anyone who aim to include biophilia in their home or work environment.
3) It can be used as a resource in educational establishments for design-oriented programs.
4) They present the possibilities for interactions and integration of various disciplines in the field of biophilic design.

- Threats:

1) May simplify the biophilic design characteristics by classifying them in simple terms that may not capture the complexity of the concept.
2) 72 characteristics of personality that have not been supported by empirical data or scientific research.
3) Dissemination: The information presented in the document may become obsolete with time due to the new findings and advancements in the field of biophilic design.

2. Classifying the Biophilic design 72 Features:

Methodology:

The research method used in this study was analytical to analyze the 72 characteristics of biophilic design.

- **Duration:** Characteristics were divided according to time of interaction with human beings as short term, medium term, and long term.
- **Impact:** Characteristics were categorized based on the source where the impact characteristics came from (internal or external).
- **Complexity:** Data were further analyzed based on the level of characteristics (simple/complex).

Study Results:

The analysis of the study results revealed that the overwhelming number of biophilic design characteristics can be attributed to the long-lasting ones that are characterized by the complexity of the effects and their balance between internal and external factors.

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- **Duration:** It was established that most characteristics are classified as enduring, meaning that these aspects remain fixed for extended periods, and profoundly influence people for a long time.
- **Impact:** The assessment revealed that most characteristics are moderate between internal and external effects; therefore, the features are highly dependent on internal forces such as perceptions and emotions, along with external forces like physical and environmental factors.
- **Complexity**: In the study, most specific characteristics are classified as complex, meaning that the human/non-human nature interaction is not straightforward but multilayered and multifaceted.

Discussion of Results:

Therefore, the findings of this research indicate that biophilic design characteristics have a definite influence on the human-nature interface. The very fact that these characteristics are long-term, multifaceted, and have an equal distribution of internal and external factors, gives reason to believe that such features have developed for many years and affect people in the long term.

These outcomes expand the knowledge of human-nature connections and have important implications for architects and designers in terms of how they can integrate biophilic design into the constructed environment.

3. Awareness and Attitudes towards Biophilic Design in Saudi Arabia "Questionnaire Findings":

The questionnaire was designed specifically to collect data and knowledge about Biophilic Design and its application to the facilities in Saudi Arabia. The survey was set to establish the degree of awareness and knowledge in this area among the professionals and to determine the key challenges and strategies in the Saudi context regarding the implementation of biophilic design.

Methodology:

To achieve the research goal, online questionnaire with 18 questions were developed, which included the participants' demographic data (age, gender, nationality, and the type of work they were engaged in) and questions regarding the level of awareness and the amount of knowledge about biophilic design, the sources of this knowledge, the importance of this type of design, and the main challenges and possible solutions in this sphere. The questionnaire was directed at a purposive sample of working professionals engaged in fields like real estate development, architectural design, interior design and research in Biophilic design. The statistics used in data analysis were descriptive statistics.

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Study Findings:

Demographic Characteristics of Participants:

- The largest number of participants 47% was in the age group of 31-40 years, while 32% of the participants were in the age group of 31–40 years, while 32% were in the age group of 41–50 years.
- The majority of the participants were male, 68% while the proportion of female participants was 32%.
- The majority of the participants (84%) were Saudis.

The most prominent fields of work of the participants were: architects (26%), followed by interior designers (21%), and researchers in the field of biophilic design. (16%)

Awareness and Expertise in Biophilic Design:

- The majority of participants (74%) supported the idea that they'd like to incorporate biophilic design into their projects.
- According to the survey, 47% of participants possessed a moderate level of familiarity with biophilic design, and 32% possessed extensive familiarity.
- The main sources of knowledge regarding biophilic design were prior projects (47%) and experience (58%).
- Regarding the perceived importance of biophilic design in facilities in the Kingdom, 79% of the participants supported the notion that it is very important.
- About 63% of the participants opined that there was a need for biophilic design to be adopted on a large scale in Saudi Arabia.
- The main obstacles were: The major challenges that respondents cited included lack of awareness and understanding (63%), high costs (58 %), and the absence of standard guidelines and practices.(%47)
- The most important proposed solutions were awareness and training were the most cited needs of 79% of the respondents, followed by the establishment of supporting legal frameworks at 63% and the provision of financial incentives at 53%.

Discussion of Findings:

The study findings show that Saudi professionals are interested in using biophilic design in properties and most of them have moderate to extensive experience in this field. This interest was related to the realization of the significance of biophilic design in Saudi Arabia and the necessity to promote it.

However, several significant issues arose that affect the application of biophilic design in the Kingdom; most of these challenges are cognitive, organizational. Thus, the identified solutions were aimed at overcoming these challenges by enhancing awareness and training, establishing permissive legislation and policies.

Overall, these findings underscore the necessity of creating the conducive environment for the implementation of biophilic design in the Saudi Arabia by focusing on the cognitive, organizational. They also stress the need to further explore this area to establish suitable strategies and interventions in the Saudi context.

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Conclusion

This research delves into the feasibility of integrating the concept of biophilic design into properties in Saudi Arabia: a region that is characterized by a desert climate and a deep-rooted culture. The study understands that the application of the biophilic design concept cannot be universal in this context, and therefore requires an understanding of the Saudi Arabian environment to address these issues and take advantage of the opportunities available. By conducting an extensive literature review and a systematic assessment of 72 biophilic design features, the study establishes several important findings. Firstly, it is important to consider how to incorporate the elements of biophilic design into the hot climate of Saudi Arabia. Techniques such as natural air circulation, use of shades and incorporation of local plants that can survive without water for a long time should be employed in designing the space. Secondly, cultural sensitivity is critical since it involves dealing with people from different cultural backgrounds. Applying the principles of traditional architectural and ornamental design, using materials from the region, and adhering to local motifs and symbolism can help improve the quality of life and create a stronger bond between people and the place they inhabit. Finally, applying the SWOT analysis approach is effective for recognizing the benefits, shortcomings, opportunities, and challenges concerning biophilic design in Saudi Arabia and can be useful for further planning and application. As such, the research infers that embracing biophilic design in Saudi Arabia yields multiple advantages, such as better occupant health and comfort, better productivity, and better environment. However, successful implementation of these features depends on the architects, designers, developers, policymakers, and society in general. When it comes to future research directions, it is essential to proceed further. It is therefore important to generate operational recommendations and benchmarks of how biophilic design can be applied in various property types as well as various user segments in Saudi Arabia. The need to understand and measure the economic value of biophilic design as well as identifying ways of presenting such value to ensure the uptake of the concept cannot be overemphasized. Last but not the least, it is important that research addresses the question of how biophilic design is to be integrated into existing buildings, to effectively spread the benefit of biophilic design across the built environment. Overall, based on the literature and the proposed theoretical framework, this research seeks to support the enhancement of the built environment in Saudi Arabia through the enhancement of human interactions with nature. The results of this study will be beneficial for architects, designers, developers, policy makers, and the society to embrace a sustainable and human-oriented approach in the future development in Saudi Arabia.

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