

Sustainability Spaces: Circularity, Biophilia and Culture in Expo Osaka 2025 Pavilions

Abstract:

This paper examines how key components within sustainability—circularity, biophilia, and culture—were demonstrated at Expo Osaka 2025. Four national pavilions were carefully selected from attending countries: Switzerland, Germany, China, and Italy, all of which exemplified unique, future-forward approaches to sustainable design through architectural means. The primary focus of this paper was to examine how architects have called for action in addressing the pressing ecological challenges of the 21st century, aligning with Expo Osaka's overarching theme of "Designing a Future Society for Our Lives."

This paper incorporates primary and secondary research to investigate, firstly, how the pavilion's architects attempted to depict the overarching theme of sustainability, and secondly, what the visitors experienced and felt about each selected pavilion. This was achieved through thematic analysis of case studies on selected countries' pavilions, on-site fieldwork, and interviews with visitors.

This research suggests that the future of sustainable architecture lies in regenerative architecture in which circularity, biophilia, and cultural identity converge to transform how we build and interact with the world more effectively.

1. Introduction:

Japan was the host for the World Expo 2025 in Osaka prefecture. The pavilions showcased the official participants' nations' attitudes on innovations and concepts at the Expo. One of the World Expo's primary purposes is to serve as a global cultural exchange in a single location, inspiring hope worldwide by showcasing progress in addressing global challenges, while fostering a sense of community and collaboration on a worldwide scale[1][9].

The Osaka Expo lasted 184 days, from April 13th to October 13th, 2025. An event at the large scale of World Expos, holds the power to change behaviors and inspire globally, which sparks anticipation of the event's lasting impact on society, the economy, and the environment [7]. The urgency for sustainable innovations was particularly heightened at Expo Osaka, as it was the final Expo before the 2030 deadline for achieving the Sustainable Development Goals (SDGs). Therefore, this particular Expo was the materialization of not only the accumulated achievements of the SDGs, but also a leap beyond, "SDGs + Beyond", showcasing a larger future beyond 2030 [7].

Additionally, the demand for built urban environments is escalating at an unprecedented pace, as forecasts indicate that by 2060, Earth will have constructed over twice the current total built area [3]. It raises concerns about where and how the resources required for such an expansion will come from. To respond, at Expo Osaka, visions such as *Japan's Society 5.0* illustrate the importance of regenerative, human-centered architectural solutions that align ecological well-being with economic development [4]. Moreover, this transformation cannot be solely

reliant on technological advancements; it demands a cultural and design shift, a “re(e)volution” as Mario Cucinella calls, grounded in human and environmentally aware qualities [5].

Furthermore, Expo Osaka’s central theme and objective were sustainable architecture, part of a broader effort to enhance the quality of life globally, with the goal of “*Designing a Future Society for Our Lives*” [1][7][8]. With the Expo’s theme in mind, the architects of national pavilions were compelled to incorporate circularity, biophilic designs, and culturally sensitive practices into their practice. Another focus of the Expo was on resource management, as many pavilions considered material pollution and the importance of natural restoration and circularity in the larger context of sustainability [7][8].

While the technological spectacles at Expos are likely to capture immediate attention, this research argues that equal, if not greater, attention should be paid to how pavilions leverage architecture to generate discussions on sustainable practices, cultural narratives, and ultimately promote a brighter future. In this paper, the fundamental purpose of Expos is highlighted, which is to serve as blueprints for environments that nurture both humans and the Earth.

2. Literature Review:

World Expos are large-scale global gatherings where numerous countries come together every five years to showcase their achievements in multiple fields within a dedicated physical space, aiming to uncover and exchange solutions to contemporary challenges through interactive exhibitions by nations all around the world [9]. It all started with the Great Exhibition of London in 1851, and 35 Expos followed. As each Expo showcases impressive advancements in technology, science, economics, and more, each Expo has attracted millions of visitors worldwide, leaving a lasting, unique impact on the host city each time [7].

One of the key global challenges in the most recent Expos has been sustainability [10][11]. The United Nations Brundtland Commission’s 1987 definition of sustainability provided the foundation that Expos’ architects built upon: “meeting the needs of the present without compromising the ability of future generations to meet their own needs” [12]. In this paper, the definition of sustainability extends past environmental commitment. Sustainability in this paper encompasses sub-themes of circularity, biophilia, and culture in architectural practices, which offers a multifaceted approach that was to be subjectively interpreted by the architects [8][7].

Circularity:

Circularity revolutionizes the management and utilization of construction materials by minimizing the use of raw materials and breathing new life into previously overlooked architecture [24]. Consequently, circularity plays a significant role in mitigating the environmental consequences of architecture [26][25]. Circularity has recently emerged as a cornerstone in sustainable architecture, and thus, has been showcased more explicitly by nations’ pavilions in recent Expos, which is why it was chosen as one of the focal points in this research.

The Netherlands’ pavilion at Expo Hannover 2000 demonstrated the prospect of circularity through its architecture. With its six-floor landscape, which integrated various forms of nature, such as water, vegetation, and energy systems, into its structure, the pavilion highlighted

circularity through a unique and distinct architecture that encouraged people to consider circularity as a viable factor in sustainable architecture [13][23]. It was then revisited at Expo Milan 2015, with the Italian pavilion. The pavilion further advanced the potential of circularity by evolving the 'cradle-to-cradle' approach through its use of structural materials and construction [25][28][24]. The Italian pavilion's exterior was made from cutting-edge photocatalytic elements of new concrete and other materials, such as its photovoltaic glass, which was also designed to be fully dismantled and reused afterwards. Through both their forms and function, these pavilions are great testaments to how sustainable architecture can be adaptable, reversible, and resource-conscious altogether [26][27].

Biophilic Design:

Biophilic design emphasizes the connection between people and natural elements in spaces by integrating daylight, vegetation, and sensory flow. It supports psychological well-being beyond its environmental impact, yet has been discounted in the context of sustainability [29].

In previous Expos, 'The Big Roof' of the Japan pavilion at Expo Aichi 2005 introduced biophilic design on a vast scale [31]. The architecture was primarily composed of recycled paper tubes and bamboo-and-paper membranes, with an emphasis on natural and renewable materials that served both aesthetic and environmentally friendly purposes [32][33]. Following suit, the Singapore pavilion at Expo Dubai 2020 redefined biophilic design through an arid climate [34]. The pavilion features immersive green spaces, including a vertical garden, a forest valley, and a canopy walk framed by hanging gardens [35]. This was achieved within a net-zero energy and water footprint, serving as a living model of climate-resilient and human-centered architecture and becoming one of the clearest manifestations of biophilia at the Expo. Biophilic design in architecture is not only for aesthetics, as it can also serve as a stagnant system that reduces reliance on artificial climate control and contributes to the long-term health of humans [30].

Culture:

World Expos in other words are an international platform for countries around the globe to showcase their culture, heritage, and values through architecture [36]. Cultural sustainability means preserving and adapting these unique cultural identities in a climate-conscious world, which is becoming increasingly inherent to architecture [37].

At Expo Shanghai 2010, the United Arab Emirates pavilion drew inspiration from the expansive, sleek forms of the country's sand dunes to signify its natural landscape [38]. The outer shell structure of the pavilion not only referenced traditional motifs but also employed contemporary materials to adapt to the urban international context by merging traditional traditions and techniques with more modern, sustainable design principles [38]. It presented itself as both a literal and a symbolic representation, bridging time and demonstrating how cultural identity can be effectively embedded in a sustainable strategy. Similarly, at Expo Dubai 2020, the Morocco pavilion embodied a new, nuanced approach to cultural architecture, drawing upon vernacular Moroccan architecture, such as earth villages, within its pavilion [39]. The architecture featured an earthen facade using traditional construction techniques suited for hot climates in Dubai [41]. The architects' culturally aware choices enabled the pavilion's carbon footprint to be reduced, while also showcasing how ancestral materials and construction methods could be reimaged in a contemporary Expo setting [40][41].

These pavilions exemplified how the architecture of Expo pavilions serves as a vessel for each country to convey its cultural narratives while addressing environmental challenges. This paper highlights two national pavilions, one from Western culture and another from Eastern culture, to present diverse perspectives on how each nation incorporates culture into Expo Osaka 2025's sustainable narrative.

These innovations and pavilion's unique design choices in architectural planning demonstrate how Expos have evolved into an experimental hub for reimagining viable solutions in sustainable architecture, setting new global precedents for sustainable design. The thematic analysis in this paper pushed to consider how these themes intersected and reinforced one another: circular systems reduce long-term environmental strain, biophilic strategies ensure those systems support human well-being, cultural expression, when sustainable, anchors innovation in continuity and meaning, revealing how Expo pavilions can inform future architectural practice that not only builds sustainably but also lives sustainably, with empathy, adaptability, and cultural consciousness at its core.

3. Methodology:

After a thorough examination and observation through Expo Osaka official website and reports as well as architect's portfolios prior to the Expo, the selected four pavilions and three emerging sub-categories from the theme of sustainability were chosen as the focal points of this study to highlight some of the remarkable revolutions in architecture: circularity, biophilic design, and cultural expression. This paper used a mixed-methods approach to gather qualitative data through numerous case studies and thematic analysis.

The fieldwork involved in-person observations and photographic studies of selected pavilions at Expo Osaka, along with brief interviews with a small group of eight Expo visitors conducted in April and May 2025. Five key questions were composed to gain a deeper understanding of visitors' feelings and impressions of the pavilions and how architects attempted to convey specific artistic messages. These conversations strived to capture authentic, ordinary reactions of visitors rather than focus on the technical understanding of the subject. The interviews were conducted with a small group to gather richer qualitative information and helped establish a trusted relationship between the researcher and the interviewees, enabling more genuine responses.

This approach aimed to provide a holistic view of how the three sub-categories of sustainability, circularity, biophilic design, and cultural expression are intertwined within the Expo's architectural pavilions, through detailed architectural case studies of four national pavilions at Expo Osaka: Switzerland, Germany, China, and Italy. In the following sub-paragraphs, each method is described in more detail.

3.1 Desk Study:

This research was conducted months prior to and during the initial few months of the Expo Osaka's opening. Diverse sources were systematically consulted for the literature review and case studies on the four pavilions, the official Expo 2025 website and reports, which provided updated information on pavilion themes and design intentions; the architects' official pages,

which offered deep insight into the conceptual frameworks, design philosophies, and material choices; architecture journals and media outlets, which provided an insight into how sustainability and architecture are portrayed in the media to the people; and several relevant publications and books in fields of sustainability, circularity, biophilic design, and culture.

3.2 Criteria for the Selection and Categorization Pavilions:

Out of all international pavilions at Expo Osaka 2025, this paper only covers the four most relevant pavilions, as identified in the Methodology: Switzerland, Germany, Italy, and China.

Switzerland’s pavilion was chosen to represent biophilia due to its strong focus on natural materials and their sustainable functions, as well as environmental responsibility. Germany’s pavilion was selected to represent circularity as it reflected a growing trend toward an architecture that prioritizes fostering a zero-energy circular economy. For culture, the pavilions from Italy and China were selected to compare Eastern and Western cultural expressions through their architectural forms, as both pavilions outwardly present their culture as their focal eye-catching feature.

Table 1: Intensity of Sustainability Sub-Themes Being Represented Across Selected Expo 2025 Pavilions

| Country: | Circularity | Biophilia | Culture |
|-------------|-------------|-----------|---------|
| Switzerland | 1 | 3 | 2 |
| Germany | 3 | 2 | 1 |
| China | 1 | 2 | 3 |
| Italy | 2 | 1 | 3 |

Table 1: This table provides a comparative evaluation of how each selected pavilion, Switzerland, Germany, Italy, and China, prioritized the three identified sub-themes of sustainability: circularity, biophilic design, and cultural expression. Each country was rated on a scale of 1 to 3 for all three sub-themes (circularity, biophilia and culture), with 3 indicating the most intense thematic emphasis, based on a qualitative analysis through the Desk Study.

3.3 Interviews:

Unstructured interviews were conducted with a small group of eight people to obtain richer, qualitative insights and encourage authentic responses. The target interviewees were adults and elderly residents in Japan. The demographic was chosen because many Japanese citizens view the Expo as an educational facility showcasing global innovations based on the year’s theme rather than a tourist location, with some having attended previous Expos in Japan as part of their school expeditions.

Leading questions, which may vary depending on the conversation with interviewees, due to it being an unstructured interview:

1. Are there any details or cultural elements that capture your attention in relation to the country of origin?
 - a. If yes, please provide a few examples.
2. Were there any surprising cultural elements or traditions from other countries that challenged your pre-existing knowledge or assumptions?
3. How important is it for world events like Expo 2025 to highlight cultural diversity through architecture and design?
 - a. Likert Scale: 1 (not significant) ~ 10 (extremely significant)
 - b. Please elaborate.
4. How would you describe your experience with this pavilion?
 - a. Was there anything that particularly caught your attention or made you feel something?
5. What does sustainability mean to you?

4. Analysis

Case Study 1:

Figure 1: Swiss Pavilion: From Heidi to High-Tech. Copyright [2025] by the author



The Swiss pavilion essentially took its inspiration from the nation's diverse landscapes and traditions. It embodied a harmonious blend of biophilic design, sustainability, and cultural storytelling, with the pavilion placing a strong emphasis on "Innovative Switzerland" through a regenerative architectural approach and a powerful showcase of both sustainability and prosperity, highlighting the nation's innovations through spherical structures that resembled soap bubbles.

Biophilic Design

The architects envisioned the pavilion to provide a glimpse into the country's breathtaking nature while claiming that innovations are based on 'a sense of nature and a tradition of humanism' [42]. This was evident in the pavilion's five plant-clad sphere structures, which featured expansive and abundant greenery on their exterior. Nature was clearly physically interwoven with the architecture in the Swiss pavilion, as the architects intended, with "Nature grows into, and overgrows the building and surrounds it," symbolizing a fusion of natural and built spaces [42]. Biophilia was incorporated through and comprised of Swiss local plant species, such as wisteria, sourced from their nurseries, which were then transported and grown directly onto the exterior of the five spheres. This living skin of the pavilion's structure softened the rigidity of the architecture, and as each kilogram of plant mass at the Swiss pavilion corresponded to one kilogram of CO₂ absorbed from the environment, it held sustainable facets with biophilic design [43]. Participant Three praised the exterior landscape of the Swiss pavilion, reinforcing its effectiveness in conveying a sense of biophilia, as they stated,

"I found the weaving of plants and flowers on its exterior to be eye-catching and pleasing to the eye. It was especially nice to have something to take my eyes off my phone while I waited in line to get in. Learning about how they exceed the aesthetic appeal and function as sustainable elements later on was a nice addition as well."

While the pavilion's biophilic landscape was well appreciated by visitors, its sustainable implications were not readily understood until they were revealed through the exhibition space within the pavilion [44].

The inclusion of flora, developed in collaboration with a landscape architect, provided additional sustainability factors, with local plants overgrowing the building's surface to reinforce the architect's aesthetic message [42]. To amplify the biophilic intent, various elements, such as light, ventilation, and color, were all manipulated scenically to mimic a natural sensation and guide visitors freely through the pavilion [42][45]. Not only that, but the pavilion's ground-level layout also promoted accessibility and sustainability by avoiding vertical circulation through the use of elevators and escalators [42]. The greenery created microclimates, such as shading for cooler interiors, evapotranspiration that reduced heat in Japan's hot weather, and a habitat-like ambiance to add to [45]. The structure utilized pneumatic pressure in its ETFE shells instead of walls, eliminating the need for airlocks. This allowed for a subtle permeation of fresh air, enabling the interior of the pavilion to maintain a natural airflow in harmony with the ambient environment, thanks to the greenery outside [42][45].

All in all, the Swiss pavilion incorporated eye-catching biophilic elements that captured visitors' attention, showcasing a model example of how biophilic design can be utilized to optimize sustainable architecture in the future.

Circularity

The spherical structure was the pavilion's standout feature; weighing approximately 400 kilograms, it represented one percent of a conventional building and earned the distinction of having the lowest ecological and carbon footprint among all pavilions at the Expo [45][44][48]. The impressive lightness stemmed from the external shell, made from an ETFE membrane, which replaced traditionally heavy materials such as concrete [51]. This allowed natural light to pass through while offering dual-coloration of surfaces, thereby saving unnecessary resources and

reducing the need for massive machinery [45]. The membrane used was a modular and reusable construction material fit for sustainable architecture [48]. Its high initial cost and temperature-related challenges limit its applicability. However, the Swiss pavilion showcased new potential with the material through its unique plans to repurpose the easily disassemblable membranes, turning them into furniture [48]. This demonstrated a strong commitment to sustainability and the promotion of the circular economy, extending beyond the Expo. They furthermore collaborated with students and professors from the Kyoto Institute of Technology in their early design stages, which further emphasizes how sustainability has always been at the forefront of the architect's intentions [45][49].

Culture

Even with the pavilion's primary focus rooted in biophilic design, it also blended environmental innovation with Swiss cultural values through iconic imagery featuring Heidi and the Girl of the Alps, which built emotional resonance with visitors, particularly those familiar with the 1974 animation adaptation [50]. Heidi was the perfect choice for a cultural symbol, as she embodies the intersection of cultural motif and sustainability, symbolizing Switzerland's abundant nature in a city of technology [37]. This was especially evident in the responses of Japanese visitors to question two, as Participant Four stated,

"Heidi was another key aspect they were promoting heavily, whom I loved since I learned about her in elementary school."

Their reference to Heidi reinforced the notable impact that Switzerland employed through strategic cultural symbolism to make its biophilic message relatable and emotionally impactful. Another visitor emphasized this duality by stating Heidi

"linked nature and innovation together,"

presenting Switzerland's heritage not as dormant, but as the seed for forward-thinking, sustainable design [50]. These perceptions stressed how the pavilion challenged assumptions and reframed national identity by synthesizing culture, sustainability, and technology. Heidi serves as a cultural bridge, reinforcing Swiss-Japanese ties and linking their heritage to a vision of future innovation [50][44]. As the pavilion title suggests, the Swiss pavilion showcased Switzerland's evolution from its Alpine lineage to a global hub of technology. The pavilion's various spaces offered a meditative space for visitors to engage with Switzerland's values of openness, sustainability, and advancement [45]. The Heidi Café, situated within one of the pavilion's spherical structures, was overgrown with plants and overlooks Osaka Bay as the pavilion presented biophilia beyond the exhibition space [45].

Biophilic architecture was portrayed as being able to achieve sustainability not just visually but structurally, resourcefully, and functionally. The Swiss pavilion was a compelling model of how innovations truly grounded in humanism and nature can shape built environments.

Case Study 2:

Figure 2: Germany Pavilion: "Wa! Germany". Copyright [2025] by the author



The German pavilion at Expo Osaka was the tangible embodiment of the future circular economy. The pavilion's architecture facilitated an exhibition that guided visitors through an extraordinary experience envisioning pathways toward a sustainable, circular world. The coined term "Wa" by the German pavilion signified three different meanings in Japanese: circularity, harmony, and exclamation [55]. The term encapsulates its overall focus on circular economy, the harmony and balance between nature and technology, as well as the awe-inspiring potential of sustainable design.

Circularity

The German pavilion architects aimed to answer questions such as, "Are circular cities our future habitats?", "How will a circular economy succeed in securing our energy supply?", "What does it mean for each of us as individuals to inhabit a circular society?" [57].

First and foremost, the seven circular wooden structures of the German pavilion visually depicted the theme of circularity through their exterior circular design, utilizing not only visual elements but also sustainable resources and recyclable materials. The German pavilion was symbolic of circularity in every component, which was intended for a second life beyond the duration of the Expo [56][61]. The pavilion featured various organic, sustainable materials, including hempcrete, loam, and fungal mycelia panels, which were specifically chosen for their biodegradability as a key aspect of its circular design [59]. This was explained to visitors through labeling and thorough explanations provided by their speaking mascot, which they carried around. Visitors of the pavilions noticed this as Participant Six stated,

"I liked how even the materials of the walls were explained, and it was engaging being able to touch and feel the materials in real time alongside the explanation."

The architects chose inorganic materials, such as steel and glulam structures, as they were driven by their recyclability within the industrial sector, aligning with the rejection of traditional concrete, which is responsible for over half of global emissions, in favor of regenerative materials [60]. Not only that, but the German pavilion also incorporated traditional sustainable materials, such as rammed earth and glass, which were repurposed [61]. This further demonstrates Germany's commitment to reducing carbon emissions and waste within its pavilion. The distinction of the materials not only being sustainable but also versatile with long-lasting utility paints a new vision for circularity and circular architecture that's not only eco-friendly but also

practical in the meantime [59][60][57]. All of which mitigated environmental impacts and reinforced the German pavilion's commitment to long-term ecological goals.

The fusion of sustainability and innovation stems from tradition, honoring local knowledge, while advancing global sustainability goals. Many visitors felt the passion and hopeful outlook for the future of the circular economy through the German pavilion, as Participant Five stated,

“I feel optimistic about the future, the German pavilion paints. I learned more about how foreign countries are making advances in such fields, and their commitment to circularity was conveyed effectively.”

It confirmed how visitors were able to notice and feel the thematic framing of the circularity in both the exhibition and the space they created. It illustrated sustainability as a humanistic endeavor through architectural storytelling. The German pavilion successfully achieved its goal of educating visitors on the circular economy and cross-cultural sustainability, particularly highlighting European perspectives.

Biophilic Design

In the German pavilion, biophilic design was integrated into its central theme of circularity through its architecture and landscape, as the architects predicted that the functions of a biosphere would become a key feature of urban environments in the future [52][53]. Out of the seven cylindrical wooden structures that comprised the pavilion, two that seamlessly merged into accessible green spaces and the roof garden paid homage to Expo Osaka 1970, highlighting how the natural world evolved over time alongside architecture [59][62]. The pavilion featured a diverse array of natural species borrowed from local nurseries in Osaka. These plants enhanced both the aesthetic appeal and biodiversity, as well as ecological balance [61]. The green roofs and vegetation helped facilitate passive cooling in the pavilion, reducing the need for mechanical air conditioning—a key aspect of biophilic design [61]. Water management was another critical element of consideration for the German pavilion, as it featured permeable paving, bioswales, and gravel trenches to effectively collect rainwater runoff and repurpose it for irrigation later on [61]. This demonstrated how biophilic design contributes to a circular water system that mitigates flooding risks and supports plant life.

Culture

The German pavilion's take on culture was different from the others. Instead of focusing solely on its own national culture and tradition, it also took Japanese culture into account, keeping in mind that 90% of visitors were anticipated to be Japanese. The pavilion's exhibit featured a handheld talking circular mascot, 'Circulars', inspired by Japan's *kawaii* culture, to accompany visitors through the exhibition in an engaging and accessible format, offering options of German, English, and Japanese [63]. This was well accepted by visitors as Participant Six stated,

“It was lovely, having a helpful and cute guide in my hands; it made me feel less alone and made it more comfortable to take my time to take in all the information.”

The German culture was not evident as evident in its architectural form, as Participant Five commented,

“Other than the sign that read 'Germany,' I wasn't sure what other links there were to the country.”

This highlights a limitation in cultural communication that the pavilion had, as it suggests the ecological themes may have overshadowed localized cultural storytelling. Nevertheless, culture was expressed through a sensorial aspect that emerged primarily with the smells, which were not initially considered in the Desk Study but were discovered during on-site research, as Participants Five and Six both commented that the scent of German beer, sausage, and pork knuckle had drawn them in and made it evident of its country origin.

The German pavilion served as a key testament to the indefinite potential of circularity and the integration of the circular economy into architecture. It was a powerful prototype for future sustainable design, aligning with the Expo Osaka's theme of "Designing Future Society for Our Lives," as it encapsulated the intersection of circularity and, biophilic design and culture through various means.

Case Study 3:

Figure 3: China: Building a Community of Life for Man and Nature-Future Society of Green Development. Copyright [2025] by the author



The Chinese pavilion embodied a strong sense of cultural architecture through its representation of historical heritage, while also incorporating sustainable design principles in the modern era, reflecting China's commitment to harmonious coexistence with nature and green development.

Culture

The pavilion was deeply influenced by China's cultural heritage, as it presented a powerful architectural narrative drawn from multiple traditional inspirations, mainly including ancient bamboo slips and calligraphy scrolls [64]. The pavilion's entrance featured an inscription of ancient Chinese poetry on bamboo slips, symbolizing the transmission of knowledge through time and cultural continuity in China [64]. The entirety of the pavilion functioned to represent China's 5,000-year-old civilization and its current vision of green development, bridging the past and the future [47]. Inside the pavilion, visitors experienced a column-free interior that fostered an open environment, mimicking the elongated, unfolding shape of a scroll [14]. The structures resembling scrolls not only paid homage to China's rich literary heritage and served as a visually

striking symbol, but also fulfilled a practical purpose with their illuminations and energy-reducing innovations, acting as a cutting-edge showcase to the world of their ideas and technological advancements, both on the exterior and interior [47]. The Chinese calligraphy and poetry engravings feature 119 classical poems written in five different calligraphy styles, drawn from influential texts such as the Shi Jing and Chu Ci, as the pavilion took every opportunity to showcase its rich chronology at the Expo [54].

A notable feature of the Chinese pavilion was its ten-meter calligraphy 'waterfall' display. It narrated the evolution of Chinese writing over three millennia, and coupled with touchscreens that explore ancient scripts and poetry, it enabled national heritage to bridge modern technological presentation, reinforcing the pavilion's theme of cultural continuity and innovation [64]. Visitors in particular enjoyed the creative, engaging pathways in learning through such devices as Participant One commented,

"The touch screen with several language options was very helpful in incentivising visitors to learn."

A unique initiative showcasing China's culture was that its exhibits and events were rotated through 30 different provinces and regions of China during the duration of the Expo, allowing visitors to experience a broad cultural narrative and diverse heritage [15]. Visitors were able to relish in the eclectic, rich history and heritage of China, even with multiple visits, as Participant Two stated,

"This is my second time here, and I was shocked to find new artifacts being displayed; it drew my attention to how they were different."

The visitor's response indicated that cultural semiotics were conveyed as intended and effectively embodied, as the pavilion succeeded in effectively showcasing a strong national identity of Chinese culture.

Yet, the pavilion's contemporary use of literary characters led to confusion among visitors. Some mistakenly associated the Chinese pavilion with Japanese pavilion. This misidentification may suggest that the pavilion's conceptual architecture, while appealing, may have obscured cultural signifiers for those less familiar with national distinctions. It raises questions about how linguistic cues in architecture function in international settings, whether clarity is sacrificed for artistic expression, and if ambiguities open discussions on cultural identity in geopolitics.

The dichotomy of the pavilion's cultural symbols reflects the challenges of communicating complex cultural narratives in a globalized setting. Moreover, it suggests opportunities for future pavilions to strike a balance between contemporary design and artistic elements in architecture.

Biophilic Design

As previously introduced, the contemporary interpretation of bamboo culture was also incorporated into the pavilion's ceiling design [66]. The bamboo-like ceiling decorations embodied the growth cycles of nature and agriculture, allowing visitors to feel 'the life code' in the exhibition space, where visitors could experience all four seasonal transitions in [66]. The interior of the pavilion had also incorporated natural lighting for a seamless flow, which enhanced the connection between humans and nature [47]. The benefit of natural light as the

primary light source is not only limited to sustainability by reducing ecological footprints, but also creates a more visually comfortable space, reducing eye strain for visitors. In the pavilion, the material choice of bamboo, as one of its core materials—a renewable resource—demonstrated both traditional Chinese aesthetics and sustainable design, reinforcing the framework for culturally rooted biophilic design.

Circularity

While the primary focus was on the exhibition and structure, circularity and ecological vision were nonetheless key aspects of the pavilion’s architectural process as they implemented a zero-waste construction code [65]. For instance, the development of renewable bamboo-wood panels made with advanced 3D and Building Information Modeling (BIM) technologies highlighted how innovations contribute to the creation of a circular architecture [65]. These bamboo-wood panels were also prefabricated in Chinese factories, which reduced costs by 90% and mitigated waste, allowing them to be disassembled and reused in China after the Expo [65], thereby exemplifying circularity through responsible resource management. In addition, energy-saving features were also integrated into the design to accommodate the hot Japanese weather, including a centralized cooling system with optimized airflow, smart lighting, and energy-efficient elevators [54]. The construction process overall for the Chinese pavilion minimized waste by utilizing augmented reality for design visualization, which reduced the need for on-site fabrication, upholding circular values, albeit being international.

The pavilion also displayed an immersive short film that conveyed China’s vision of sustainable development, inspired by traditional Chinese solar terms, which heavily influenced how the exhibitions were set up [6]. This allowed visitors to discover China’s cultural concepts through the exhibition, which enabled visitors to partake in the experience instead of passing by unknowingly. This emphasized the cyclical nature of time and the interdependence of humans and nature, conveying the substance of circularity in architecture.

This pavilion presented China’s commitment to building a future world and economy that values sustainable design, while incorporating cultural representation. It showcases an example of architectural design that honors history, combining it with new and emerging technologies.

Case Study 4:

Figure 4: Italy: Art Regenerates Life. Copyright [2025] by the author



The Italian pavilion's theme, "Art Regenerates Life," was largely inspired by the Renaissance concept of the *Ideal City*—a utopian vision of urban design characterized by order and harmony. The pavilion thereby seamlessly merged art, culture, and innovation to present a visionary model of a reimagined Ideal City, also showcasing Italy's commitment to environmental responsibility and its cultural heritage.

Culture

The Italian pavilion was deeply rooted in the theme of cultural transmission, seeking to reinterpret rather than simply recreate symbols of its past [16]. Visitors to the pavilion were guided through an experience of Italy, featuring Renaissance paintings, sculptures, and cultural artifacts, as they gradually were lured to be "breathing the air of Italy" [21].

The Italian Pavilion attempted a bold cultural reinterpretation through its theme, *The Ideal City*, a reference to Italy's Renaissance concept of *la città ideale*, famously depicted in 15th-century perspective paintings by artists such as Luciano Laurana [17][20][21]. However, many visitors seem to have misinterpreted the reinterpretation presented in the pavilion's entrance, as the arched colonnaded entrance was misinterpreted as a nod to the Roman era, rather than recognizing the deeper allusion to the harmonious, rational geometry of Renaissance urban utopias. Participants Seven and Eight both picked out that

"The entrance reminded me of the Colosseum,"

as a significant indicator of the country's culture and origin, confirming the recurring misinterpretation that had been present at the Expo. In contrast, the Ideal City that they wanted to represent does not utilize arched entrances. The spaces between the initial entrance and the exhibition inside are what is known as a *portico* in the Renaissance era, specifically the *portici italiani*, which emphasized coexistence, rather than being outside or inside [19]. The Renaissance is also Greek, where ideals, techniques, and spiritual values were often explored in comparison to the Roman Empire, which was more pragmatic, focused on ownership and imperialism, and the spreading of culture. The architects' intention was to use those historic urban metaphors—the theatre, portico, piazza, and garden—to create a future-oriented "living fabric" that expresses Italy's regional diversity and innovative identity [16].

This meant it conveyed a different impression of intentions than intended, as the Roman era is heavily associated with conquest and war. In contrast, the Renaissance era was marked by significant discoveries and a period of rebirth [18]. What the architects of the Italy pavilion sought to convey was more representative of revolutionary cities, as well as the flourishing of inventions. Therefore, the intention was not clearly communicated to visitors, and as a result, it was ineffective.

It can be considered successful in that the pavilion successfully evoked strong cultural imagery through its architectural form for visitors. However, this misreading raises essential questions: Did the conceptualization rely too heavily on abstract motifs without offering clear interpretive guidance? Or was the execution perhaps overly simplified for the public, who expected more literal and familiar cues?

While the architects aimed to convey Italy's vision of reimagined utopian design through their reinterpretation of the *Ideal City* from the Renaissance era, the conveyed intentions did not align with the visitors' impressions, which raised questions about how abstract concepts can be better executed to facilitate easy understanding for visitors.

Circularity

Sustainability and circularity acted as a foundational philosophy within the Italian pavilion's reimagined architecture [16]. All the resources used and design choices were made in conjunction with a broader goal of adaptive reuse, making it a model of circular architecture [22]. For instance, the pavilion was constructed using certified laminated wood and a dry construction system, which allowed for reconfiguration and disassembly, enabling the materials to be recycled after the Expo, considering its six-month duration [22]. The exterior structure was made from permeable mineral fibres, which could passively regulate temperature, light, and airflow. It acted as both the skin of the pavilion and the interface that connected internal climate to external conditions, symbolizing Italy's transparent approach to sustainable design. The lightweight textile of the outer face reduced energy demands, enabling the pavilion to behave like a living organism, which allowed it to adapt to seasonal rhythms and environmental changes in Japan—a core tenet of circularity [22].

Biophilic Design

Lead architect Mario Cucinella stated, “The Italian Pavilion stands for a new idea of society, and for the city as a living organism where the relationships between people, art, the environment, and history can materialise” [21]. The Italian pavilion's integration of biophilic design was intended to reconnect humans with nature. The rooftop of the pavilion featured an Italian-style garden that served as a contemporary labyrinth, with flowers and small trees that spread various scents, creating sensory dimensions inspired by Renaissance harmony and in keeping with the theme of the *Ideal City* [16]. The organic ecosystem speaks to today's ecological imperatives, as the garden embodied native plants, fountains, sculptures, alongside winding paths that symbolized both human geometry and natural irregularity [16]. Biophilia at the Italian pavilion was multi-sensory and multi-spatial as the rhythms of the days were reflected in the pavilion's exhibition, much like dappled sunlight through a forest canopy. This enhanced emotional awareness within the space serves as a deliberate antidote to the overstimulation of digital life, as it also recalls Japanese spatial philosophies of impermanence, which link Italian and Japanese approaches to beauty and environment. The theatre, piazza, and rooftop garden, together, formed a triptych of experimental biophilia that was all interconnected as spaces where art, nature, and architecture dissolved into one [16]. At the Italian pavilion, biophilic design was presented as a worldview that prioritized empathy and emotion, as well as ecological responsibility.

The Italian pavilion illustrated harmonious integration of cultural and sustainable practices. Though some symbolism was misinterpreted, the pavilion still encapsulated Italy's commitment to building a future that values the ecological balance and cultural richness in urban architecture.

5. Conclusions

The researcher was drawn to the topic of sustainability, and in particular, took the four pavilions as the focal points of this study, analyzing them through the lens of circularity, biophilia, and culture. The architectural innovations displayed by official participants' national pavilions at Expo Osaka demonstrated how sustainability must extend beyond technical performance, environmentally, to encompass broader social considerations. The unstructured interviews with pavilion visitors at the Expo highlighted how narrative clarity and symbolism play a large part in ensuring architectural intentions are conveyed effectively. As urban expansion in this century accelerates more and more and the SDGs deadline inches closer, the researcher hopes that the conclusions drawn from this paper's analysis can inform future global efforts to build not just sustainably but meaningfully with empathy and regeneration at the root of architectural practice, since the most significant takeaway from the Osaka Expo's pavilions was one of inspiration.

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Decision: Revise and resubmit.

Comments:

So, I like the overall set-up: there's a clear abstract, neat structure, and also a useful table that sums up how each pavilion tackles circularity, biophilia, and identity. The combination of desk research, on-site notes, and a handful of interviews gives it a nice first hand feel to be sure.

That said, I think the theoretical frame needs a bit more rigor. Perhaps the biggest thing for me is that the student name checks “regenerative architecture” and “cultural sustainability” (big buzz words in the field) but never quite explains how the two notions can overlap and at times clash. A short paragraph that focuses on conceptual distinctions early on would help strengthen the analytical sections that come after.

The methodology is also a bit light. 8 unstructured interviews, all with visitors who live in Japan, may be fine, but the author should tell us why that sample is enough and how the answers were coded. Same with the three point rating scale in the table: what turns a two into a three? And then there is the conclusion which claims that “narrative clarity and symbolism” are the big lessons of the Expo, yet that theme never really surfaces in the case studies. I would nudge the author to spell out that link.

Overall, these are moderate tweaks. Once they are sorted, I am sure the paper could move to external peer review!

Sustainability Spaces: Circularity, Biophilia and Culture in Expo Osaka 2025 Pavilions

Abstract:

This paper examines how key components within sustainability—circularity, biophilia, and culture—were demonstrated at Expo Osaka 2025. Four national pavilions were carefully selected from attending countries: Switzerland, Germany, China, and Italy, all of which exemplified unique, future-forward approaches to sustainable design through architectural means. The primary focus of this paper was to examine how architects have called for action in addressing the pressing ecological challenges of the 21st century, aligning with Expo Osaka's overarching theme of "Designing a Future Society for Our Lives."

This paper incorporates primary and secondary research to investigate, firstly, how the pavilion's architects attempted to depict the overarching theme of sustainability, and secondly, what the visitors experienced and felt about each selected pavilion. This was achieved through thematic analysis of case studies on selected countries' pavilions, on-site fieldwork, and interviews with visitors.

This research suggests that the future lies in sustainable architecture where three sub-categories of circularity, biophilia, and cultural identity converge to transform how we build and interact with the world more effectively. This research unpacks the concept of sustainability and so analyze the above sub categories, defining the current and future directions of living.

1. Introduction:

Japan was the host for the World Expo 2025 in Osaka prefecture. The pavilions showcased the official participants' nations' attitudes on innovations and concepts at the Expo. One of the World Expo's primary purposes is to serve as a global cultural exchange in a single location, inspiring hope worldwide by showcasing progress in addressing global challenges, while fostering a sense of community and collaboration on a worldwide scale[1][9].

The Osaka Expo lasted 184 days, from April 13th to October 13th, 2025. An event at the large scale of World Expos, holds the power to change behaviors and inspire globally, which sparks anticipation of the event's lasting impact on society, the economy, and the environment [7]. The urgency for sustainable innovations was particularly heightened at Expo Osaka, as it was the final Expo before the 2030 deadline for achieving the Sustainable Development Goals (SDGs). Therefore, this particular Expo was the materialization of not only the accumulated achievements of the SDGs, but also a leap beyond, "SDGs + Beyond", showcasing a larger future beyond 2030 [7].

Additionally, the demand for built urban environments is escalating at an unprecedented pace, as forecasts indicate that by 2060, Earth will have constructed over twice the current total built area [3]. It raises concerns about where and how the resources required for such an expansion will come from. To respond, at Expo Osaka, visions such as *Japan's Society 5.0* illustrate the importance of sustainable, human-centered architectural solutions that align ecological

well-being with economic development [4]. Moreover, this transformation cannot be solely reliant on technological advancements; it demands a cultural and design shift, a “re(e)volution” as Mario Cucinella calls, grounded in human and environmentally aware qualities [5].

Furthermore, Expo Osaka’s central theme and objective were sustainable architecture, part of a broader effort to enhance the quality of life globally, with the goal of “*Designing a Future Society for Our Lives*” [1][7][8]. With the Expo’s theme in mind, the architects of national pavilions were compelled to incorporate circularity, biophilic designs, and **culturally sensitive approach into their practices**.

Later in the paper, a clear distinction and description of the three sub-categories(circularity, biophilic design, culture) is presented and discussed.

Another focus of the Expo was on resource management, as many pavilions considered material pollution and the importance of natural restoration and circularity in the larger context of sustainability [7][8].

While the technological spectacles at Expos are likely to capture immediate attention, this research argues that equal, if not greater, attention should be paid to how pavilions leverage architecture to generate discussions on sustainable practices, cultural narratives, and ultimately promote a brighter future. In this paper, the fundamental purpose of Expos is highlighted, which is to serve as blueprints for environments that nurture both humans and the Earth.

2. Literature Review:

World Expos are large-scale global gatherings where numerous countries come together every five years to showcase their achievements in multiple fields within a dedicated physical space, aiming to uncover and exchange solutions to contemporary challenges through interactive exhibitions by nations all around the world [9]. It all started with the Great Exhibition of London in 1851, and 35 Expos followed. As each Expo showcases impressive advancements in technology, science, economics, and more, each Expo has attracted millions of visitors worldwide, leaving a lasting, unique impact on the host city each time [7].

One of the key global challenges in the most recent Expos has been sustainability [10][11]. The United Nations Brundtland Commission’s 1987 definition of sustainability provided the foundation that Expos’ architects built upon: “meeting the needs of the present without compromising the ability of future generations to meet their own needs” [12]. With architecture being responsible for approximately 40% of the world’s carbon emissions, Expo Osaka’s architects gave a large amount of attention in creating reflective pavilions, focusing in on how to take sustainability a step further. In this paper, the definition of sustainability extends past environmental commitment. Sustainability in this paper encompasses sub-categories of circularity, biophilia, and culture in architectural practices, which offers a multifaceted approach that was to be subjectively interpreted by the architects [8][7].

Circularity:

Circularity revolutionizes the management and utilization of construction materials by minimizing the use of raw materials and breathing new life into previously overlooked

architecture [24]. Consequently, circularity plays a significant role in mitigating the environmental consequences of architecture [26][25]. Circularity has recently emerged as a cornerstone in sustainable architecture, and thus, has been showcased more explicitly by nations' pavilions in recent Expos, which is why it was chosen as one of the focal points in this research.

The Netherlands' pavilion at Expo Hannover 2000 demonstrated the prospect of circularity through its architecture. With its six-floor landscape, which integrated various forms of nature, such as water, vegetation, and energy systems, into its structure, the pavilion highlighted circularity through a unique and distinct architecture that encouraged people to consider circularity as a viable factor in sustainable architecture [13][23]. It was then revisited at Expo Milan 2015, with the Italian pavilion. The pavilion further advanced the potential of circularity by evolving the 'cradle-to-cradle' approach through its use of structural materials and construction [25][28][24]. The Italian pavilion's exterior was made from cutting-edge photocatalytic elements of new concrete and other materials, such as its photovoltaic glass, which was also designed to be fully dismantled and reused afterwards. Through both their forms and function, these pavilions are great testaments to how sustainable architecture can be adaptable, reversible, and resource-conscious altogether [26][27].

Biophilic Design:

Biophilic design emphasizes the connection between people and natural elements in spaces by integrating daylight, vegetation, and sensory flow. It supports psychological well-being beyond its environmental impact, yet has been discounted in the context of sustainability [29].

In previous Expos, 'The Big Roof' of the Japan pavilion at Expo Aichi 2005 introduced biophilic design on a vast scale [31]. The architecture was primarily composed of recycled paper tubes and bamboo-and-paper membranes, with an emphasis on natural and renewable materials that served both aesthetic and environmentally friendly purposes [32][33]. Following suit, the Singapore pavilion at Expo Dubai 2020 redefined biophilic design through an arid climate [34]. The pavilion features immersive green spaces, including a vertical garden, a forest valley, and a canopy walk framed by hanging gardens [35]. This was achieved within a net-zero energy and water footprint, serving as a living model of climate-resilient and human-centered architecture and becoming one of the clearest manifestations of biophilia at the Expo. Biophilic design in architecture is not only for aesthetics, as it can also serve as a stagnant system that reduces reliance on artificial climate control and contributes to the long-term health of humans [30].

Culture:

World Expos in other words are an international platform for countries around the globe to showcase their culture, heritage, and values through architecture [36]. **Sustainability** means **culturally** preserving and adapting these unique **identities** in a climate-conscious world, which is becoming increasingly inherent to architecture, **according to studies that specifically name this phenomenon as cultural sustainability** [37].

At Expo Shanghai 2010, the United Arab Emirates pavilion drew inspiration from the expansive, sleek forms of the country's sand dunes to signify its natural landscape [38]. The outer shell structure of the pavilion not only referenced traditional motifs but also employed contemporary materials to adapt to the urban international context by merging traditional traditions and

techniques with more modern, sustainable design principles [38]. It presented itself as both a literal and a symbolic representation, bridging time and demonstrating how cultural identity can be effectively embedded in a sustainable strategy. Similarly, at Expo Dubai 2020, the Morocco pavilion embodied a new, nuanced approach to cultural architecture, drawing upon vernacular Moroccan architecture, such as earth villages, within its pavilion [39]. The architecture featured an earthen facade using traditional construction techniques suited for hot climates in Dubai [41]. The architects' culturally aware choices enabled the pavilion's carbon footprint to be reduced, while also showcasing how ancestral materials and construction methods could be reimaged in a contemporary Expo setting [40][41].

These pavilions exemplified how the architecture of Expo pavilions serves as a vessel for each country to convey its cultural narratives while addressing environmental challenges. This paper highlights two national pavilions, one from Western culture and another from Eastern culture, to present diverse perspectives on how each nation incorporates culture into Expo Osaka 2025's sustainable narrative.

These innovations and pavilion's unique design choices in architectural planning demonstrate how Expos have evolved into an experimental hub for reimagining viable solutions in sustainable architecture, setting new global precedents for sustainable design. The thematic analysis in this paper pushed to consider how these themes intersected and reinforced one another: circular systems reduce long-term environmental strain, biophilic strategies ensure those systems support human well-being, cultural expression, when sustainable, anchors innovation in continuity and meaning, revealing how Expo pavilions can inform future architectural practice that not only builds sustainably but also lives sustainably, with empathy, adaptability, and cultural consciousness at its core.

3. Methodology:

After a thorough examination and observation through Expo Osaka official website and reports as well as architect's portfolios prior to the Expo, the selected four pavilions and three emerging sub-categories from the theme of sustainability were chosen as the focal points of this study to highlight some of the remarkable revolutions in architecture: circularity, biophilic design, and cultural expression. This paper used a mixed-methods approach to gather qualitative data through numerous case studies and thematic analysis.

The fieldwork involved in-person observations and photographic studies of selected pavilions at Expo Osaka, along with brief interviews with a small group of eight Expo visitors conducted in April and May 2025. Five key questions were composed to gain a deeper understanding of visitors' feelings and impressions of the pavilions and how architects attempted to convey specific artistic messages. These conversations strived to capture authentic, ordinary reactions of visitors rather than focus on the technical understanding of the subject. The interviews were conducted with a small group to gather richer qualitative information and helped establish a trusted relationship between the researcher and the interviewees, enabling more genuine responses.

This approach aimed to provide a holistic view of how the three sub-categories of sustainability, circularity, biophilic design, and cultural expression are intertwined within the Expo's

architectural pavilions, through detailed architectural case studies of four national pavilions at Expo Osaka: Switzerland, Germany, China, and Italy. In the following sub-paragraphs, each method is described in more detail.

3.1 Desk Study:

This research was conducted months prior to and during the initial few months of the Expo Osaka's opening. Diverse sources were systematically consulted for the literature review and case studies on the four pavilions, the official Expo 2025 website and reports, which provided updated information on pavilion themes and design intentions; the architects' official pages, which offered deep insight into the conceptual frameworks, design philosophies, and material choices; architecture journals and media outlets, which provided an insight into how sustainability and architecture are portrayed in the media to the people; and several relevant publications and books in fields of sustainability, circularity, biophilic design, and culture.

3.2 Criteria for the Selection and Categorization Pavilions:

Out of all international pavilions at Expo Osaka 2025, this paper only covers the four most relevant pavilions, as identified in the Methodology: Switzerland, Germany, Italy, and China.

Switzerland's pavilion was chosen to represent biophilia due to its strong focus on natural materials and their sustainable functions, as well as environmental responsibility. Germany's pavilion was selected to represent circularity as it reflected a growing trend toward an architecture that prioritizes fostering a zero-energy circular economy. For culture, the pavilions from Italy and China were selected to compare Eastern and Western cultural expressions through their architectural forms, as both pavilions outwardly present their culture as their focal eye-catching feature.

Table 1: Intensity of Sustainability Sub-Categories Being Represented Across Selected Expo 2025 Pavilions

| Country: | Circularity | Biophilia | Culture |
|-------------|-------------|-----------|---------|
| Switzerland | 1 | 3 | 2 |
| Germany | 3 | 2 | 1 |
| China | 1 | 2 | 3 |
| Italy | 2 | 1 | 3 |

Table 1: This table provides a comparative evaluation of how each selected pavilion, Switzerland, Germany, Italy, and China, prioritized the three identified sub-categories of sustainability: circularity, biophilic design, and cultural expression. Each country was rated on a scale of 1 to 3 for all three sub-categories (circularity, biophilia and culture), with 3 indicating the most intense thematic emphasis, based on a qualitative analysis through the Desk Study. **A 1 indicates that the sub-theme was minimally present with slight mentions with trivial integration into the design**

and message. A 2 indicates that the sub-theme was moderately developed and there was evidence of the sub-theme influencing parts of the design or message, however, it was not central or deeply embedded. A 3 indicates that the sub-theme was strongly emphasized through the design and message through the architectural choices and storytelling with a clear and intentional integration aligned with sustainability.

3.3 Interviews:

Unstructured interviews were conducted with a small group of eight people to obtain richer, qualitative insights and encourage authentic responses. The target interviewees were adults and elderly residents in Japan. The demographic was chosen because many Japanese citizens view the Expo as an educational facility showcasing global innovations based on the year's theme rather than a tourist location, with some having attended previous Expos in Japan as part of their school expeditions. Interviewing Japanese residents enabled more authentic dialogues with the researcher, a native Japanese speaker, overcoming any potential occurring language barriers.

In qualitative research, depth often holds more value than breadth, therefore, the sample size was kept minimal. It was sufficient for the study to uncover preliminary patterns and initial reactions to the pavilions. The interview data were thematically analyzed to identify alignment with findings from the desk study or divergence from the design intention and audience perception.

Participants 1 and 2 were interviewees at the China pavilion, while 3 and 4 were at the Swiss pavilion, 5 and 6 were at the German pavilion, and 7 and 8 were at the Italian pavilion.

Leading questions, which may vary depending on the conversation with interviewees, due to it being an unstructured interview:

1. Are there any details or cultural elements that capture your attention in relation to the country of origin?
 - a. If yes, please provide a few examples.
2. Were there any surprising cultural elements or traditions from other countries that challenged your pre-existing knowledge or assumptions?
3. How important is it for world events like Expo 2025 to highlight cultural diversity through architecture and design?
 - a. Likert Scale: 1 (not significant) ~ 10 (extremely significant)
 - b. Please elaborate.
4. How would you describe your experience with this pavilion?
 - a. Was there anything that particularly caught your attention or made you feel something?
5. What does sustainability mean to you?

4. Analysis

Case Study 1:

Figure 1: Swiss Pavilion: From Heidi to High-Tech. Copyright [2025] by the author



The Swiss pavilion essentially took its inspiration from the nation's diverse landscapes and traditions. It embodied a harmonious blend of biophilic design, sustainability, and cultural storytelling, with the pavilion placing a strong emphasis on “Innovative Switzerland” through a sustainable architectural approach and a powerful showcase of both sustainability and prosperity, highlighting the nation's innovations through spherical structures that resembled soap bubbles.

Biophilic Design

The architects envisioned the pavilion to provide a glimpse into the country's breathtaking nature while claiming that innovations are based on ‘a sense of nature and a tradition of humanism’ [42]. This was evident in the pavilion's five plant-clad sphere structures, which featured expansive and abundant greenery on their exterior. Nature was clearly physically interwoven with the architecture in the Swiss pavilion, as the architects intended, with “Nature grows into, and overgrows the building and surrounds it,” symbolizing a fusion of natural and built spaces [42]. Biophilia was incorporated through and comprised of Swiss local plant species, such as wisteria, sourced from their nurseries, which were then transported and grown directly onto the exterior of the five spheres. This living skin of the pavilion's structure softened the rigidity of the architecture, and as each kilogram of plant mass at the Swiss pavilion corresponded to one kilogram of CO₂ absorbed from the environment, it held sustainable facets with biophilic design [43]. Participant 3 praised the exterior landscape of the Swiss pavilion, reinforcing its effectiveness in conveying a sense of biophilia, as they stated,

“I found the weaving of plants and flowers on its exterior to be eye-catching and pleasing to the eye. It was especially nice to have something to take my eyes off my phone while I waited in line to get in. Learning about how they exceed the aesthetic appeal and function as sustainable elements later on was a nice addition as well.”

While the pavilion's biophilic landscape was well appreciated by visitors, its sustainable implications were not readily understood until they were revealed through the exhibition space within the pavilion [44].

The inclusion of flora, developed in collaboration with a landscape architect, provided additional sustainability factors, with local plants overgrowing the building's surface to reinforce the architect's aesthetic message [42]. To amplify the biophilic intent, various elements, such as light, ventilation, and color, were all manipulated scenically to mimic a natural sensation and guide visitors freely through the pavilion [42][45]. Not only that, but the pavilion's ground-level layout also promoted accessibility and sustainability by avoiding vertical circulation through the use of elevators and escalators [42]. The greenery created microclimates, such as shading for cooler interiors, evapotranspiration that reduced heat in Japan's hot weather, and a habitat-like ambiance to add to [45]. The structure utilized pneumatic pressure in its ETFE shells instead of walls, eliminating the need for airlocks. This allowed for a subtle permeation of fresh air, enabling the interior of the pavilion to maintain a natural airflow in harmony with the ambient environment, thanks to the greenery outside [42][45].

All in all, the Swiss pavilion incorporated eye-catching biophilic elements that captured visitors' attention, showcasing a model example of how biophilic design can be utilized to optimize sustainable architecture in the future.

Circularity

The spherical structure was the pavilion's standout feature; weighing approximately 400 kilograms, it represented one percent of a conventional building and earned the distinction of having the lowest ecological and carbon footprint among all pavilions at the Expo [45][44][48]. The impressive lightness stemmed from the external shell, made from an ETFE membrane, which replaced traditionally heavy materials such as concrete [51]. This allowed natural light to pass through while offering dual-coloration of surfaces, thereby saving unnecessary resources and reducing the need for massive machinery [45]. The membrane used was a modular and reusable construction material fit for sustainable architecture [48]. Its high initial cost and temperature-related challenges limit its applicability. However, the Swiss pavilion showcased new potential with the material through its unique plans to repurpose the easily disassemblable membranes, turning them into furniture [48]. This demonstrated a strong commitment to sustainability and the promotion of the circular economy, extending beyond the Expo. They furthermore collaborated with students and professors from the Kyoto Institute of Technology in their early design stages, which further emphasizes how sustainability has always been at the forefront of the architect's intentions [45][49].

Culture

Even with the pavilion's primary focus rooted in biophilic design, it also blended environmental innovation with Swiss cultural values through iconic imagery featuring Heidi and the Girl of the Alps, which built emotional resonance with visitors, particularly those familiar with the 1974 animation adaptation [50]. Heidi was the perfect choice for a cultural symbol, as she embodies the intersection of cultural motif and sustainability, symbolizing Switzerland's abundant nature in a city of technology [37]. This was especially evident in the responses of Japanese visitors to question two, as Participant 4 stated,

"Heidi was another key aspect they were promoting heavily, whom I loved since I learned about her in elementary school."

Their reference to Heidi reinforced the notable impact that Switzerland employed through strategic cultural symbolism to make its biophilic message relatable and emotionally impactful. Participant 3 emphasized this duality by stating Heidi

"linked nature and innovation together,"

presenting Switzerland's heritage not as dormant, but as the seed for forward-thinking, sustainable design [50]. These perceptions stressed how the pavilion challenged assumptions and reframed national identity by synthesizing culture, sustainability, and technology. Heidi serves as a cultural bridge, reinforcing Swiss-Japanese ties and linking their heritage to a vision of future innovation [50][44]. As the pavilion title suggests, the Swiss pavilion showcased Switzerland's evolution from its Alpine lineage to a global hub of technology. The pavilion's various spaces offered a meditative space for visitors to engage with Switzerland's values of openness, sustainability, and advancement [45]. The Heidi Café, situated within one of the pavilion's spherical structures, was overgrown with plants and overlooks Osaka Bay as the pavilion presented biophilia beyond the exhibition space [45].

Biophilic architecture was portrayed as being able to achieve sustainability not just visually but structurally, resourcefully, and functionally. The Swiss pavilion was a compelling model of how innovations truly grounded in humanism and nature can shape built environments.

Case Study 2:

Figure 2: Germany Pavilion: "Wa! Germany". Copyright [2025] by the author



The German pavilion at Expo Osaka was the tangible embodiment of the future circular economy. The pavilion's architecture facilitated an exhibition that guided visitors through an extraordinary experience envisioning pathways toward a sustainable, circular world. The coined term "Wa" by the German pavilion signified three different meanings in Japanese: circularity, harmony, and exclamation [55]. The term encapsulates its overall focus on circular economy, the harmony and balance between nature and technology, as well as the awe-inspiring potential of sustainable design.

Circularity

The German pavilion architects aimed to answer questions such as, “Are circular cities our future habitats?”, “How will a circular economy succeed in securing our energy supply?”, “What does it mean for each of us as individuals to inhabit a circular society?” [57].

First and foremost, the seven circular wooden structures of the German pavilion visually depicted the theme of circularity through their exterior circular design, utilizing not only visual elements but also sustainable resources and recyclable materials. The German pavilion was symbolic of circularity in every component, which was intended for a second life beyond the duration of the Expo [56][61]. The pavilion featured various organic, sustainable materials, including hempcrete, loam, and fungal mycelia panels, which were specifically chosen for their biodegradability as a key aspect of its circular design [59]. This was explained to visitors through labeling and thorough explanations provided by their speaking mascot, which they carried around. Visitors of the pavilions noticed this as Participant 6 stated,

“I liked how even the materials of the walls were explained, and it was engaging being able to touch and feel the materials in real time alongside the explanation.”

The architects chose inorganic materials, such as steel and glulam structures, as they were driven by their recyclability within the industrial sector, aligning with the rejection of traditional concrete, which is responsible for over half of global emissions, in favor of sustainable materials [60]. Not only that, but the German pavilion also incorporated traditional sustainable materials, such as rammed earth and glass, which were repurposed [61]. This further demonstrates Germany's commitment to reducing carbon emissions and waste within its pavilion. The distinction of the materials not only being sustainable but also versatile with long-lasting utility paints a new vision for circularity and circular architecture that's not only eco-friendly but also practical in the meantime [59][60][57]. All of which mitigated environmental impacts and reinforced the German pavilion's commitment to long-term ecological goals.

The fusion of sustainability and innovation stems from tradition, honoring local knowledge, while advancing global sustainability goals. Many visitors felt the passion and hopeful outlook for the future of the circular economy through the German pavilion, as Participant 5 stated,

“I feel optimistic about the future, the German pavilion paints. I learned more about how foreign countries are making advances in such fields, and their commitment to circularity was conveyed effectively.”

It confirmed how visitors were able to notice and feel the thematic framing of the circularity in both the exhibition and the space they created. It illustrated sustainability as a humanistic endeavor through architectural storytelling. The German pavilion successfully achieved its goal of educating visitors on the circular economy and cross-cultural sustainability, particularly highlighting European perspectives.

Biophilic Design

In the German pavilion, biophilic design was integrated into its central theme of circularity through its architecture and landscape, as the architects predicted that the functions of a biosphere would become a key feature of urban environments in the future [52][53]. Out of the seven cylindrical wooden structures that comprised the pavilion, two that seamlessly merged into accessible green spaces and the roof garden paid homage to Expo Osaka 1970, highlighting

how the natural world evolved over time alongside architecture [59][62]. The pavilion featured a diverse array of natural species borrowed from local nurseries in Osaka. These plants enhanced both the aesthetic appeal and biodiversity, as well as ecological balance [61]. The green roofs and vegetation helped facilitate passive cooling in the pavilion, reducing the need for mechanical air conditioning—a key aspect of biophilic design [61]. Water management was another critical element of consideration for the German pavilion, as it featured permeable paving, bioswales, and gravel trenches to effectively collect rainwater runoff and repurpose it for irrigation later on [61]. This demonstrated how biophilic design contributes to a circular water system that mitigates flooding risks and supports plant life.

Culture

The German pavilion's take on culture was different from the others. Instead of focusing solely on its own national culture and tradition, it also took Japanese culture into account, keeping in mind that 90% of visitors were anticipated to be Japanese. The pavilion's exhibit featured a handheld talking circular mascot, 'Circulars', inspired by Japan's *kawaii* culture, to accompany visitors through the exhibition in an engaging and accessible format, offering options of German, English, and Japanese [63]. This was well accepted by visitors as Participant 6 stated,

"It was lovely, having a helpful and cute guide in my hands; it made me feel less alone and made it more comfortable to take my time to take in all the information."

The German culture was not evident as evident in its architectural form, as Participant Five commented,

"Other than the sign that read 'Germany,' I wasn't sure what other links there were to the country."

This highlights a limitation in cultural communication that the pavilion had, as it suggests the ecological themes may have overshadowed localized cultural storytelling. Nevertheless, culture was expressed through a sensorial aspect that emerged primarily with the smells, which were not initially considered in the Desk Study but were discovered during on-site research, as Participants Five and Six both commented that the scent of German beer, sausage, and pork knuckle had drawn them in and made it evident of its country origin.

The German pavilion served as a key testament to the indefinite potential of circularity and the integration of the circular economy into architecture. It was a powerful prototype for future sustainable design, aligning with the Expo Osaka's theme of "Designing Future Society for Our Lives," as it encapsulated the intersection of circularity and, biophilic design and culture through various means.

Case Study 3:

Figure 3: China: Building a Community of Life for Man and Nature-Future Society of Green Development. Copyright [2025] by the author



The Chinese pavilion embodied a strong sense of cultural architecture through its representation of historical heritage, while also incorporating sustainable design principles in the modern era, reflecting China's commitment to harmonious coexistence with nature and green development.

Culture

The pavilion was deeply influenced by China's cultural heritage, as it presented a powerful architectural narrative drawn from multiple traditional inspirations, mainly including ancient bamboo slips and calligraphy scrolls [64]. The pavilion's entrance featured an inscription of ancient Chinese poetry on bamboo slips, symbolizing the transmission of knowledge through time and cultural continuity in China [64]. The entirety of the pavilion functioned to represent China's 5,000-year-old civilization and its current vision of green development, bridging the past and the future [47]. Inside the pavilion, visitors experienced a column-free interior that fostered an open environment, mimicking the elongated, unfolding shape of a scroll [14]. The structures resembling scrolls not only paid homage to China's rich literary heritage and served as a visually striking symbol, but also fulfilled a practical purpose with their illuminations and energy-reducing innovations, acting as a cutting-edge showcase to the world of their ideas and technological advancements, both on the exterior and interior [47]. The Chinese calligraphy and poetry engravings feature 119 classical poems written in five different calligraphy styles, drawn from influential texts such as the *Shi Jing* and *Chu Ci*, as the pavilion took every opportunity to showcase its rich chronology at the Expo [54].

A notable feature of the Chinese pavilion was its ten-meter calligraphy 'waterfall' display. It narrated the evolution of Chinese writing over three millennia, and coupled with touchscreens that explore ancient scripts and poetry, it enabled national heritage to bridge modern technological presentation, reinforcing the pavilion's theme of cultural continuity and innovation [64]. Visitors in particular enjoyed the creative, engaging pathways in learning through such devices as Participant 1 commented,

“The touch screen with several language options was very helpful in incentivising visitors to learn.”

A unique initiative showcasing China's culture was that its exhibits and events were rotated through 30 different provinces and regions of China during the duration of the Expo, allowing visitors to experience a broad cultural narrative and diverse heritage [15]. Visitors were able to

relish in the eclectic, rich history and heritage of China, even with multiple visits, as Participant 2 stated,

“This is my second time here, and I was shocked to find new artifacts being displayed; it drew my attention to how they were different.”

The visitor’s response indicated that cultural semiotics were conveyed as intended and effectively embodied, as the pavilion succeeded in effectively showcasing a strong national identity of Chinese culture.

Yet, the pavilion’s contemporary use of literary characters led to confusion among visitors. Some mistakenly associated the Chinese pavilion with Japanese pavilion. This misidentification may suggest that the pavilion’s conceptual architecture, while appealing, may have obscured cultural signifiers for those less familiar with national distinctions. It raises questions about how linguistic cues in architecture function in international settings, whether clarity is sacrificed for artistic expression, and if ambiguities open discussions on cultural identity in geopolitics.

The dichotomy of the pavilion’s cultural symbols reflects the challenges of communicating complex cultural narratives in a globalized setting. Moreover, it suggests opportunities for future pavilions to strike a balance between contemporary design and artistic elements in architecture.

Biophilic Design

As previously introduced, the contemporary interpretation of bamboo culture was also incorporated into the pavilion’s ceiling design [66]. The bamboo-like ceiling decorations embodied the growth cycles of nature and agriculture, allowing visitors to feel ‘the life code’ in the exhibition space, where visitors could experience all four seasonal transitions in [66]. The interior of the pavilion had also incorporated natural lighting for a seamless flow, which enhanced the connection between humans and nature [47]. The benefit of natural light as the primary light source is not only limited to sustainability by reducing ecological footprints, but also creates a more visually comfortable space, reducing eye strain for visitors. In the pavilion, the material choice of bamboo, as one of its core materials—a renewable resource—demonstrated both traditional Chinese aesthetics and sustainable design, reinforcing the framework for culturally rooted biophilic design.

Circularity

While the primary focus was on the exhibition and structure, circularity and ecological vision were nonetheless key aspects of the pavilion’s architectural process as they implemented a zero-waste construction code [65]. For instance, the development of renewable bamboo-wood panels made with advanced 3D and Building Information Modeling (BIM) technologies highlighted how innovations contribute to the creation of a circular architecture [65]. These bamboo-wood panels were also prefabricated in Chinese factories, which reduced costs by 90% and mitigated waste, allowing them to be disassembled and reused in China after the Expo [65], thereby exemplifying circularity through responsible resource management. In addition, energy-saving features were also integrated into the design to accommodate the hot Japanese weather, including a centralized cooling system with optimized airflow, smart lighting, and energy-efficient elevators [54]. The construction process overall for the Chinese pavilion

minimized waste by utilizing augmented reality for design visualization, which reduced the need for on-site fabrication, upholding circular values, albeit being international.

The pavilion also displayed an immersive short film that conveyed China's vision of sustainable development, inspired by traditional Chinese solar terms, which heavily influenced how the exhibitions were set up [6]. This allowed visitors to discover China's cultural concepts through the exhibition, which enabled visitors to partake in the experience instead of passing by unknowingly. This emphasized the cyclical nature of time and the interdependence of humans and nature, conveying the substance of circularity in architecture.

This pavilion presented China's commitment to building a future world and economy that values sustainable design, while incorporating cultural representation. It showcases an example of architectural design that honors history, combining it with new and emerging technologies.

Case Study 4:

Figure 4: Italy: Art Regenerates Life. Copyright [2025] by the author



The Italian pavilion's theme, "Art Regenerates Life," was largely inspired by the Renaissance concept of the *Ideal City*—a utopian vision of urban design characterized by order and harmony. The pavilion thereby seamlessly merged art, culture, and innovation to present a visionary model of a reimagined *Ideal City*, also showcasing Italy's commitment to environmental responsibility and its cultural heritage.

Culture

The Italian pavilion was deeply rooted in the theme of cultural transmission, seeking to reinterpret rather than simply recreate symbols of its past [16]. Visitors to the pavilion were guided through an experience of Italy, featuring Renaissance paintings, sculptures, and cultural artifacts, as they gradually were lured to be "breathing the air of Italy" [21].

The Italian Pavilion attempted a bold cultural reinterpretation through its theme, *The Ideal City*, a reference to Italy's Renaissance concept of *la città ideale*, famously depicted in 15th-century perspective paintings by artists such as Luciano Laurana [17][20][21]. However, many visitors seem to have misinterpreted the reinterpretation presented in the pavilion's entrance, as the arched colonnaded entrance was misinterpreted as a nod to the Roman era, rather than recognizing the deeper allusion to the harmonious, rational geometry of Renaissance urban utopias. Participants 7 and 8 both picked out that

“The entrance reminded me of the Colosseum,”

as a significant indicator of the country's culture and origin, confirming the recurring misinterpretation that had been present at the Expo. In contrast, the Ideal City that they wanted to represent does not utilize arched entrances. The spaces between the initial entrance and the exhibition inside are what is known as a *portico* in the Renaissance era, specifically the *portici italiani*, which emphasized coexistence, rather than being outside or inside [19]. The Renaissance is also Greek, where ideals, techniques, and spiritual values were often explored in comparison to the Roman Empire, which was more pragmatic, focused on ownership and imperialism, and the spreading of culture. The architects' intention was to use those historic urban metaphors—the theatre, portico, piazza, and garden—to create a future-oriented “living fabric” that expresses Italy's regional diversity and innovative identity [16].

This meant it conveyed a different impression of intentions than intended, as the Roman era is heavily associated with conquest and war. In contrast, the Renaissance era was marked by significant discoveries and a period of rebirth [18]. What the architects of the Italy pavilion sought to convey was more representative of revolutionary cities, as well as the flourishing of inventions. Therefore, the intention was not clearly communicated to visitors, and as a result, it was ineffective.

It can be considered successful in that the pavilion successfully evoked strong cultural imagery through its architectural form for visitors. However, this misreading raises essential questions: Did the conceptualization rely too heavily on abstract motifs without offering clear interpretive guidance? Or was the execution perhaps overly simplified for the public, who expected more literal and familiar cues?

While the architects aimed to convey Italy's vision of reimagined utopian design through their reinterpretation of the *Ideal City* from the Renaissance era, the conveyed intentions did not align with the visitors' impressions, which raised questions about how abstract concepts can be better executed to facilitate easy understanding for visitors.

Circularity

Sustainability and circularity acted as a foundational philosophy within the Italian pavilion's reimagined architecture [16]. All the resources used and design choices were made in conjunction with a broader goal of adaptive reuse, making it a model of circular architecture [22]. For instance, the pavilion was constructed using certified laminated wood and a dry construction system, which allowed for reconfiguration and disassembly, enabling the materials to be recycled after the Expo, considering its six-month duration [22]. The exterior structure was made from permeable mineral fibres, which could passively regulate temperature, light, and airflow. It acted as both the skin of the pavilion and the interface that connected internal climate to external conditions, symbolizing Italy's transparent approach to sustainable design. The lightweight textile of the outer face reduced energy demands, enabling the pavilion to behave like a living organism, which allowed it to adapt to seasonal rhythms and environmental changes in Japan—a core tenet of circularity [22].

Biophilic Design

Lead architect Mario Cucinella stated, “The Italian Pavilion stands for a new idea of society, and for the city as a living organism where the relationships between people, art, the environment, and history can materialise” [21]. The Italian pavilion’s integration of biophilic design was intended to reconnect humans with nature. The rooftop of the pavilion featured an Italian-style garden that served as a contemporary labyrinth, with flowers and small trees that spread various scents, creating sensory dimensions inspired by Renaissance harmony and in keeping with the theme of the *Ideal City* [16]. The organic ecosystem speaks to today’s ecological imperatives, as the garden embodied native plants, fountains, sculptures, alongside winding paths that symbolized both human geometry and natural irregularity [16]. Biophilia at the Italian pavilion was multi-sensory and multi-spatial as the rhythms of the days were reflected in the pavilion’s exhibition, much like dappled sunlight through a forest canopy. This enhanced emotional awareness within the space serves as a deliberate antidote to the overstimulation of digital life, as it also recalls Japanese spatial philosophies of impermanence, which link Italian and Japanese approaches to beauty and environment. The theatre, piazza, and rooftop garden, together, formed a triptych of experimental biophilia that was all interconnected as spaces where art, nature, and architecture dissolved into one [16]. At the Italian pavilion, biophilic design was presented as a worldview that prioritized empathy and emotion, as well as ecological responsibility.

The Italian pavilion illustrated harmonious integration of cultural and sustainable practices. Though some symbolism was misinterpreted, the pavilion still encapsulated Italy’s commitment to building a future that values the ecological balance and cultural richness in urban architecture.

5. Conclusions

The researcher was drawn to the topic of sustainability, and in particular, took the four pavilions as the focal points of this study, analyzing them through the lens of circularity, biophilia, and culture. The architectural innovations displayed by official participants’ national pavilions at Expo Osaka demonstrated how sustainability must extend beyond technical performance, environmentally, to encompass broader social considerations. The unstructured interviews with pavilion visitors at the Expo highlighted how **the clarity of the architectural intentions play a large part in ensuring they are conveyed effectively**. As urban expansion in this century accelerates more and more and the SDGs deadline inches closer, the researcher hopes that the conclusions drawn from this paper’s analysis can inform future global efforts to build not just sustainably but meaningfully with empathy and regeneration at the root of architectural practice, since the most significant takeaway from the Osaka Expo’s pavilions was one of inspiration.

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Comments:

So, I like the overall set-up: there's a clear abstract, neat structure, and also a useful table that sums up how each pavilion tackles circularity, biophilia, and identity. The combination of desk research, on-site notes, and a handful of interviews gives it a nice first hand feel to be sure.

That said, I think the theoretical frame needs a bit more rigor. Perhaps the biggest thing for me is that the student name checks "regenerative architecture" and "cultural sustainability" (big buzz words in the field) but never quite explains how the two notions can overlap and at times clash.

→ Cultural sustainability has been further explained at page 3(red text) with the original reference '[37] Soini, K., & Birkeland, I. (2014). Exploring the scientific discourse on cultural sustainability. *Geoforum*, 51, 213–223. <https://doi.org/10.1016/j.geoforum.2013.12.001>'. The meaning of regenerative architecture overlaps with the notion of sustainability, so therefore, to avoid confusion, the adjective 'regenerative' has been removed. Thank you for this comment.

A short paragraph that focuses on conceptual distinctions early on would help strengthen the analytical sections that come after.

→ Distinctions have been clarified in the abstract and the introduction, stating that the three sub-categories will be analyzed later in the paper(red text). Thank you.

The methodology is also a bit light. 8 unstructured interviews, all with visitors who live in Japan, may be fine, but the author should tell us why that sample is enough and how the answers were coded.

→ While, reasons for the small sample and the choice of the demographic was already explained in page 6, paragraph 3.3 has been expanded with clearer explanations(red text). How the answers were coded are also now explained in page 6 paragraph 3.3(red text). Thank you.

Same with the three point rating scale in the table: what turns a two into a three?

→ Addressed in page 5 and 6(red text). Thank you.

And then there is the conclusion which claims that "narrative clarity and symbolism" are the big lessons of the Expo, yet that theme never really surfaces in the case studies. I would nudge the author to spell out that link.

→ 'Narrative clarity and symbolism' have been changed to 'clarity of the architectural intentions' in the conclusion. The intention behind the phrase, 'narrative clarity and symbolism' was to reference the Italy pavilion's misinterpretation of the architect's intent. Thank you.

Overall, these are moderate tweaks. Once they are sorted, I am sure the paper could move to external peer review!

→ Thank you very much!

I recommend this paper for publication pending minor revisions.

I found that this new version of the paper showed how much dedication and genuine curiosity the author has brought to the process of revision. It is clear that the author engaged deeply with both reviewers' feedback and used it as an opportunity to refine both the argument and the writing voice, making the structure feel purposeful and coherent. The introduction situates the reader effectively within the context of Expo Osaka 2025, and the strengthened framing of the three key dimensions (circularity, biophilia, and culture) gives the paper a clear backbone now. The expanded literature review also stands out as a major improvement, providing both historical grounding and conceptual clarity. It demonstrates the author's ability to weave together different types of sources (not just academic but also institutional and design-based) into a cohesive narrative that supports the paper's central argument.

The analyses of the individual pavilions are rich and engaging on many levels. The author successfully captures the spirit of each project, from the Swiss pavilion's biophilic design and cultural storytelling to the German pavilion's focus on circularity, and the Chinese and Italian pavilions' dense symbolic and interpretive layers. One can tell that the balance between description and analysis has improved significantly, allowing the reader to understand both what was observed and why it matters. The integration of visitor interviews adds a very important human and experiential dimension to the paper, grounding the discussion in real perceptions rather than abstract ideas. Notably, the reflection on how visitors sometimes misread architectural intent, in the Italian pavilion most significantly, offers valuable insight into the relationship between design, communication, and sustainability. These moments of interpretation feel well considered, as they give the work a non-negligible affective dimension (a component of architectural analysis that's too often neglected), in addition to the required intellectual depth.

Before publication I would recommend working on a couple more details, namely giving the methodology section a little more precision and polish so that it reads with the same clarity as the rest of the paper. It would help to explain briefly why unstructured interviews were the most appropriate choice, how participants were selected, and whether there were any limitations to the process. Even two or three sentences here would make the research design feel more deliberate and academically grounded. The author might also revisit a few recurring phrases across the case studies and vary them slightly, since expressions such as "strong commitment to sustainability" or "successfully integrated" appear often and can lose impact with repetition (a minor detail). The transitions between case studies could also be made smoother by inserting a short linking line at the end of each section that reminds the reader how the example advances the broader argument about sustainability's multiple dimensions.

Finally, it would be wise to go through the reference list carefully one last time to ensure consistency and reliability, especially for items that currently appear incomplete or difficult to trace. Citation n.69 looks like a conference proceeding or student symposium paper more than a peer-reviewed source (from looking it up online), the author could perhaps look to the bibliography of this conference proceeding to find a more reliable source. A few web-based references could also be formatted more precisely, with stable URLs and full retrieval information, to maintain a professional standard. Finally, attentive proofreading will help eliminate small grammatical errors and occasional awkward phrasing that interrupt the otherwise fluent style. These final adjustments are relatively minor, but they will give the paper the polish and precision it needs to reach publication quality.

Review of Paper Submitted to Convergence Journal:
“Sustainability Spaces: Circularity, Biophilia and Culture in Expo Osaka 2025 Pavilions”

Recommendation: Accept, with moderate revisions

The paper is insightful in connecting each pavilion to one or more specific facets or factors of sustainability. The mixed methods approach provides a variety of interesting perspectives, ranging from official descriptions to secondary sources to first-person accounts of visitors; this combination is intriguing and effective. The descriptions of the pavilions are engaging and compelling, particularly that of the Swiss pavilion.

The researcher effectively leveraged their native knowledge of Japanese language and culture to interpret and present elements of the pavilions, as with the “Wa” of the German pavilion, and that pavilion’s integration of elements of Japanese popular culture. The reader appreciates this level of knowledge and detail.

Overall, the connection between cultural elements and sustainability could be more convincingly established and explained. For example, while the author explains that some of the interviewees expressed confusion about the cultural signifiers at the China pavilion, the connection of this issue to the broader sustainability theme is not fully clear.

The following sentences should be removed: “In qualitative research, depth often holds more value than breadth, therefore, the sample size was kept minimal. It was sufficient for the study to uncover preliminary patterns and initial reactions to the pavilions.” It comes across as a defensive justification for the small number of interviewees and the preliminary nature of the findings; it is not necessary, convincing, or helpful. Having eight interviews is fine; this can be rephrased in a more positive light.

The paper explains the selection criteria for the pavilions and the interviewees. The attributes of the interviewees, beyond the fact that they are elderly Japanese local residents, could be further elucidated.

A sentence about the Italian pavilion would benefit from revision: “However, many visitors seem to have misinterpreted the reinterpretation presented in the pavilion’s entrance...” It is unclear what is meant by “many,” given that there were two interviewees for each pavilion (the two interviewees who are numbered 7 and 8, in the case of the Italian pavilion). The phrase “misinterpreted the reinterpretation” is somewhat convoluted as well and could be adjusted for clarity. More importantly, the connection between this discussion (about cultural symbols) and the broad theme of sustainability is, again, tenuous. Either the connection could be strengthened, or the elements of culture and environment could be explicitly differentiated. The paper’s Conclusion could do this more effectively as well, though it does effectively summarize the paper’s questions and findings.

The Conclusion would be far stronger if it were to recommend ideas for future research. In other words: what questions are the product of this study? This means, what questions can the researcher ask now that the researcher would not have known to ask prior to the study? Limitations of the study, and any challenges or uncertainties in the interpretations, could also be acknowledged and briefly mentioned.

The introduction is effective and convincing in explaining the context, significance, and contributions of the Expo. The connection between the Expo and the UN's SDGs is made clear to the reader. The use of detailed explanations of the key terms, including authoritative references and, crucially, helpful examples, make the subcategories easy for the reader to understand and appreciate.

The methodology is clearly presented, and the paper's citations and references are effectively used and thoroughly implemented.

Both the introduction and the literature review present key concepts from prior research, situating the current study and informing the reader about the relevant background information. The explanations about Expo history and about the concept and theory of sustainability are particularly effective.

The paragraph that was added to the abstract (in red) is effective in summarizing the purpose and findings of the research. However, the paragraph needs some editing. I have edited it, as follows – additions are in bold, and removed text has strikethrough; edited parts are highlighted in yellow for reference.

“This research suggests that the future lies in sustainable architecture, where **the** three sub-categories of circularity, biophilia, and cultural identity converge to ~~allow~~**transform how** ~~people~~**we to** build and interact with the world more effectively. This research unpacks the concept of sustainability ~~by analyzing and so analyze~~ the above **subcategories**, defining the current and future directions of living.”

Some of the wording needs adjustment. For example, the term “sub-paragraphs” is confusing. There are some minor grammatical errors; for example, the subject and verb of a sentence should not be separated by a comma. Proofreading is needed; for example, the header “Criteria for the Selection and Categorization Pavilions” is missing the word “of” before “Pavilions.” The term “leading question” has a pejorative connotation in English and should be replaced. However, overall, the paper is quite clear and the writing is of high quality.

Feedback on Convergence submission 100023

I recommend this paper be significantly revised and resubmitted. I think there are some elements here that could be shaped into a higher quality manuscript, but there is definitely a need for major revisions to justify publication. If significant changes are not made in line with this feedback, however, I would suggest rejection.

The biggest strength here is the observational data about the Expo itself. I feel like there is a lot of material that could be used to build a more robust argument if there was some additional structure and context added to the paper overall. The main thing that felt like it was missing was engagement with literature, disciplines, and scholarly conversations on this topic. There was very little in the way of a clear argument-- the content was primarily descriptive-- and even as I made my way to the conclusion I was unsure what the author wanted me to take away after reading the text. I thought the writing style was understandable and easy to read overall, and if used in service of the development of an argument I feel it would be effective.

My biggest suggestions for improvement have to do with situating this work within a scholarly context and explaining and integrating the observational data into a clear, well-structured argument.

The author does not really explain how or why they chose the methods they did, and it was difficult to tell what style of analysis (e.g. from what disciplinary bases) they thought they were doing with the data. For example, the way in which the list of questions is cut and pasted into the article on pg. 6 felt out of line with how this kind of interview data tends to be presented in the social sciences and was distracting in terms of understanding what the author was trying to do. I'd remove it entirely. Rather than spending so much time going on about details of the methodological choices there should be a stronger explanation of why these kinds of methods can provide particular insight into the chosen topic.

I also felt like the quotes which were included felt poorly integrated into the paper overall. They mostly felt general and a bit distracting, and they definitely didn't feel robust enough to stand alone in terms of analysis, which feels like what the author was trying to do. If they're not integrated into a broader argument, I'd just stick with the more visual/observational aspects of the data, since the author seems more comfortable with those. Additionally, there is no connection of the methods to the arguments getting made-- I don't quite know what field the author wants to be contributing to here, and I think that needs to be made clearer, perhaps through building a stronger disciplinary context as suggested in the rest of my comments.

There is virtually no peer reviewed literature included in this paper nor is there much context of either historical or disciplinary context (is it meant to be architecture? heritage studies? something else?). Particularly given the rich historical background around these kinds of exhibitions, I found it notable that the author did not present that background at all. A section discussing the role of Worlds' Fairs and expos and their

historical roles and impacts would do a lot to show why the reader should care about the various elements presented later in the paper.

The other contextual issue comes from the choices made around the analytical categories engaged in the discussion of the various case studies. It is VITAL that the author present in clear, specific terms how they are defining these categories and where they come from. Is it from architecture? Sustainability more broadly? It's not enough to allude to them, I want a clear formulation such as "the concept of biophilia is [clear definition] and comes from [wherever]" before the author proceeds to explain the usage of these categories. Otherwise, it is unclear why the reader should think these analytical categories are worth thinking about. If these concepts are important in the field, explain "why" to the reader, and then make sure the link between the ideas and the cases are clear.

To be very specific, based on the way "circularity" is engaged in the text, for example, it is not completely clear that the author doesn't think the concept has to do primarily with things being circular. Also to someone from an anthropology and heritage background, the very vague idea of how "culture" is being used seems close to stereotyping and ethnocentrism.

Ultimately, I think this is an interesting topic, and there is possibly some good data (at least the visually related elements), but the structure and focus feels a bit arbitrary and without a clear argument it feels more or less entirely descriptive. I think the author needs to really figure out what they are trying to say (and how) to strengthen the quality of their work and really pull this together into something of publishable quality.

Sustainable Spaces: Circularity, Biophilia, and Culture in Expo Osaka 2025 Pavilions

Abstract:

This paper examines how key components within sustainability—circularity, biophilia, and culture—were demonstrated at Expo Osaka 2025. Four national pavilions were carefully selected from attending countries: Switzerland, Germany, China, and Italy, all of which exemplified unique, future-forward approaches to sustainable design through architectural means. The primary focus of this paper was to examine how architects have called for action in addressing the pressing ecological challenges of the 21st century, aligning with Expo Osaka's overarching theme of "Designing a Future Society for Our Lives."

This paper incorporates primary and secondary research to investigate, firstly, how the pavilion's architects attempted to depict the overarching theme of sustainability, and secondly, what the visitors experienced and felt about each selected pavilion. This was achieved through thematic analysis of case studies on selected countries' pavilions, on-site fieldwork, and interviews with visitors.

This research suggests that the future lies in sustainable architecture, where [the three subcategories](#) of circularity, biophilia, and cultural identity converge to [allow people to](#) build and interact with the world more effectively. This research unpacks the concept of sustainability [by analyzing](#) the above [subcategories](#), defining the current and future directions of living.

1. Introduction:

Japan was the host country for the World Expo 2025 in Osaka prefecture. The pavilions showcased the official participants' nations' attitudes on innovations and concepts at the Expo. One of the World Expo's primary purposes is to serve as a global cultural exchange in a single location, inspiring hope worldwide by showcasing progress in addressing global challenges, while fostering a sense of community and collaboration on a worldwide scale [1][9][69].

The Osaka Expo lasted 184 days, from April 13th to October 13th, 2025. An event as large-scale as World Expos holds the power to change behaviors and inspire globally, which sparks anticipation of the event's lasting impact on society, the economy, and the environment [7][71]. The urgency for progression in sustainability was particularly heightened at Expo Osaka, as it was the final Expo before the 2030 deadline for achieving the Sustainable Development Goals (SDGs). Therefore, this particular Expo was the materialization of not only the accumulated achievements of the SDGs, but also a leap beyond, "SDGs + Beyond", anticipating a larger future beyond 2030 [7].

Additionally, the demand for built urban environments is escalating at an unprecedented pace, as forecasts indicate that by 2060, Earth will have constructed over twice the current total built

area [3]. This is raising concerns globally about where and how the resources required will be provided. Visions such as *Japan's Society 5.0* introduced with Expo Osaka 2025, illustrated the importance of sustainable and human-centered architectural solutions that also align ecological well-being with economic development [4].

In addition to *Japan's Society 5.0*, Expo Osaka aimed to bring forward ways of enhancing global quality of life, under its overarching theme of "*Designing a Future Society for Our Lives*" [1][7][8]. With the Expo's theme in mind, the architects of national pavilions incorporated circularity, biophilic designs, and a culturally sensitive approach into their practices.

Later in the paper, a clear distinction and description of the three **subcategories** (circularity, biophilic design, and culture) are presented and discussed.

Another focus of the Expo was on resource management, as many pavilions considered material pollution and the importance of natural restoration and circularity in the larger context of sustainability [7][8].

While the technological spectacles at World Expos are likely to capture immediate attention from visitors, this paper argues that equal, if not greater, attention should be paid to how national pavilions utilize architecture to generate discussions and interest in sustainable practices and cultural narratives, thereby promoting a brighter future. In this paper, the highlights are of the fundamental purpose of Expos, which is to serve as blueprints for environments that nurture both humans and the Earth.

2. Literature Review:

World Expos are large-scale global gatherings where numerous countries come together every five years to showcase their achievements in multiple fields that all started with the Great Exhibition of London in 1851, and 35 Expos have followed. **Within a dedicated physical space, Expos aim to uncover and exchange solutions to contemporary challenges through interactive exhibitions by nations all around the world [69]. Furthermore, Expos have advanced knowledge-based architecture by fostering collaboration between architects, engineers, and scientists [69].** As each Expo showcases impressive advancements in technology, science, economics, and more, each Expo has attracted millions of visitors worldwide, leaving a lasting, unique impact on the host city each time [7][71].

One of the key global challenges in the most recent Expos has been sustainability [10][11]. The United Nations Brundtland Commission's 1987 definition of sustainability provided the foundation that Expos' architects built upon: "meeting the needs of the present without compromising the ability of future generations to meet their own needs" [12]. With architecture being responsible for approximately 40% of the world's carbon emissions, Expo Osaka's architects gave a large amount of attention to create reflective pavilions, focusing on how to take sustainability a step further.

In this paper, the definition of sustainability extends past environmental commitment. Sustainability in this paper encompasses **subcategories** of circularity, biophilia, and culture in

architectural practices, offering a multifaceted approach that is subjectively interpreted by the architects [8][7].

Circularity:

The concept of circularity originated from the field of sustainable development and the theory of the circular economy. Circularity revolutionizes the management and utilization of construction materials by minimizing waste of raw materials and breathing a second life into previously overlooked materials [24]. Circularity challenges the traditional 'take-make-dispose' model and instead promotes regenerative cycles within the built environment [68]. Circularity has recently emerged as a cornerstone in sustainable architecture, and thus, has been showcased more explicitly by nations' pavilions in recent Expos, which is why circularity was chosen as one of the focal points in this research.

A prime example is the Netherlands' pavilion at Expo Hannover 2000. The pavilion demonstrated the prospect of circularity through its architecture. With its six-floor structure, which integrated various forms of nature, such as water, vegetation, and energy systems, the pavilion highlighted circularity through a unique and distinct architecture that encouraged visitors to open their minds to circularity as a viable component in sustainable architecture [13][23]. A more recent example was at Expo Milan 2015, with the Italian pavilion. It further advanced the potential of circularity by evolving the 'cradle-to-cradle' approach through its use of structural materials and construction that once again brought circularity to more people [25][28][24]. The Italian pavilion's exterior was made of cutting-edge photocatalytic elements of new concrete and other materials, such as photovoltaic glass, which was also designed to be able to be fully dismantled and be reused afterwards. Through both their forms and function, these pavilions were significant testaments to how sustainable architecture could be circular: adaptable, reversible, and resource-conscious altogether [26][27].

Biophilic Design:

Biologist Edward O. Wilson was the first to introduce the concept of biophilia in 1984 in his book 'Biophilia'. It described the innate human affinity for nature and living systems. In architecture, biophilic design seek to expose people to natural elements for example, through the integration of daylight, greenery, or sensory flow. It supports psychological well-being beyond environmental impact, yet has been discounted in the context of sustainability [29]. Biophilic design contributes to sustainability as the integration of it reduces energy consumption, enhances indoor environmental quality, and supports biodiversity in various landscapes. It was chosen as the second key component to be explored in this paper as truly sustainable design extends beyond meeting ecological metrics.

In previous Expos, the Japan pavilion at Expo Aichi 2005 introduced biophilic design on a scale that had been rarely witnessed prior [31]. The architecture of the Japan pavilion was primarily composed of recycled paper tubes and bamboo-and-paper membranes, which had an emphasis on natural and renewable materials that served both aesthetic and environmentally friendly purposes [32][33]. Following suit, the Singapore pavilion at Expo Dubai 2020 pushed the boundaries of biophilic design by dominating an arid indoor climate with immersive green spaces, including a vertical garden, a forest valley, and a canopy walk framed by hanging gardens [34][35]. This achieved a net-zero energy and water footprint, serving as a 'living' model of climate-resilient and human-centered architecture and becoming one of the clearest

manifestations of biophilia at an Expo. Biophilic design in architecture is not only aesthetically pleasing to the human eye, but it can also serve as a sustainable system that reduces reliance on artificial climate control and contributes to the long-term health of humans [30].

Culture:

World Expos, in other words, are an international platform for countries around the globe to showcase their culture, heritage, and values through architectural means [36]. **Furthermore, culture is integral to Expo pavilions and the Expo itself [2].** Sustainability includes culturally preserving and adapting these unique identities in a climate-conscious world, which is becoming increasingly inherent to architecture, according to studies that name this phenomenon as cultural sustainability [37].

In this paper, culture refers to the shared symbolic systems, values, and norms that shape human communities and differentiate them from the natural environment.

At first glance, culture may not appear integral to sustainability, as the origin of sustainability is rooted in ecological concerns. However, culture, alongside environmental components, is increasingly becoming recognized as a vital aspect of sustainability. This is because culture shapes how societies understand, value, and interact with their environments.

Culture is a significant shaper of people's behaviors, consumption patterns, and relationships with natural resources, and consequently impacts the design, applicability, and sustainability of solutions in our society. It fosters a sense of belonging and tradition, and bolsters community resilience in the face of social and environmental change. Cultural heritage is also a reservoir of embodied knowledge and adaptation techniques that can inform innovative and locally suitable methods of sustainability. UNESCO's Culture for Sustainable Development agenda highlights culture as a cross-cutting enabler of the 2030 Agenda and its Sustainable Development Goals through emphasizing that advancement in sustainability cannot be achieved without integrating cultural identity and heritage into practice [67]. Unless cultural viewpoints are incorporated, sustainability could potentially develop into a generic approach that is disconnected from real-life experiences of the populations it is intended to benefit.

Architect Mario Cucinella is another advocate for a view of sustainability that goes beyond technical solutions to include a cultural and humanistic understanding of sustainable architecture. He highlights the interconnectedness of ecosystems and disciplines as a model for integrating cultural complexity into design [5]. Sustainable architecture is more than just reducing carbon output or improving efficiency. Additionally, it requires creating an understanding of environmental challenges as well as including historical and cultural understanding, thus guaranteeing that design in architecture interactively engages human and ecological environments.

In Expo Shanghai 2010, the UAE pavilion drew inspiration from the expansive and streamlined forms of the UAE's sand dunes to echo its natural topography [38]. Not only did its outer shell pay tribute to traditional motifs of the UAE, but by combining traditional customs and methods with innovative, sustainable design principles, it became a tangible metaphorical representation, linking past historical contexts and vignettes of successful integration of cultural identity into a sustainable context.

More recently, at Expo Dubai 2020, the Morocco pavilion showcased a refined view of cultural architecture by drawing upon Morocco's vernacular architecture. Particularly, the incorporation of an earthen facade that utilized traditional construction methods best suited to the host nation, Dubai's hot climate, resulted in a minimized carbon footprint for the pavilion. Such culturally and environmentally aware design choices by the architects demonstrated how a country can leverage its culture to resonate with visitors and bridge information gaps, fostering a sense of community within a contemporary Expo setting [39][40][41].

These pavilions exemplified how the architecture of Expo pavilions can serve as vessels to convey cultural narratives while simultaneously addressing environmental challenges.

This paper evaluates two national pavilions from Western and Eastern cultures to present diverse perspectives on how different nations incorporate culture into Expo Osaka 2025's sustainable narrative.

The case studies in this paper push to consider how these themes intersect and reinforce one another: circular systems reduce long-term environmental strain, biophilic strategies ensure those systems support human well-being sustainably, and cultural expression, when sustainable, anchors innovation in continuity and meaning. Revealing how Expo pavilions can inform future architectural practice that not only builds sustainably but also lives sustainably, with empathy, adaptability, and cultural consciousness at its core [70].

3. Methodology:

After a thorough examination and observation through Expo Osaka's official website and reports, as well as architects' portfolios prior to the Expo, the selected four pavilions and three emerging [subcategories](#) from the theme of sustainability were chosen as the focal points of this study to highlight some of the remarkable revolutions in architecture: circularity, biophilic design, and cultural expression. This paper used a mixed-methods approach to gather qualitative data through numerous case studies and thematic analysis.

The fieldwork involved in-person observations and photographic studies of selected pavilions at Expo Osaka, along with brief interviews with a small group of eight Expo visitors conducted in April and May 2025. Five key questions were composed to gain a deeper understanding of visitors' feelings and impressions of the pavilions and how architects attempted to convey specific artistic messages. These conversations strived to capture authentic, ordinary reactions of visitors rather than focus on the technical understanding of the subject. The interviews were conducted with a small group to gather richer qualitative information and helped establish a trusted relationship between the researcher and the interviewees, enabling more genuine responses.

This approach aimed to provide a holistic view of how the three [subcategories](#) of sustainability, circularity, biophilic design, and cultural expression are intertwined within the Expo's architectural pavilions, through detailed architectural case studies of four national pavilions at Expo Osaka: Switzerland, Germany, China, and Italy. In the following [sections](#), each method is described in more detail.

3.1 Desk Study:

This research was conducted months prior to and the initial months after the opening of Expo Osaka 2025. Diverse sources were systematically consulted for the Literature Review and case studies on the four pavilions. The official Expo 2025 website and reports that were public provided updated information on pavilion themes and design intentions. The architects' official pages offered deep insight into the conceptual frameworks, design philosophies, and material choices. Architecture journals and media outlets provided an insight into how sustainability and architecture are portrayed in the media to the people, and several relevant publications and books in the fields of sustainability, circularity, biophilic design, and culture.

3.2 Criteria for the Selection and Categorization of Pavilions:

Out of all international pavilions at Expo Osaka 2025, this paper only covers the four most relevant pavilions, as identified in the Methodology: Switzerland, Germany, Italy, and China.

Switzerland's pavilion was chosen to represent biophilia due to its strong focus on natural materials and their sustainable functions, as well as environmental responsibility. Germany's pavilion was selected to represent circularity as it reflected a growing trend toward an architecture that prioritizes fostering a zero-energy circular economy. For culture, the pavilions from Italy and China were selected to compare Eastern and Western cultural expressions through their architectural forms, as both pavilions outwardly present their culture as their focal eye-catching feature.

Table 1: Intensity of Sustainability Subcategories Being Represented Across Selected Expo 2025 Pavilions

| Country: | Circularity | Biophilia | Culture |
|-------------|-------------|-----------|---------|
| Switzerland | 1 | 3 | 2 |
| Germany | 3 | 2 | 1 |
| China | 1 | 2 | 3 |
| Italy | 2 | 1 | 3 |

Table 1: This table provides a comparative evaluation of how each selected pavilion, Switzerland, Germany, Italy, and China, prioritized the three identified subcategories of sustainability: circularity, biophilic design, and cultural expression. Each country was rated on a scale of 1 to 3 for all three subcategories (circularity, biophilia, and culture), with 3 indicating the most intense thematic emphasis, based on a qualitative analysis through the Desk Study. A 1 indicates that the sub-theme was minimally present with slight mentions with trivial integration into the design and message. A 2 indicates that the sub-theme was moderately developed and there was evidence of the sub-theme influencing parts of the design or message; however, it was not central or deeply embedded. A 3 indicates that the sub-theme was strongly emphasized through

the design and message through the architectural choices and storytelling, with a clear and intentional integration aligned with sustainability.

3.3 Interviews:

Unstructured interviews were conducted with a small group of eight people **through opportunity sampling** to obtain richer, qualitative insights and encourage authentic responses. The target interviewees were adults and elderly residents in Japan. The demographic was chosen because many Japanese citizens view the Expo as an educational facility showcasing global innovations based on the year's theme, rather than a tourist location, with some having attended previous Expos in Japan as a part of their school expeditions.

Interviewing Japanese residents cultivated authentic dialogues between the researcher, a native Japanese speaker, and helped overcome any potential language barriers. **It was fascinating to note that most of the interviewees were well-educated and came from diverse backgrounds, including construction, teaching, and business.**

This was an on-field research, and therefore, the interviewees were visitors of the EXPO with a genuine interest in architecture and related fields, and to contribute to potential research.

Participants 1 and 2 were interviewees at the China pavilion, while participants 3 and 4 were at the Swiss pavilion, participants 5 and 6 were at the German pavilion, and participants 7 and 8 were at the Italian pavilion. **These interviews were conducted directly and immediately at the Expo pavilions to allow participants to continuously view and accurately assess the pavilions from their own perspectives without having to rely on potentially erroneous recollections.**

Guiding questions were well-developed before the site visits in order to help the conversations flow with the interviews.

4. Analysis

Case Study 1:

Figure 1: Swiss Pavilion From Heidi to High-Tech. Copyright [2025] by the author



The Swiss pavilion brought much inspiration from the nation's proud, diverse landscapes and traditions. The pavilion embodied a harmonious blend of biophilic design, circularity, and cultural storytelling, with the pavilion having a strong emphasis on "Innovative Switzerland". This was achieved through a powerful showcase of both sustainability and prosperity that highlighted the nation's innovations in its spherical bubble-like structures.

Biophilic Design

The architects aimed to convey their national innovations as being rooted in 'a tradition of humanism and a sense of nature' by designing the Swiss pavilion to provide a glimpse into the beautiful nature of Switzerland [42].

Biophilic elements were clearly physically interwoven with the pavilion's architecture, comprising Swiss local plant species, such as wisteria, sourced from their nurseries, which were then transported and grown directly onto the exterior of the five spherical structures. This 'living' skin of the pavilion's structure was one of the focal points of the pavilion, as each kilogram of plant mass at the Swiss pavilion corresponded to one kilogram of CO₂ absorbed from the environment [43]. Participant 3 praised the exterior landscape of the Swiss pavilion, reinforcing its effectiveness in conveying the significance of biophilia, as they stated,

"I found the weaving of plants and flowers on its exterior to be eye-catching and pleasing to the eye. ... Learning about how they exceed the aesthetic appeal and function as sustainable elements later on was a wonderful addition."

The flora elements provided an additional biophilic design factor with local plants being planted across the building's surface and surroundings that reinforced the architects' pride for their nation's natural landscapes [42]. To further engage a biophilic intention, light, ventilation, and color were all scenically manipulated to create a welcoming ambiance and distribute visitors freely throughout the pavilion [42][45]. Not only that, but the one-level plane of the pavilion further enabled accessibility and sustainability by avoiding the use of vertical circulation, of elevators and escalators [42].

The spheres utilized pneumatic pressure in its ETFE shells instead of walls and eliminated the need for airlocks. This allowed for a subtle permeation of fresh air at all times, enabling the interior of the pavilion to maintain a natural airflow in harmony with the ambient environment [42][45].

The Swiss pavilion was successful in incorporating innovative biophilic design elements and it was a model example of how biophilic design can be utilized to optimize sustainable architecture in the future.

Circularity

The spherical structure was the pavilion's standout feature; weighing approximately 400 kilograms, it represented one percent of a conventional building and earned the distinction of having the lowest ecological and carbon footprint among all pavilions at the Expo [45][44][48].

This impressive lightness of the pavilion stemmed from the external shell, made out of what is known as an ETFE membrane, which replaced traditionally heavy materials such as concrete [51]. This membrane allows natural light to pass through whilst offering dual-coloration of surfaces, which saved unnecessary energy, resources and the need for massive machinery [45]. The membrane used was a modular and reusable construction material fit for sustainable architecture [48]. Its high initial cost and temperature-related challenges limit its applicability. However, the Swiss pavilion showcased new potential with the material through its unique plans to repurpose the easily disassemblable membranes, turning them into furniture [48]. This demonstrated a strong commitment to sustainability and the promotion of the circular economy, extending beyond the Expo. They furthermore collaborated with students and professors from the Kyoto Institute of Technology in their early design stages, which further emphasizes how sustainability had always been at the forefront of the architect's intentions [45][49].

Culture

The architects blended environmental innovation with Swiss' cultural values through iconic imagery featuring Heidi and the Girl of the Alps that emotionally resonated with visitors [50]. The character, Heidi was the perfect choice for a cultural symbol, as she embodies the intersection of cultural motif and sustainability, symbolizing Switzerland's abundant nature in a city of technology [37]. This was especially evident in the responses of Japanese visitors to question two, as Participant 4 stated,

"Heidi was another key aspect they were promoting heavily, whom I loved since I learned about her in elementary school."

Their reference to Heidi reinforced the notable impact that Switzerland employed through strategic cultural symbolism to make its biophilic message relatable and emotionally impactful, particularly to those familiar with the 1974 animation adaptation. Participant 3 emphasized this by commenting that Heidi

"linked nature and innovation together,"

presenting Switzerland's heritage not as dormant, but as the seed for forward-thinking, sustainable design [50].

Heidi served as a cultural broker to enhance relations between Japan and Switzerland while linking their cultures to a desirable future of innovation [50][44]. As suggested by the name of the pavilion, the Swiss exhibition showcased Switzerland's development from its Alpine heritage to a world technology hub. Various zones of the pavilion included an introspective space to allow visitors to ponder Swiss values of openness, sustainability, and innovation [45]. The Heidi Café, inside one of the dome-like structures of the pavilion, featured greenery and a glimpse of Osaka Bay, thus stretching the principle of biophilia beyond the boundaries of the exhibition hall [45].

The Swiss pavilion is a compelling model of how innovations truly grounded in humanism and nature can shape built environments. Specifically, biophilic design was portrayed as being able to achieve sustainability not just visually but structurally, resourcefully, and functionally by the Swiss pavilion.

Case Study 2:

Figure 2: German Pavilion "Wa! Germany". Copyright [2025] by the author



The German pavilion was symbolic of circularity in every component, which was intended for a second life beyond the duration of the Expo [56][61]. The coined term “Wa” by the German pavilion signified three different meanings in Japanese: circularity, harmony, and exclamation [55]. The term encapsulates its overall focus on circular economy, the harmony and balance between nature and technology, as well as the awe-inspiring potential of sustainable design.

Circularity

The German pavilion architects aimed to answer questions such as, “Are circular cities our future habitats?”, “How will a circular economy succeed in securing our energy supply?”, “What does it mean for each of us as individuals to inhabit a circular society?” [57].

Firstly, the seven circular wooden structures of the German pavilion visually depicted the theme of circularity through their exterior circular design, utilizing visual elements to convey its focus and commitment to circularity in architecture. The various organic, sustainable materials, including hempcrete, loam, and fungal mycelia panels were specifically chosen for their biodegradability as a key aspect of its circular design by the architects [59]. This was explained to visitors through labeling and thorough explanations provided by their speaking mascot, which they carried around. Visitors of the pavilions noticed this as Participant 6 stated,

“I liked how even the materials of the walls were explained through the talking hand-held mascot. It was immersing, being able to touch the raw materials with the explanation was a factor I deeply appreciated.”

While some inorganic materials were used, materials that would be easily recycled within the industrial sector, such as steel and glulam structures, were chosen. At the same time, rejecting other inorganic materials, such as concrete, that are responsible for over half of the global carbon emissions [60]. The architects also incorporated traditional resources of rammed earth to be repurposed after the Expo, which further reinforces Germany's commitment to circularity and reducing waste [61]. The distinction of the materials not only being sustainable but also versatile with long-lasting utility paints a new vision for circularity and circular architecture that's not only eco-friendly but also practical in the meantime [59][60][57]. All of which mitigated environmental impacts and reinforced the German pavilion's commitment to long-term ecological goals.

The fusion of sustainability and innovation stems from tradition, honoring local knowledge, whilst advancing global sustainability goals. Many visitors felt the passion and hopeful outlook for the future of the circular economy through the German pavilion, as Participant 5 stated,

“I feel optimistic about the future, the German pavilion paints. I learned more about how foreign countries are making advances in such fields, and their commitment to circularity was conveyed effectively.”

It confirmed how visitors were able to notice and feel the thematic framing of the circularity in both the exhibition and the space they created. It illustrated sustainability as a humanistic endeavor through architectural storytelling. The German pavilion successfully achieved its goal of educating visitors on the circular economy and cross-cultural sustainability, particularly highlighting European perspectives.

Biophilic Design

In the German pavilion, biophilic design was integrated into its central theme of circularity through its architecture and landscape, as the architects predicted that the functions of a biosphere would become a key feature of urban environments in the future [52][53]. Out of the seven cylindrical wooden structures that comprised the pavilion, two that seamlessly merged into accessible green spaces and the roof garden paid homage to Expo Osaka 1970, highlighting how the natural world evolved over time alongside architecture [59][62].

The pavilion featured a diverse array of natural species borrowed from local nurseries in Osaka. These plants enhanced both the aesthetic appeal and biodiversity, as well as ecological balance [61]. The green roofs and vegetation helped facilitate passive cooling in the pavilion, reducing the need for mechanical air conditioning—a key aspect of biophilic design [61].

Culture

The German pavilion's take on culture was different from the others in two ways. Firstly, instead of embedding culture into the structural elements of the pavilion, culture was represented mainly through the exhibition experience. Secondly, in place of focusing solely on its own national culture and tradition, the German pavilion also highlighted Japanese culture. This was indeed effective in garnering excitement and engagement with the handheld talking circular mascot, 'Circulars', inspired by Japan's *kawaii* culture [63]. This was well accepted by Japanese visitors during the Expo, especially as Japanese visitors made up 90% of the total Expo visitors, as Participant 6 stated,

“It was lovely, having a helpful and cute guide in my hands; it made me feel less alone and made it more comfortable to take my time to take in all the information.”

The German culture was not evident in its architectural form, as Participant Five commented,

“Other than the sign that read 'Germany,' I wasn't sure what other links there were to the country.”

This highlights a limitation in cultural communication that the pavilion had, as it suggests the ecological themes may have overshadowed localized cultural storytelling. Nevertheless, culture

was expressed through a sensorial aspect that emerged primarily with the smells, which were not initially considered in the Desk Study but were discovered during on-site research, as Participants Five and Six both commented that the scent of German beer, sausage, and pork knuckle had drawn them in and made it evident of its country of origin.

The German pavilion at Expo Osaka serves as a key testament to the indefinite potential of circularity and the integration of the circular economy into architecture. It was a powerful prototype for future sustainable design, aligning with Expo Osaka's theme of "Designing Future Society for Our Lives," as it encapsulated the intersection of circularity and biophilic design and culture through diverse innovative means.

Case Study 3:

Figure 3: China Pavilion Building a Community of Life for Man and Nature-Future Society of Green Development. Copyright [2025] by the author



The pavilion took profound inspiration from China's cultural heritage, as it presented a powerful architectural narrative drawn from multiple traditional inspirations, embodied a prime example of cultural sustainability [64]. To reflect the country's intention for a harmonious coexistence of cultural heritage and environmental development.

Culture

At the entrance of the pavilion stood an inscription of classical Chinese poetry on bamboo slips that was indicative of the transmission of knowledge through time and the heritage of China [64].

The Chinese pavilion represented China's 5,000-year-old civilization and its current vision of green development, bridging the past and the future through sustainability [47]. The Chinese calligraphy and poetry engravings within the pavilion featured over a hundred different classical poems written in five different calligraphy styles, drawn from influential texts such as the Shi Jing and Chu Ci, highlighting how the pavilion took every opportunity to showcase its rich chronology at the Expo [54].

One of the distinctive aspects of the Chinese pavilion was its ten-meter calligraphy 'waterfall' demonstration that impressed visitors, as Participants 1 and 2 refer to the 'waterfall' as an impressive aspect of the pavilion. It tells about Chinese writing development spanning three millennia, and combined with interactive touchscreens that delve into ancient scripts and poetry, it allowed national heritage to link contemporary technological presentation so as to

support the cultural continuance and innovation that ran through the pavilion's theme [64]. Visitors in particular enjoyed the creative, engaging pathways in learning, as Participant 1 commented,

“The touch screen with several language options was very accommodating in incentivising visitors to learn.”

A unique initiative showcasing China's culture was that its exhibits and events were routinely rotated to be able to showcase 30 different provinces and regions of China during the six month duration of the Expo to allow visitors to experience a broad cultural narrative and diverse heritage [15]. Visitors were able to relish in the eclectic, rich history and heritage of China, even with multiple visits, as Participant 2 stated,

“This is my second time here, and I was shocked to find new artifacts being displayed; it drew my attention to how they were different.”

The visitor's response indicated that cultural semiotics were conveyed as intended and effectively embodied, as the pavilion succeeded in effectively showcasing a strong national identity of Chinese culture.

The pavilion also displayed an immersive short film that conveyed China's vision of sustainable development, inspired by traditional Chinese solar terms. This allowed visitors to discover China's cultural concepts through the exhibition, which enabled visitors to partake in the experience instead of passing by unknowingly. This emphasized the cyclical nature of time and the interdependence of humans and nature, conveying the substance of circularity in architecture.

These cultural features also reflect ecological principles, such as circularity and interdependence, with their emphasis on time, cycles, and heritage paralleling ideas of resource continuity and environmental responsibility. Integrating culture into sustainable architecture ensures that buildings are environmentally responsible, socially meaningful, and capable of fostering a shared understanding among diverse audiences.

Biophilic Design

The bamboo-like ceiling decorations embodied the growth cycles of nature and agriculture, allowing visitors to feel ‘the life code’ in the exhibition space, where visitors were able to experience all four seasonal transitions in [66]. The pavilion had also integrated natural lighting for a seamless flow, which enhanced the connection between humans and nature [47]. Natural light is one of the most common uses of biophilia in architecture for human well-being purposes, however, it is not only limited to well-being as it also plays a large role in sustainability by reducing ecological footprints. In the pavilion, the material choice of bamboo, as one of its core materials—a renewable resource—demonstrated both traditional Chinese aesthetics and sustainable design, reinforcing the framework for culturally rooted biophilic design.

Circularity

Whilst the primary focus was on the exhibition and structure, circularity and ecological vision were nonetheless key aspects of the pavilion's architectural approach, shown through the implementation of a zero-waste construction code [65].

For instance, the China pavilion highlighted future circular materials, such as renewable bamboo-wood panels. They were specially made using advanced 3D and building information modeling (BIM) technologies in China [65]. These panels being prefabricated in China even though the Expo was held in Japan enabled costs to be reduced by 90% and ensured that these panels could be brought back to China to be reclaimed after the completion of the Expo [65]. The China pavilion exemplified circularity in materials through innovative, responsible resource management.

The materials used for the construction of the Chinese pavilion had been designed with energy-saving features to accommodate the hot Japanese weather, which included a centralized cooling system with optimized airflow, bright lighting, and energy-efficient elevators as well [54].

The Chinese pavilion presented China's commitment to designing a future world and economy that places sustainable design at its core, while incorporating cultural representation. It showcases an example of architectural design that honors history, combining it with new and emerging technologies.

Case Study 4:

Figure 4: Italy Pavilion Art Regenerates Life. Copyright [2025] by the author



The Italian pavilion's theme, "Art Regenerates Life," was largely inspired by the Renaissance concept of the *Ideal City*, a utopian vision of urban design characterized by order and harmony. Accordingly, the pavilion seamlessly merged art, culture, and innovation to present a proactive model of a reimagined Ideal City, while simultaneously, showcasing Italy's commitment to environmental responsibility and its cultural heritage.

Culture

The architects of the Italian pavilion aimed to entice visitors to feel as if they were "breathing the air of Italy" through an immersive exhibition of Italy, featuring Renaissance paintings, sculptures, and cultural artifacts [21].

The Italian Pavilion attempted a bold cultural reinterpretation through its theme, *The Ideal City*, a reference to Italy's Renaissance concept of *la città ideale*, famously depicted in 15th-century

perspective paintings by artists such as Luciano Laurana [17][20][21]. However, [interviewees](#) seem to have [misread the architects' reinterpretation](#) presented in the pavilion's entrance, as the arched colonnaded entrance was [misunderstood](#) as a nod to the Roman era, rather than recognizing the deeper allusion to the harmonious, rational geometry of Renaissance urban utopias. Participants 7 and 8 both picked out that

"The entrance reminded me of the Colosseum,"

as a significant indicator of the country's culture and origin, confirming the recurring misinterpretation that had been present at the Expo. However, the Ideal City that the architects aimed to portray does not utilize arches. The Renaissance is also Greek, where ideals, techniques, and spiritual values were often explored in comparison to the Roman Empire, which was more pragmatic, focused on ownership and imperialism, and the spreading of culture. The architects' intention was to use those historic urban metaphors—the theatre, portico, piazza, and garden—to create a future-oriented "living fabric" that expresses Italy's regional diversity and innovative identity [16].

This meant it conveyed a different impression of intentions than it actually intended. The Renaissance era is marked by significant discoveries and a period of rebirth [18]. What the architects of the Italy pavilion sought to convey was more representative of revolutionary cities, as well as the flourishing of inventions inspired by the Renaissance era. Therefore, [the execution may have limited clarity for the public](#) and was ineffective.

[This misunderstanding prevented visitors from understanding the intended meaning behind the design choices, which were intended to inspire. Socially sustainable architecture allows spaces to be meaningful by understanding how visitors perceive cultural symbolism at these pavilions. The pavilion provides valuable data for architects to design spaces that are both culturally resonant and environmentally sustainable. Analyzing how visitors perceive cultural symbolism at these pavilions provides valuable data for architects to design spaces that are both culturally resonant and supportive of sustainable social practices.](#)

Did the conceptualization rely too heavily on abstract motifs without offering clear interpretive guidance? Or was the execution perhaps overly simplified for the public, who expected more literal and familiar cues?

Whilst the architects aimed to convey Italy's vision of reimagined utopian design through their reinterpretation of the *Ideal City* from the Renaissance era, the conveyed intentions did not align with the visitors' impressions, which raised questions about how abstract concepts could be better executed to provide effortless understanding for visitors. However, it could be considered successful in that the pavilion successfully evoked strong Italian imagery through its architectural form to Expo visitors.

Circularity

The Italian pavilion's take on circularity was largely seen through its influence with the broader goal of adaptive reuse after the Expo to make the pavilion a model of circular architecture [22].

The pavilion was constructed using certified laminated wood and a dry construction system. This allowed for reconfiguration and disassembly, enabling the materials to be recycled after the Expo, considering its six-month duration [22].

The exterior structure was made from permeable mineral fibres, which could passively regulate temperature, light, and airflow. It acted as both the skin of the pavilion and the interface that connected internal climate to external conditions, symbolizing Italy's transparent approach to sustainable design. The lightweight textile of the outer face reduced energy demands, enabling the pavilion to behave like a living organism, which allowed it to adapt to seasonal rhythms and environmental changes in Japan—a core tenet of circularity [22].

Biophilic Design

Lead architect Mario Cucinella stated, “The Italian Pavilion stands for a new idea of society, and for the city as a living organism where the relationships between people, art, the environment, and history can materialise” [21]. The Italian pavilion's integration of biophilic design was intended to reconnect humans with nature through proximity. The rooftop of the pavilion featured an Italian-style garden that served as a contemporary labyrinth, with flowers and small trees that spread various scents, creating sensory dimensions for visitors to weave through inspired by Renaissance harmony and in keeping with the theme of the *Ideal City* [16]. An organic biophilic ecosystem was designed innovatively, with the garden embodying native plants, fountains, sculptures, alongside winding paths that symbolized both human geometry and natural irregularity [16].

Biophilia at the Italian pavilion was multi-sensory and multi-spatial, as the pavilion's exhibition mirrored the rhythms of a day through the use of dappled sunlight filtering through a forest canopy. This enhanced awareness functioned as an antidote to the overstimulation of digital life, connecting Japanese spatial philosophies of impermanence with Italian approaches to beauty and environment.

Key components of the pavilions, such as the theatre, piazza, and rooftop garden, formed a triptych of experimental biophilia that all showcased the Italian pavilion's focus on biophilic design that prioritized empathy and emotion, as much as ecological responsibility.

The pavilion illustrated harmonious integration of cultural and sustainable practices, despite some elements being misinterpreted; the pavilion still encapsulated Italy's commitment to building a future that values the ecological balance and cultural richness in urban architecture.

5. Conclusions

The researcher was drawn to the topic of sustainability, and in particular, took the four pavilions as the focal points of this study, analyzing them through the lens of circularity, biophilia, and culture. The architectural innovations displayed by official participants' national pavilions at Expo Osaka demonstrated how sustainability must extend beyond technical performance, environmentally, to encompass broader social considerations. **Each national pavilion at the Osaka Expo 2025 exemplified various aspects of sustainability. The Swiss pavilion showcased biophilia, the German pavilion demonstrated circularity, and the Italian and Chinese pavilions conveyed cultural symbolism, all of which evidently resonated with the visitors present. These**

design approaches can be inspirational for future research and design that focus on the notion of sustainability as a form of biophilia integration, circularity, and culture. The unstructured interviews with pavilion visitors at the Expo highlighted how the clarity of the architectural intentions plays a large part in ensuring they are conveyed effectively. In essence, the clarity of architectural intentions directly impacts and enhances the social effectiveness of sustainable spaces.

However, this study has several limitations: due to time constraints and the ongoing nature of the Expo, information was limited, and only four out of more than fifty pavilions were selected for analysis. Additionally, sustainability encompasses many more potential subcategories, excluding the three explored in this paper. Future research could examine other aspects of sustainability that remain underexplored, for example, neuroarchitecture, innovative applications of technology, or additional social and cultural dimensions.

As urban expansion in this century accelerates more and more and the SDGs deadline inches closer, the researcher hopes that the conclusions drawn from this paper's analysis can inform future global efforts to build not just sustainably but meaningfully with empathy and regeneration at the root of architectural practice. The most consequential takeaway from the Osaka Expo's pavilions is one of inspiration.

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Reviewer 1: revisions made in blue

Review of Paper Submitted to Convergence Journal:

“Sustainability Spaces: Circularity, Biophilia and Culture in Expo Osaka 2025 Pavilions”

Recommendation: Accept, with moderate revisions

The paper is insightful in connecting each pavilion to one or more specific facets or factors of sustainability. The mixed methods approach provides a variety of interesting perspectives, ranging from official descriptions to secondary sources to first-person accounts of visitors; this combination is intriguing and effective. The descriptions of the pavilions are engaging and compelling, particularly that of the Swiss pavilion.

→ Thank you very much for your comprehensive evaluation.

The researcher effectively leveraged their native knowledge of Japanese language and culture to interpret and present elements of the pavilions, as with the “Wa” of the German pavilion, and that pavilion’s integration of elements of Japanese popular culture. The reader appreciates this level of knowledge and detail.

→ Thank you for your thoughtful and encouraging feedback.

Overall, the connection between cultural elements and sustainability could be more convincingly established and explained. For example, while the author explains that some of the interviewees expressed confusion about the cultural signifiers at the China pavilion, the connection of this issue to the broader sustainability theme is not fully clear.

→ I understand, have added a more in-depth explanation in the Literature Review section under Culture, and have elaborated further for the cultural signifiers for the Case Study of the China pavilion.

“In this paper, culture refers to the shared symbolic systems, values, and norms that shape human communities and differentiate them from the natural environment.

At first glance, culture may not appear integral to sustainability, as the origin of sustainability is rooted in ecological concerns. However, culture, alongside environmental components, is increasingly becoming recognized as a vital aspect of sustainability. This is because culture shapes how societies understand, value, and interact with their environments.

Culture is a significant shaper of people's behaviors, consumption patterns, and relationships with natural resources, and consequently impacts the design, applicability, and sustainability of solutions in our society. It fosters a sense of belonging and tradition, and bolsters community resilience in the face of social and environmental change. Cultural heritage is also a reservoir of embodied knowledge and adaptation techniques that can inform innovative and locally suitable methods of sustainability. UNESCO's Culture for Sustainable Development agenda highlights culture as a cross-cutting enabler of the 2030 Agenda and its Sustainable Development Goals

through emphasizing that advancement in sustainability cannot be achieved without integrating cultural identity and heritage into practice [67]. Unless cultural viewpoints are incorporated, sustainability could potentially develop into a generic approach that is disconnected from real-life experiences of the populations it is intended to benefit.

Architect Mario Cucinella is another advocate for a view of sustainability that goes beyond technical solutions to include a cultural and humanistic understanding of sustainable architecture. He highlights the interconnectedness of ecosystems and disciplines as a model for integrating cultural complexity into design [5]. Sustainable architecture is more than just reducing carbon output or improving efficiency. Additionally, it requires creating an understanding of environmental challenges as well as including historical and cultural understanding, thus guaranteeing that design in architecture interactively engages human and ecological environments.”

Improvements for the Chinese pavilion in connecting culture back to sustainability:

“The pavilion also displayed an immersive short film that conveyed China’s vision of sustainable development, inspired by traditional Chinese solar terms. This allowed visitors to discover China’s cultural concepts through the exhibition, enabling them to participate in the experience rather than pass by unknowingly. This emphasized the cyclical nature of time and the interdependence of humans and nature, conveying the substance of circularity in architecture.

These cultural features also reflect ecological principles, such as circularity and interdependence, with their emphasis on time, cycles, and heritage paralleling ideas of resource continuity and environmental responsibility. Integrating culture into sustainable architecture ensures that buildings are environmentally responsible, socially meaningful, and capable of fostering a shared understanding among diverse audiences.”

The following sentences should be **removed**: “In qualitative research, depth often holds more value than breadth, therefore, the sample size was kept minimal. It was sufficient for the study to uncover preliminary patterns and initial reactions to the pavilions.” It comes across as a defensive justification for the small number of interviewees and the preliminary nature of the findings; it is not necessary, convincing, or helpful. Having eight interviews is fine; this can be rephrased in a more positive light.

→ Yes, I see how it can come across as defensive and have removed it entirely from my paper.

The paper explains the selection criteria for the pavilions and the interviewees. The attributes of the interviewees, beyond the fact that they are elderly Japanese local residents, could be further elucidated.

→ To clarify my selection criteria and avoid confusion, I’ve added a sentence to my Methodology section under 3.3 Interviews as follows: “**This was an on-field research, and therefore, the interviewees were visitors of the EXPO with a genuine interest in architecture and related fields, and to contribute to potential research.**”

The attributes of the interviewees have been referenced as follows: “It was fascinating to note that most of the interviewees were well-educated and came from diverse backgrounds, including construction, teaching, and business.”

A sentence about the Italian pavilion would benefit from revision: “However, many visitors seem to have misinterpreted the reinterpretation presented in the pavilion’s entrance...” It is unclear what is meant by “many,” given that there were two interviewees for each pavilion (the two interviewees who are numbered 7 and 8, in the case of the Italian pavilion). The phrase “misinterpreted the reinterpretation” is somewhat convoluted as well and could be adjusted for clarity. More importantly, the connection between this discussion (about cultural symbols) and the broad theme of sustainability is, again, tenuous. Either the connection could be strengthened, or the elements of culture and environment could be explicitly differentiated. The paper’s Conclusion could do this more effectively as well, though it does effectively summarize the paper’s questions and findings.

→ The word ‘many’ has been removed and replaced by interviews. The phrase “misinterpreted the reinterpretation” has been altered to “misread the architects’ reinterpretation” for clarity.

The tenuous connection between cultural symbols and the broad theme of sustainability has been strengthened through the addition of “It could be considered successful in that the pavilion successfully evoked strong cultural imagery through its architectural form for visitors. “This misunderstanding prevented visitors from understanding the intended meaning behind the design choices, which were intended to inspire. Socially sustainable architecture allows spaces to be meaningful by understanding how visitors perceive cultural symbolism at these pavilions. The pavilion provides valuable data for architects to design spaces that are both culturally resonant and environmentally sustainable. Analyzing how visitors perceive cultural symbolism at these pavilions provides valuable data for architects to design spaces that are both culturally resonant and supportive of sustainable social practices.”

The conclusion has been edited to effectively tighten the connection between the elements of culture and sustainability as follows: “In essence, the clarity of architectural intentions directly impacts and enhances the social effectiveness of sustainable spaces.”

The Conclusion would be far stronger if it were to recommend ideas for future research. In other words: what questions are the product of this study? This means, what questions can the researcher ask now that the researcher would not have known to ask prior to the study? Limitations of the study, and any challenges or uncertainties in the interpretations, could also be acknowledged and briefly mentioned.

→ Thank you for the suggestions; I agree and have included recommendations for future research as well as limitations and challenges or uncertainties in the interpretation as follows in the Conclusion: “However, this study has several limitations: due to time constraints and the ongoing nature of the Expo, information was limited, and only four out of more than fifty pavilions were selected for analysis. Additionally, sustainability encompasses many more potential subcategories, excluding the three explored in this paper. Future research could examine other aspects of sustainability that remain underexplored, for example,

neuroarchitecture, innovative applications of technology, or additional social and cultural dimensions.”

The introduction is effective and convincing in explaining the context, significance, and contributions of the Expo. The connection between the Expo and the UN’s SDGs is made clear to the reader. The use of detailed explanations of the key terms, including authoritative references and, crucially, helpful examples, make the subcategories easy for the reader to understand and appreciate.

→ Thank you so much.

The methodology is clearly presented, and the paper’s citations and references are effectively used and thoroughly implemented.

→ Thank you for acknowledging my work.

Both the introduction and the literature review present key concepts from prior research, situating the current study and informing the reader about the relevant background information. The explanations about Expo history and about the concept and theory of sustainability are particularly effective.

→ Thank you, I sincerely appreciate it.

The paragraph that was added to the abstract (in red) is effective in summarizing the purpose and findings of the research. However, the paragraph needs some editing. I have edited it, as follows – additions are in bold, and removed text has strikethrough; edited parts are highlighted in yellow for reference.

“This research suggests that the future lies in sustainable architecture, where **the** three sub-categories of circularity, biophilia, and cultural identity converge to **allow transform how people we to** build and interact with the world more effectively. This research unpacks the concept of sustainability **by analyzing and so analyze** the above **subcategories**, defining the current and future directions of living.”

→ I understand. I have made the requested changes as follows: “This research suggests that the future lies in sustainable architecture, where **the** three **subcategories** of circularity, biophilia, and cultural identity converge to **allow people to** build and interact with the world more effectively. This research unpacks the concept of sustainability **by analyzing** the above **subcategories**, defining the current and future directions of living.”

Some of the wording needs adjustment. For example, the term “sub-paragraphs” is confusing. There are some minor grammatical errors; for example, the subject and verb of a sentence should not be separated by a comma. Proofreading is needed; for example, the header “Criteria for the Selection and Categorization Pavilions” is missing the word “of” before “Pavilions.” The term “leading question” has a pejorative connotation in English and should be replaced. However, overall, the paper is quite clear and the writing is of high quality.

→ Thank you very much for your high praise. Thank you for kindly pointing them out. I've also proofread the paper multiple times and believe that all grammatical errors have been fixed accordingly. "sub-paragraph" has been paraphrased into "[sections](#)". "Leading" has been changed to "[guiding](#)". "Criteria for the Selection and Categorization Pavilions" has been changed to "[Criteria for the Selection and Categorization of Pavilions](#)."

Reviewer 2: revisions made in red

Feedback on Convergence submission 100023

I recommend this paper be significantly revised and resubmitted.

I think there are some elements here that could be shaped into a higher quality manuscript, but there is definitely a need for major revisions to justify publication. If significant changes are not made in line with this feedback, however, I would suggest rejection.

→ Thank you for reviewing my paper. I have read your comments thoroughly and hope that my response helps clarify my viewpoint.

The biggest strength here is the observational data about the Expo itself. I feel like there is a lot of material that could be used to build a more robust argument if there was some additional structure and context added to the paper overall. The main thing that felt like it was missing was engagement with literature, disciplines, and scholarly conversations on this topic. There was very little in the way of a clear argument-- the content was primarily descriptive-- and even as I made my way to the conclusion I was unsure what the author wanted me to take away after reading the text. I thought the writing style was understandable and easy to read overall, and if used in service of the development of an argument I feel it would be effective.

→ The Literature Review section has been further expanded according to the Reviewers' comments.

This aimed to clarify the notion of circularity, biophilia, and culture, while the primary focus still remains on the architecture discipline and its perceptions.

The Introduction and the Literature now give a broad context of the Expo's history and the evolution of sustainability and environmental commitment in architectural practices.

The conclusion has been revised to provide a more concrete recommendation for those in the architecture field based on the results in this paper, as follows: "Each national pavilion at the Osaka Expo 2025 exemplified various aspects of sustainability. The Swiss pavilion showcased biophilia, the German pavilion demonstrated circularity, and the Italian and Chinese pavilions conveyed cultural symbolism, all of which evidently resonated with the visitors present. These design approaches can be inspirational for future research and design that focus on the notion of sustainability as a form of biophilia integration, circularity, and culture."

My biggest suggestions for improvement have to do with situating this work within a scholarly context and explaining and integrating the observational data into a clear, well-structured argument.

→ Having now revised architectural research papers and their scholarly literature, this paper, which uses observational data collection and interviews as complementary methods, also incorporates case studies, categorization, typological analysis, and morphological analysis. I have further explained this in my following replies.

The author does not really explain how or why they chose the methods they did, and it was difficult to tell what style of analysis (e.g. from what disciplinary bases) they thought

they were doing with the data. For example, the way in which the list of questions is cut and pasted into the article on pg. 6 felt out of line with how this kind of interview data tends to be presented in the social sciences and was distracting in terms of understanding what the author was trying to do. I'd remove it entirely. Rather than spending so much time going on about details of the methodological choices there should be a stronger explanation of why these kinds of methods can provide particular insight into the chosen topic.

→ I have removed the interview questions as suggested. The methods adopted were similar to those used in most of the papers and publications cited in this paper, which were published in architecture and urban studies journals. To elaborate further on why these kinds of methods were utilized, I have edited my Methodology as follows in 3.3 Interviews: "Unstructured interviews were conducted with a small group of eight people **through opportunity sampling** to obtain richer, qualitative insights and encourage authentic responses. The target interviewees were adults and elderly residents in Japan. ... **These interviews were conducted directly and immediately at the Expo pavilions to allow participants to continuously view and accurately assess the pavilions from their own perspectives without having to rely on potentially erroneous recollections.**"

I also felt like the quotes which were included felt poorly integrated into the paper overall. They mostly felt general and a bit distracting, and they definitely didn't feel robust enough to stand alone in terms of analysis, which feels like what the author was trying to do. If they're not integrated into a broader argument, I'd just stick with the more visual/observational aspects of the data, since the author seems more comfortable with those. Additionally, there is no connection of the methods to the arguments getting made-- I don't quite know what field the author wants to be contributing to here, and I think that needs to be made clearer, perhaps through building a stronger disciplinary context as suggested in the rest of my comments.

→ The field and disciplinary context is architecture and sustainable design, as stated in the abstract, "approaches to sustainable design through architectural means." The interviews were integral to supporting my claims about the raw reactions of visitors, explaining how and why certain aspects were practical and not otherwise.

There is virtually no peer reviewed literature included in this paper nor is there much context of either historical or disciplinary context (is it meant to be architecture? heritage studies? something else?). Particularly given the rich historical background around these kinds of exhibitions, I found it notable that the author did not present that background at all. A section discussing the role of Worlds' Fairs and expos and their historical roles and impacts would do a lot to show why the reader should care about the various elements presented later in the paper.

→ I understand your concern. In the Literature Review, the World Expos have been presented and discussed. The historical roles and impacts have now been added with citations of peer-reviewed papers as follows: "**Within a dedicated physical space, Expos aim to uncover and exchange solutions to contemporary challenges through interactive exhibitions by nations all**

around the world [69]. Furthermore, Expos have advanced knowledge-based architecture by fostering collaboration between architects, engineers, and scientists [69].”

“As each Expo showcases impressive advancements in technology, science, economics, and more, each Expo has attracted millions of visitors worldwide, leaving a lasting, unique impact on the host city each time [7][71].”

Alongside the addition of several more peer-reviewed papers for other sections, “Furthermore, culture is integral to Expo pavilions and the Expo itself [2].”

“The case studies in this paper pushed to consider how these themes intersected and reinforced one another: circular systems reduce long-term environmental strain, biophilic strategies ensure those systems support human well-being, cultural expression, when sustainable, anchors innovation in continuity and meaning, revealing how Expo pavilions can inform future architectural practice that not only builds sustainably but also lives sustainably, with empathy, adaptability, and cultural consciousness at its core [70].”

The other contextual issue comes from the choices made around the analytical categories engaged in the discussion of the various case studies. It is VITAL that the author present in clear, specific terms how they are defining these categories and where they come from. Is it from architecture?

Sustainability more broadly? It's not enough to allude to them, I want a clear formulation such as "the concept of biophilia is [clear definition] and comes from [wherever]" before the author proceeds to explain the usage of these categories. Otherwise, it is unclear why the reader should think these analytical categories are worth thinking about. If these concepts are important in the field, explain "why" to the reader, and then make sure the link between the ideas and the cases are clear.

→ Thank you for the detailed suggestion. The Literature Review is structured into four sub-paragraphs. Each of them now thoroughly describes the architectural concept of circularity, biophilia, and culture formulated by other authors and practitioners as follows: “The concept of circularity originated from the field of sustainable development and the theory of the circular economy ... Circularity challenges the traditional ‘take-make-dispose’ model and instead promotes regenerative cycles within the built environment [68].”

“Biologist Edward O. Wilson was the first to introduce the concept of biophilia in 1984 in his book 'Biophilia'. It described the innate human affinity for nature and living systems. ... Biophilic design, which contributes to sustainability, reduces energy consumption, enhances indoor environmental quality, and supports biodiversity, was chosen for inclusion in this paper because truly sustainable design extends beyond meeting ecological metrics.”

For culture, more care was taken in crafting an explanation of the origin and the reasoning for its inclusion in this paper, as highlighted in blue, in the Literature Review section.

Ultimately, I think this is an interesting topic, and there is possibly some good data (at least the visually related elements), but the structure and focus feels a bit arbitrary and without a clear argument it feels more or less entirely descriptive. I think the author needs to really figure out what they are trying to say (and how) to strengthen the quality of their work and really pull this together into something of publishable quality.

→ Thank you. The structure has been revised, and the research aims have been clarified.

The author has done a thorough, attentive, conscientious job of responding to my initial review and implementing the necessary revisions.

The connection between culture and sustainability is now clearer and stronger, and the author has even included relevant citations and references to that effect. That said, the connection could be made clearer and stronger still; what are some additional ways in which culture and sustainability are connected, and what is the importance of those? The author has addressed this in the revision, but a few more sentences about this matter could improve the paper.

The two added sentences about the interviewees are helpful, and certainly a step in the right direction; however, if the author has any more information about the interviewees – such as their ages, what cities/towns they live in, what international experience (if any) they have – then it would be beneficial to include these details as well. If the author didn't collect that information during the field research, then that's acceptable. In future fieldwork, for other projects, it would be best to collect such information – demographics and some biographical details of the respondents, who are, after all, the source of the study's empirical data.

In that same section about the interviews, the phrase “This was an on-field research, and therefore” can be removed. “On-field” is unclear/non-standard wording, and the point being made is obvious, so it's best to cut this part.

In the following added sentence – “Additionally, sustainability encompasses many more potential subcategories, excluding the three explored in this paper.” – the word “excluding” should probably be replaced with the word “beyond”; this better matches, I think, what the author is trying to express.

I like the paragraph that was added to the “Culture” section of Case Study #3.

The revised Conclusion is an improvement. However, it seems that the author did not fully understand, and/or did not fully implement, my recommendation about follow-up research questions. The author added, “Future research could examine other aspects of sustainability that remain underexplored, for example, neuroarchitecture, innovative applications of technology, or additional social and cultural dimensions.” This is good and certainly can be kept. However, these areas for potential future research are not really *products* of the current study; in other words, the author hasn't really said what he/she can ask now that he/she would not have known to ask prior to analyzing the results of this study. So, in addition to “other aspects” there should be some true follow-up questions. That means a question that digs deeper into one or more results of the study, such as by looking more deeply into the reasons or implications for the study's findings. The conclusion can even question, or challenge or subvert, one or more premises or assumptions that the study and paper had made earlier. In one or more of these ways, the conclusion needs to be expanded and strengthened a bit. Two or three sentences would make a big difference if they use the abovementioned approach.

Overall I am impressed by the paper and by the revision, and I'm confident that the paper will be ready for publication once the author implements the recommended additional revisions. Excellent work. I look forward to seeing the final version in print.

Sustainable Spaces: Circularity, Biophilia, and Culture in Expo Osaka 2025 Pavilions

Abstract:

This paper examines how key components within sustainability—circularity, biophilia, and culture—were demonstrated at Expo Osaka 2025. Four national pavilions were carefully selected from attending countries: Switzerland, Germany, China, and Italy, all of which exemplified unique, future-forward approaches to sustainable design through architectural means. The primary focus of this paper was to examine how architects have called for action in addressing the pressing ecological challenges of the 21st century, aligning with Expo Osaka's overarching theme of "Designing a Future Society for Our Lives."

This paper incorporates primary and secondary research to investigate, firstly, how the pavilion's architects attempted to depict the overarching theme of sustainability, and secondly, what the visitors experienced and felt about each selected pavilion. This was achieved through thematic analysis of case studies on selected countries' pavilions, on-site fieldwork, and interviews with visitors.

This research suggests that the future lies in sustainable architecture, where the three subcategories of circularity, biophilia, and cultural identity converge to allow people to build and interact with the world more effectively. This research unpacks the concept of sustainability by analyzing the above subcategories, defining the current and future directions of living.

1. Introduction:

Japan was the host country for the World Expo 2025 in Osaka prefecture. The pavilions showcased the official participants' nations' attitudes on innovations and concepts at the Expo. One of the World Expo's primary purposes is to serve as a global cultural exchange in a single location, inspiring hope worldwide by showcasing progress in addressing global challenges, while fostering a sense of community and collaboration on a worldwide scale (Bureau International des Expositions (BIE), 2025a; "Master Plan," n.d.; Mohajer, 2016).

The Osaka Expo lasted 184 days, from April 13th to October 13th, 2025. An event as large-scale as World Expos holds the power to change behaviors and inspire globally, which sparks anticipation of the event's lasting impact on society, the economy, and the environment (Richards, 2020; Sustainability Bureau, 2025). The urgency for progression in sustainability was particularly heightened at Expo Osaka, as it was the final Expo before the 2030 deadline for achieving the Sustainable Development Goals (SDGs). Therefore, this particular Expo was the materialization of not only the accumulated achievements of the SDGs, but also a leap beyond "SDGs + Beyond", anticipating a larger future beyond 2030 (Sustainability Bureau, 2025).

Additionally, the demand for built urban environments is escalating at an unprecedented pace, as forecasts indicate that by 2060, Earth will have constructed over twice the current total built area (*Why The Built Environment – Architecture 2030*, n.d.). This is raising concerns globally about where and how the resources required will be provided. Visions such as *Japan's Society 5.0* introduced with Expo Osaka 2025, illustrated the importance of sustainable and human-centered architectural solutions that also align ecological well-being with economic development (*Society 5.0*, n.d.).

In addition to *Japan's Society 5.0*, Expo Osaka aimed to bring forward ways of enhancing global quality of life, under its overarching theme of "*Designing a Future Society for Our Lives*" ("Master Plan," n.d.; Sustainability Bureau, 2024). With the Expo's theme in mind, the architects of national pavilions incorporated circularity, biophilic designs, and a culturally sensitive approach into their practices.

Later in the paper, a clear distinction and description of the three subcategories (circularity, biophilic design, and culture) are presented and discussed.

Another focus of the Expo was on resource management, as many pavilions considered material pollution and the importance of natural restoration and circularity in the larger context of sustainability (Sustainability Bureau, 2024, 2025).

While the technological spectacles at World Expos are likely to capture immediate attention from visitors, this paper argues that equal, if not greater, attention should be paid to how national pavilions utilize architecture to generate discussions and interest in sustainable practices and cultural narratives, thereby promoting a brighter future. In this paper, the highlights are of the fundamental purpose of Expos, which is to serve as blueprints for environments that nurture both humans and the Earth.

2. Literature Review:

World Expos are large-scale global gatherings where numerous countries come together every five years to showcase their achievements in multiple fields that all started with the Great Exhibition of London in 1851, and 35 Expos have followed. Within a dedicated physical space, Expos aim to uncover and exchange solutions to contemporary challenges through interactive exhibitions by nations all around the world (Mohajer, 2016). Furthermore, Expos have advanced knowledge-based architecture by fostering collaboration between architects, engineers, and scientists (Mohajer, 2016). As each Expo showcases impressive advancements in technology, science, economics, and more, each Expo has attracted millions of visitors worldwide, leaving a lasting, unique impact on the host city each time (Richards, 2020; Sustainability Bureau, 2025).

One of the key global challenges in the most recent Expos has been sustainability (Bureau International des Expositions (BIE), 2010; *Expo 2020 Dubai*, n.d.). The United Nations Brundtland Commission's 1987 definition of sustainability provided the foundation that Expos' architects built upon: "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (Nations, 2014). With architecture being responsible for approximately 40% of the world's carbon emissions, Expo Osaka's architects gave a large amount of attention to create reflective pavilions, focusing on how to take sustainability a step further.

In this paper, the definition of sustainability extends past environmental commitment. Sustainability in this paper encompasses subcategories of circularity, biophilia, and culture in architectural practices, offering a multifaceted approach that is subjectively interpreted by the architects (Sustainability Bureau, 2024, 2025).

Circularity:

The concept of circularity originated from the field of sustainable development and the theory of the circular economy. Circularity revolutionizes the management and utilization of construction materials by minimizing waste of raw materials and breathing a second life into previously overlooked materials (CONAI, 2016). Circularity challenges the traditional 'take-make-dispose' model and instead promotes regenerative cycles within the built environment (Timm, 2023). Circularity has recently emerged as a cornerstone in sustainable architecture, and thus, has been showcased more explicitly by nations' pavilions in recent Expos, which is why circularity was chosen as one of the focal points in this research.

A prime example is the Netherlands' pavilion at Expo Hannover 2000. The pavilion demonstrated the prospect of circularity through its architecture. With its six-floor structure, which blended various forms of nature, such as water, vegetation, and energy systems, the pavilion highlighted circularity through a unique and distinct architecture that encouraged visitors to open their minds to circularity as a viable component in sustainable architecture (Arquitectura Viva, 2000; MVRDV, 2001). A more recent example was at Expo Milan 2015, with the Italian pavilion. It further advanced the potential of circularity by evolving the 'cradle-to-cradle' approach through its use of structural materials and construction that once again brought circularity to more people (CONAI, 2016; Nemesi, 2015; Nickel, 2025). The Italian pavilion's exterior was made of cutting-edge photocatalytic elements of new concrete and other materials, such as photovoltaic glass, which was also designed to be able to be fully dismantled and be reused afterwards. Through both their forms and function, these pavilions were significant testaments to how sustainable architecture could be circular: adaptable, reversible, and resource-conscious altogether (ArchDaily, 2015; *The_expo_we_learned_en_web-Pdf*, n.d.).

Biophilic Design:

Biologist Edward O. Wilson was the first to introduce the concept of biophilia in 1984 in his book 'Biophilia'. It described the innate human affinity for nature and living systems. In architecture, biophilic design seeks to expose people to natural elements, for example, through the integration of daylight, greenery, or sensory flow. It supports psychological well-being beyond environmental impact, yet has been discounted in the context of sustainability (Zhong, 2021). Biophilic design contributes to sustainability as the integration of it reduces energy consumption, enhances indoor environmental quality, and supports biodiversity in various landscapes. It was chosen as the second key component to be explored in this paper as truly sustainable design extends beyond meeting ecological metrics.

In previous Expos, the Japan pavilion at Expo Aichi 2005 introduced biophilic design on a scale that had been rarely witnessed prior (Nomura, 2005). The architecture of the Japan pavilion was primarily composed of recycled paper tubes and bamboo-and-paper membranes, which had an emphasis on natural and renewable materials that served both aesthetic and environmentally friendly purposes (Japan Association, 2005; *PDF*, n.d.). Following suit, the Singapore pavilion at

Expo Dubai 2020 pushed the boundaries of biophilic design by dominating an arid indoor climate with immersive green spaces, including a vertical garden, a forest valley, and a canopy walk framed by hanging gardens (Expo Dubai 2020, 2022; Naidu, 2024). This achieved a net-zero energy and water footprint, serving as a 'living' model of climate-resilient and human-centered architecture and becoming one of the clearest manifestations of biophilia at an Expo. Biophilic design in architecture is not only aesthetically pleasing to the human eye, but it can also serve as a sustainable system that reduces reliance on artificial climate control and contributes to the long-term health of humans (Browning, 2014).

Culture:

World Expos, in other words, are an international platform for countries around the globe to showcase their culture, heritage, and values through architectural means (Bureau International des Expositions (BIE), 2025b). Furthermore, culture is integral to Expo pavilions and the Expo itself (Piatkowska, 2013). Sustainability includes culturally preserving and adapting these unique identities in a climate-conscious world, which is becoming increasingly inherent to architecture, according to studies that name this phenomenon as cultural sustainability (Soini & Birkeland, 2014).

In this paper, culture refers to the shared symbolic systems, values, and norms that shape human communities and differentiate them from the natural environment.

At first glance, culture may not appear integral to sustainability, as the origin of sustainability is rooted in ecological concerns. However, culture, alongside environmental components, is increasingly becoming recognized as a vital aspect of sustainability. This is because culture shapes how societies understand, value, and interact with their environments.

Culture is a significant shaper of people's behaviors, consumption patterns, and relationships with natural resources, and consequently impacts the design, applicability, and sustainability of solutions in our society. It fosters a sense of belonging and tradition, and bolsters community resilience in the face of social and environmental change. Cultural heritage is also a reservoir of embodied knowledge and adaptation techniques that can inform innovative and locally suitable methods of sustainability. UNESCO's Culture for Sustainable Development agenda highlights culture as a cross-cutting enabler of the 2030 Agenda and its Sustainable Development Goals through emphasizing that advancement in sustainability cannot be achieved without integrating cultural identity and heritage into practice (UNESCO, 2025). Unless cultural viewpoints are incorporated, sustainability could potentially develop into a generic approach that is disconnected from real-life experiences of the populations it is intended to benefit.

Culture and sustainability are closely intertwined; traditional knowledge allows architecture to remain both environmentally responsive and culturally resonant. When cultural values of community align with values of sustainability and harmony with nature, it transforms into a deeply rooted enduring sustainable design that reflects collective identity rather than a purely technical pursuit.

Architect Mario Cucinella is another advocate for a view of sustainability that goes beyond technical solutions to include a cultural and humanistic understanding of sustainable architecture. He highlights the interconnectedness of ecosystems and disciplines as a model for

integrating cultural complexity into design (*BUILDING GREEN FUTURES – Mario Cucinella Architects - Forma Edizioni*, 2020). Sustainable architecture is more than just reducing carbon output or improving efficiency. Additionally, it requires creating an understanding of environmental challenges as well as including historical and cultural understanding, thus guaranteeing that design in architecture interactively engages human and ecological environments.

In Expo Shanghai 2010, the UAE pavilion drew inspiration from the expansive and streamlined forms of the UAE's sand dunes to echo its natural topography (Foster+Partners, 2010). Not only did its outer shell pay tribute to traditional motifs of the UAE, but by combining traditional customs and methods with innovative, sustainable design principles, it became a tangible metaphorical representation, linking past historical contexts and vignettes of successful integration of cultural identity into a sustainable context.

More recently, at Expo Dubai 2020, the Morocco pavilion showcased a refined view of cultural architecture by drawing upon Morocco's vernacular architecture. Particularly, the incorporation of an earthen facade that utilized traditional construction methods best suited to the host nation, Dubai's hot climate, resulted in a minimized carbon footprint for the pavilion. Such culturally and environmentally aware design choices by the architects demonstrated how a country can leverage its culture to resonate with visitors and bridge information gaps, fostering a sense of community within a contemporary Expo setting (Lewis, 2021; OUALALOU+CHOI, 2021, 2021).

These pavilions exemplified how the architecture of Expo pavilions can serve as vessels to convey cultural narratives while simultaneously addressing environmental challenges.

This paper evaluates two national pavilions from Western and Eastern cultures to present diverse perspectives on how different nations incorporate culture into Expo Osaka 2025's sustainable narrative.

The case studies in this paper push to consider how these themes intersect and reinforce one another: circular systems reduce long-term environmental strain, biophilic strategies ensure those systems support human well-being sustainably, and cultural expression, when sustainable, anchors innovation in continuity and meaning. Revealing how Expo pavilions can inform future architectural practice that not only builds sustainably but also lives sustainably, with empathy, adaptability, and cultural consciousness at its core (Martinsuo & Huemann, 2021).

3. Methodology:

After a thorough examination and observation through Expo Osaka's official website and reports, as well as architects' portfolios prior to the Expo, the selected four pavilions and three emerging subcategories from the theme of sustainability were chosen as the focal points of this study to highlight some of the remarkable revolutions in architecture: circularity, biophilic design, and cultural expression. This paper used a mixed-methods approach to gather qualitative data through numerous case studies and thematic analysis.

The fieldwork involved in-person observations and photographic studies of selected pavilions at Expo Osaka, along with brief interviews with a small group of eight Expo visitors conducted in April and May 2025. Five key questions were composed to gain a deeper understanding of visitors' feelings and impressions of the pavilions and how architects attempted to convey specific artistic messages. These conversations strived to capture authentic, ordinary reactions of visitors rather than focus on the technical understanding of the subject. The interviews were conducted with a small group to gather richer qualitative information and helped establish a trusted relationship between the researcher and the interviewees, enabling more genuine responses.

This approach aimed to provide a holistic view of how the three subcategories of sustainability, circularity, biophilic design, and cultural expression are intertwined within the Expo's architectural pavilions, through detailed architectural case studies of four national pavilions at Expo Osaka: Switzerland, Germany, China, and Italy. In the following sections, each method is described in more detail.

3.1 Desk Study:

This research was conducted months prior to and the initial months after the opening of Expo Osaka 2025. Diverse sources were systematically consulted for the Literature Review and case studies on the four pavilions. The official Expo 2025 website and reports that were public provided updated information on pavilion themes and design intentions. The architects' official pages offered deep insight into the conceptual frameworks, design philosophies, and material choices. Architecture journals and media outlets provided an insight into how sustainability and architecture are portrayed in the media to the people, and several relevant publications and books in the fields of sustainability, circularity, biophilic design, and culture.

3.2 Criteria for the Selection and Categorization of Pavilions:

Out of all international pavilions at Expo Osaka 2025, this paper only covers the four most relevant pavilions, as identified in the Methodology: Switzerland, Germany, Italy, and China.

Switzerland's pavilion was chosen to represent biophilia due to its strong focus on natural materials and their sustainable functions, as well as environmental responsibility. Germany's pavilion was selected to represent circularity as it reflected a growing trend toward an architecture that prioritizes fostering a zero-energy circular economy. For culture, the pavilions from Italy and China were selected to compare Eastern and Western cultural expressions through their architectural forms, as both pavilions outwardly present their culture as their focal eye-catching feature.

Table 1: Intensity of Sustainability Subcategories Being Represented Across Selected Expo 2025 Pavilions

| Country: | Circularity | Biophilia | Culture |
|-------------|-------------|-----------|---------|
| Switzerland | 1 | 3 | 2 |

| | | | |
|---------|---|---|---|
| Germany | 3 | 2 | 1 |
| China | 1 | 2 | 3 |
| Italy | 2 | 1 | 3 |

Table 1: This table provides a comparative evaluation of how each selected pavilion, Switzerland, Germany, Italy, and China, prioritized the three identified subcategories of sustainability: circularity, biophilic design, and cultural expression. Each country was rated on a scale of 1 to 3 for all three subcategories (circularity, biophilia, and culture), with 3 indicating the most intense thematic emphasis, based on a qualitative analysis through the Desk Study. A 1 indicates that the sub-theme was minimally present with slight mentions with trivial integration into the design and message. A 2 indicates that the sub-theme was moderately developed and there was evidence of the sub-theme influencing parts of the design or message; however, it was not central or deeply embedded. A 3 indicates that the sub-theme was strongly emphasized through the design and message through the architectural choices and storytelling, with a clear and intentional integration aligned with sustainability.

3.3 Interviews:

Semi-structured interviews were conducted with a small group of eight people through opportunity sampling to obtain richer, qualitative insights and encourage authentic responses. The interviews were semi-structured to allow for comparability among participants, flexibility to explore new ideas, and comfort in optimizing honest responses while ensuring that core questions were asked. The target interviewees were adults and elderly residents in Japan aged 30s to 70s. The demographic was chosen because many Japanese citizens, who have only lived in Japan, view the Expo as an educational facility showcasing global innovations based on the year's theme, rather than a tourist location, with some having attended previous Expos in Japan as a part of their school expeditions. A limitation of these interviews is that they were chosen based on who was available at the time, so the sample may not reflect the broader population.

Interviewing Japanese residents cultivated authentic dialogues between the researcher, a native Japanese speaker, and helped overcome any potential language barriers. It was fascinating to note that most of the interviewees were well-educated and came from diverse backgrounds, including construction, teaching, and business.

Participants 1 and 2 were interviewees at the China pavilion, while participants 3 and 4 were at the Swiss pavilion, participants 5 and 6 were at the German pavilion, and participants 7 and 8 were at the Italian pavilion. These interviews were conducted directly and immediately at the Expo pavilions to allow participants to continuously view and accurately assess the pavilions from their own perspectives without having to rely on potentially erroneous recollections.

Guiding questions were well-developed before the site visits in order to help the conversations flow with the interviews.

4. Analysis

Case Study 1:

Figure 1: Swiss Pavilion From Heidi to High-Tech. Copyright [2025] by the author



The Swiss pavilion brought much inspiration from the nation's proud, diverse landscapes and traditions. The pavilion embodied a harmonious blend of biophilic design, circularity, and cultural storytelling, with the pavilion having a strong emphasis on "Innovative Switzerland". This was achieved through a powerful showcase of both sustainability and prosperity that highlighted the nation's innovations in its spherical bubble-like structures.

Biophilic Design

The architects aimed to convey their national innovations as being rooted in 'a tradition of humanism and a sense of nature' by designing the Swiss pavilion to provide a glimpse into the beautiful nature of Switzerland (Manuel Herz Architects, 2025).

Biophilic elements were clearly physically interwoven with the pavilion's architecture, comprising Swiss local plant species, such as wisteria, sourced from their nurseries, which were then transported and grown directly onto the exterior of the five spherical structures. This 'living' skin of the pavilion's structure was one of the focal points of the pavilion, as each kilogram of plant mass at the Swiss pavilion corresponded to one kilogram of CO₂ absorbed from the environment (Zeitoun, 2024). Participant 3 praised the exterior landscape of the Swiss pavilion, reinforcing its effectiveness in conveying the significance of biophilia, as they stated,

"I found the weaving of plants and flowers on its exterior to be eye-catching and pleasing to the eye. ... Learning about how they exceed the aesthetic appeal and function as sustainable elements later on was a wonderful addition."

The flora elements provided an additional biophilic design factor with local plants being planted across the building's surface and surroundings that reinforced the architects' pride for their nation's natural landscapes (Manuel Herz Architects, 2025). To further engage a biophilic intention, light, ventilation, and color were all scenically manipulated to create a welcoming ambiance and distribute visitors freely throughout the pavilion (EXPO Osaka 2025, 2025b). Not only that, but the one-level plane of the pavilion further enabled accessibility and sustainability by avoiding the use of vertical circulation, of elevators and escalators (Manuel Herz Architects, 2025).

The spheres utilized pneumatic pressure in its ETFE shells instead of walls and eliminated the need for airlocks. This allowed for a subtle permeation of fresh air at all times, enabling the interior of the pavilion to maintain a natural airflow in harmony with the ambient environment (EXPO Osaka 2025, 2025b; Manuel Herz Architects, 2025).

The Swiss pavilion was successful in incorporating innovative biophilic design elements and it was a model example of how biophilic design can be utilized to optimize sustainable architecture in the future.

Circularity

The spherical structure was the pavilion's standout feature; weighing approximately 400 kilograms, it represented one percent of a conventional building and earned the distinction of having the lowest ecological and carbon footprint among all pavilions at the Expo (EXPO Osaka 2025, 2025b; Gent, 2025; Vitality Swiss, 2023).

This impressive lightness of the pavilion stemmed from the external shell, made out of what is known as an ETFE membrane, which replaced traditionally heavy materials such as concrete (Fakharany, 2025b). This membrane allows natural light to pass through whilst offering dual-coloration of surfaces, which saves unnecessary energy, resources and the need for massive machinery (EXPO Osaka 2025, 2025b). The membrane used was a modular and reusable construction material fit for sustainable architecture (Vitality Swiss, 2023). Its high initial cost and temperature-related challenges limit its applicability. However, the Swiss pavilion showcased new potential with the material through its unique plans to repurpose the easily disassemblable membranes, turning them into furniture (Vitality Swiss, 2023). This upheld sustainability as a core design philosophy and the promotion of the circular economy, extending beyond the Expo. They furthermore collaborated with students and professors from the Kyoto Institute of Technology in their early design stages, which further emphasizes how sustainability had always been at the forefront of the architect's intentions (EXPO Osaka 2025, 2025b; KYOTO Design Lab, 2025).

Culture

The architects blended environmental innovation with Swiss' cultural values through iconic imagery featuring Heidi and the Girl of the Alps that emotionally resonated with visitors (Muth, 2025). The character, Heidi was the perfect choice for a cultural symbol, as she embodies the intersection of cultural motif and sustainability, symbolizing Switzerland's abundant nature in a city of technology (Soini & Birkeland, 2014). This was especially evident in the responses of Japanese visitors to question two, as Participant 4 stated,

"Heidi was another key aspect they were promoting heavily, whom I loved since I learned about her in elementary school."

Their reference to Heidi reinforced the notable impact that Switzerland employed through strategic cultural symbolism to make its biophilic message relatable and emotionally impactful, particularly to those familiar with the 1974 animation adaptation. Participant 3 emphasized this by commenting that Heidi

"linked nature and innovation together;"

presenting Switzerland's heritage not as dormant, but as the seed for forward-thinking, sustainable design (Muth, 2025).

Heidi served as a cultural broker to enhance relations between Japan and Switzerland while linking their cultures to a desirable future of innovation (Gent, 2025; Muth, 2025). As suggested by the name of the pavilion, the Swiss exhibition showcased Switzerland's development from its Alpine heritage to a world technology hub. Various zones of the pavilion included an introspective space to allow visitors to ponder Swiss values of openness, sustainability, and innovation (EXPO Osaka 2025, 2025b). The Heidi Café, inside one of the dome-like structures of the pavilion, featured greenery and a glimpse of Osaka Bay, thus stretching the principle of biophilia beyond the boundaries of the exhibition hall (EXPO Osaka 2025, 2025b).

The Swiss pavilion is a compelling model of how innovations truly grounded in humanism and nature can shape built environments to be more sustainable. Specifically, biophilic design was portrayed as being able to achieve sustainability not just visually but structurally, resourcefully, and functionally by the Swiss pavilion. While their approach was specific to their own nation, they brought to light how biophilic design, rooted in one's culture, can elicit a positive ambiance in a space and pass it on to individuals.

Case Study 2:

Figure 2: German Pavilion "Wa! Germany". Copyright [2025] by the author



The German pavilion was symbolic of circularity in every component, which was intended for a second life beyond the duration of the Expo (230411_PK_Booklet_EN.Indd, n.d.; LAVA, 2025). The coined term “Wa” by the German pavilion signified three different meanings in Japanese: circularity, harmony, and exclamation (EXPO Osaka 2025, 2025a). The term encapsulates its overall focus on circular economy, the harmony and balance between nature and technology, as well as the awe-inspiring potential of sustainable design.

Circularity

The German pavilion architects aimed to answer questions such as, “Are circular cities our future habitats?”, “How will a circular economy succeed in securing our energy supply?”, “What does it mean for each of us as individuals to inhabit a circular society?” (FEDERAL MINISTRY FOR ECONOMIC AFFAIRS AND ENERGY, 2023b).

Firstly, the seven circular wooden structures of the German pavilion visually depicted the theme of circularity through their exterior circular design, utilizing visual elements to convey its focus and dedication to circularity in architecture. The various organic, sustainable materials, including hempcrete, loam, and fungal mycelia panels were specifically chosen for their biodegradability as a key aspect of its circular design by the architects (Kanning, 2025). This was explained to visitors through labeling and thorough explanations provided by their speaking mascot, which they carried around. Visitors of the pavilions noticed this as Participant 6 stated,

“I liked how even the materials of the walls were explained through the talking hand-held mascot. It was immersing, being able to touch the raw materials with the explanation was a factor I deeply appreciated.”

While some inorganic materials were used, materials that would be easily recycled within the industrial sector, such as steel and glulam structures, were chosen. At the same time, rejecting other inorganic materials, such as concrete, that are responsible for over half of the global carbon emissions (BIG SEE, 2025). The architects also incorporated traditional resources of rammed earth to be repurposed after the Expo, which further reinforces Germany's commitment to circularity and reducing waste (LAVA, 2025). The distinction of the materials not only being sustainable but also versatile with long-lasting utility paints a new vision for circularity and circular architecture that's not only eco-friendly but also practical in the meantime (BIG SEE, 2025; FEDERAL MINISTRY FOR ECONOMIC AFFAIRS AND ENERGY, 2023b; Kanning, 2025). All of which mitigated environmental impacts and reinforced the German pavilion's illustrated a clear consciousness to long-term ecological goals.

The fusion of sustainability and innovation stems from tradition, honoring local knowledge, whilst advancing global sustainability goals. Many visitors felt the passion and hopeful outlook for the future of the circular economy through the German pavilion, as Participant 5 stated,

“I feel optimistic about the future.”

I learned more about how foreign countries are making advances in such fields, and their commitment to circularity was conveyed effectively.”

It confirmed how visitors were able to notice and feel the thematic framing of the circularity in both the exhibition and the space they created. It illustrated sustainability as a humanistic endeavor through architectural storytelling. The German pavilion effectively achieved its goal of educating visitors on the circular economy and cross-cultural sustainability, particularly highlighting European perspectives.

Biophilic Design

In the German pavilion, biophilic design was integrated into its central theme of circularity through its architecture and landscape, as the architects predicted that the functions of a biosphere would become a key feature of urban environments in the future (facts and fiction, 2025; *Work - LAVA Laboratory for Visionary Architecture*, n.d.). Out of the seven cylindrical wooden structures that comprised the pavilion, two that seamlessly merged into accessible green spaces and the roof garden paid homage to Expo Osaka 1970, highlighting how the natural world evolved over time alongside architecture (Fakharany, 2025a; Kanning, 2025).

The pavilion featured a diverse array of natural species borrowed from local nurseries in Osaka. These plants enhanced both the aesthetic appeal and biodiversity, as well as ecological balance. The green roofs and vegetation helped facilitate passive cooling in the pavilion, reducing the need for mechanical air conditioning—a key aspect of biophilic design (LAVA, 2025).

Culture

The German pavilion's take on culture was different from the others in two ways. Firstly, instead of embedding culture into the structural elements of the pavilion, culture was represented mainly through the exhibition experience. Secondly, in place of focusing solely on its own national culture and tradition, the German pavilion also highlighted Japanese culture. This was indeed effective in garnering excitement and engagement with the handheld talking circular mascot, 'Circulars', inspired by Japan's *kawaii* culture (FEDERAL MINISTRY FOR ECONOMIC AFFAIRS AND ENERGY, 2023a). This was well accepted by Japanese visitors during the Expo, especially as Japanese visitors made up 90% of the total Expo visitors, as Participant 6 stated,

“It was lovely, having a helpful and cute guide in my hands; it made me feel less alone and made it more comfortable to take my time to take in all the information.”

The German culture was not evident in its architectural form, as Participant Five commented,

“Other than the sign that read 'Germany,' I wasn't sure what other links there were to the country.”

This highlights a limitation in cultural communication that the pavilion had, as it suggests the ecological themes may have overshadowed localized cultural storytelling. Nevertheless, culture was expressed through a sensorial aspect that emerged primarily with the smells, which were not initially considered in the Desk Study but were discovered during on-site research, as Participants Five and Six both commented that the scent of German beer, sausage, and pork knuckle had drawn them in and made it evident of its country of origin.

The German pavilion at Expo Osaka serves as a key testament to the indefinite potential of circularity and the integration of the circular economy into mainstream architecture. It was a powerful prototype for future sustainable design, aligning with Expo Osaka's theme of "Designing Future Society for Our Lives," as it encapsulated the intersection of circularity and biophilic design and culture through diverse innovative means, proving how considerations in all steps, notably from the materials, can make a massive difference.

Case Study 3:

Figure 3: China Pavilion Building a Community of Life for Man and Nature-Future Society of Green Development. Copyright [2025] by the author



The pavilion took profound inspiration from China's cultural heritage, as it presented a powerful architectural narrative drawn from multiple traditional inspirations, embodied a prime example of cultural sustainability (Fakharany, 2023). To reflect the country's intention for a harmonious coexistence of cultural heritage and environmental development.

Culture

At the entrance of the pavilion stood an inscription of classical Chinese poetry on bamboo slips that was indicative of the transmission of knowledge through time and the heritage of China (Fakharany, 2023).

The Chinese pavilion represented China's 5,000-year-old civilization and its current vision of green development, bridging the past and the future through sustainability (Nair, 2024). The Chinese calligraphy and poetry engravings within the pavilion featured over a hundred different classical poems written in five different calligraphy styles, drawn from influential texts such as the Shi Jing and Chu Ci, highlighting how the pavilion took every opportunity to showcase its rich chronology at the Expo (Ruoting, 2025).

One of the distinctive aspects of the Chinese pavilion was its ten-meter calligraphy 'waterfall' demonstration that impressed visitors, as Participants 1 and 2 refer to the 'waterfall' as an impressive aspect of the pavilion. It tells about Chinese writing development spanning three millennia, and combined with interactive touchscreens that delve into ancient scripts and poetry, it allowed national heritage to link contemporary technological presentation so as to support the cultural continuance and innovation that ran through the pavilion's theme (Fakharany, 2023). Visitors in particular enjoyed the creative, engaging pathways in learning, as Participant 1 commented,

“The touch screen with several language options was very accommodating in incentivising visitors to learn.”

A unique initiative showcasing China's culture was that its exhibits and events were routinely rotated to be able to showcase 30 different provinces and regions of China during the six month duration of the Expo to allow visitors to experience a broad cultural narrative and diverse heritage (CCPIT, 2025). Visitors were able to relish in the eclectic, rich history and heritage of China, even with multiple visits, as Participant 2 stated,

“This is my second time here, and I was shocked to find new artifacts being displayed; it drew my attention to how they were different.”

The visitor’s response indicated that cultural semiotics were conveyed as intended and effectively embodied, as the pavilion succeeded in effectively showcasing a strong national identity of Chinese culture.

The pavilion also displayed an immersive short film that conveyed China’s vision of sustainable development, inspired by traditional Chinese solar terms. This allowed visitors to discover China’s cultural concepts through the exhibition, which enabled visitors to partake in the experience instead of passing by unknowingly. This emphasized the cyclical nature of time and the interdependence of humans and nature, conveying the substance of circularity in architecture.

These cultural features also reflect ecological principles, such as circularity and interdependence, with their emphasis on time, cycles, and heritage paralleling ideas of resource continuity and environmental responsibility. Integrating culture into sustainable architecture ensures that buildings are environmentally responsible, socially meaningful, and capable of fostering a shared understanding among diverse audiences.

Biophilic Design

The bamboo-like ceiling decorations embodied the growth cycles of nature and agriculture, allowing visitors to feel ‘the life code’ in the exhibition space, where visitors were able to experience all four seasonal transitions in (Jumbo Globe, 2023). The pavilion had also holistically natural lighting for a seamless flow, which enhanced the connection between humans and nature (Nair, 2024). Natural light is one of the most common uses of biophilia in architecture for human well-being purposes, however, it is not only limited to well-being as it also plays a large role in sustainability by reducing ecological footprints. In the pavilion, the material choice of bamboo, as one of its core materials—a renewable resource—demonstrated both traditional Chinese aesthetics and sustainable design, reinforcing the framework for culturally rooted biophilic design.

Circularity

Whilst the primary focus was on the exhibition and structure, circularity and ecological vision were nonetheless key aspects of the pavilion’s architectural approach, shown through the implementation of a zero-waste construction code (Qiange, 2025).

For instance, the China pavilion highlighted future circular materials, such as renewable bamboo-wood panels. They were specially made using advanced 3D and building information modeling (BIM) technologies in China (Qiange, 2025). These panels being prefabricated in China even though the Expo was held in Japan enabled costs to be reduced by 90% and ensured that these panels could be brought back to China to be reclaimed after the completion of the Expo (Qiange, 2025). The China pavilion exemplified circularity in materials through innovative, responsible resource management.

The materials used for the construction of the Chinese pavilion had been designed with energy-saving features to accommodate the hot Japanese weather, which included a centralized

cooling system with optimized airflow, bright lighting, and energy-efficient elevators as well (Ruoting, 2025).

The Chinese pavilion presented China's profound engagement with designing a future world and economy that places sustainable design at its core, while incorporating cultural representation. It showcases an example of architectural design that honors history, combining it with new and emerging technologies that give visitors a vision of the future of architecture and built environments.

Case Study 4:

Figure 4: Italy Pavilion Art Regenerates Life. Copyright [2025] by the author



The Italian pavilion's theme, "Art Regenerates Life," was largely inspired by the Renaissance concept of the *Ideal City*, a utopian vision of urban design characterized by order and harmony. Accordingly, the pavilion seamlessly merged art, culture, and innovation to present a proactive model of a reimaged *Ideal City*, while simultaneously showcasing Italy's prioritization to environmental responsibility and its cultural heritage.

Culture

The architects of the Italian pavilion aimed to entice visitors to feel as if they were "breathing the air of Italy" through an immersive exhibition of Italy, featuring Renaissance paintings, sculptures, and cultural artifacts (Gonzalez, 2023).

The Italian Pavilion attempted a bold cultural reinterpretation through its theme, *The Ideal City*, a reference to Italy's Renaissance concept of *la città ideale*, famously depicted in 15th-century perspective paintings by artists such as Luciano Laurana (Centrale, 2025; EXPO Osaka 2025, 2025c; Gonzalez, 2023). However, interviewees seem to have misread the architects' reinterpretation presented in the pavilion's entrance, as the arched colonnaded entrance was misunderstood as a nod to the Roman era, rather than recognizing the deeper allusion to the harmonious, rational geometry of Renaissance urban utopias. Participants 7 and 8 both picked out that

"The entrance reminded me of the Colosseum,"

as a significant indicator of the country's culture and origin, confirming the recurring misinterpretation that had been present at the Expo. However, the *Ideal City* that the architects

aimed to portray does not utilize arches. The Renaissance is also Greek, where ideals, techniques, and spiritual values were often explored in comparison to the Roman Empire, which was more pragmatic, focused on ownership and imperialism, and the spreading of culture. The architects' intention was to use those historic urban metaphors—the theatre, portico, piazza, and garden—to create a future-oriented “living fabric” that expresses Italy’s regional diversity and innovative identity (Mario Cucinella Architects, 2025).

This meant it conveyed a different impression of intentions than it actually intended. The Renaissance era is marked by significant discoveries and a period of rebirth (HISTORY.com Editors, 2018). What the architects of the Italy pavilion sought to convey was more representative of revolutionary cities, as well as the flourishing of inventions inspired by the Renaissance era. Therefore, the execution may have limited clarity for the public and was ineffective. This misunderstanding prevented visitors from understanding the intended meaning behind the design choices, which were intended to inspire. Socially sustainable architecture allows spaces to be meaningful by understanding how visitors perceive cultural symbolism at these pavilions. The pavilion provides valuable data for architects to design spaces that are both culturally resonant and environmentally sustainable. Analyzing how visitors perceive cultural symbolism at these pavilions provides valuable data for architects to design spaces that are both culturally resonant and supportive of sustainable social practices.

Did the conceptualization rely too heavily on abstract motifs without offering clear interpretive guidance? Or was the execution perhaps overly simplified for the public, who expected more literal and familiar cues?

Whilst the architects aimed to convey Italy’s vision of reimagined utopian design through their reinterpretation of the *Ideal City* from the Renaissance era, the conveyed intentions did not align with the visitors' impressions, which raised questions about how abstract concepts could be better executed to provide effortless understanding for visitors. However, it could be considered successful in that the pavilion successfully evoked strong Italian imagery through its architectural form to Expo visitors.

Circularity

The Italian pavilion’s take on circularity was largely seen through its influence with the broader goal of adaptive reuse after the Expo to make the pavilion a model of circular architecture (Al Koshta, 2025).

The pavilion was constructed using certified laminated wood and a dry construction system. This allowed for reconfiguration and disassembly, enabling the materials to be recycled after the Expo, considering its six-month duration (Al Koshta, 2025).

The exterior structure was made from permeable mineral fibres, which could passively regulate temperature, light, and airflow. It acted as both the skin of the pavilion and the interface that connected internal climate to external conditions, symbolizing Italy’s transparent approach to sustainable design. The lightweight textile of the outer face reduced energy demands, enabling the pavilion to behave like a living organism, which allowed it to adapt to seasonal rhythms and environmental changes in Japan—a core tenet of circularity (Al Koshta, 2025).

Biophilic Design

Lead architect Mario Cucinella stated, “The Italian Pavilion stands for a new idea of society, and for the city as a living organism where the relationships between people, art, the environment, and history can materialise” (Gonzalez, 2023). The Italian pavilion’s integration of biophilic design was intended to reconnect humans with nature through proximity. The rooftop of the pavilion featured an Italian-style garden that served as a contemporary labyrinth, with flowers and small trees that spread various scents, creating sensory dimensions for visitors to weave through inspired by Renaissance harmony and in keeping with the theme of the *Ideal City* (Mario Cucinella Architects, 2025). An organic biophilic ecosystem was designed innovatively, with the garden embodying native plants, fountains, sculptures, alongside winding paths that symbolized both human geometry and natural irregularity (Mario Cucinella Architects, 2025).

Biophilia at the Italian pavilion was multi-sensory and multi-spatial, as the pavilion's exhibition mirrored the rhythms of a day through the use of dappled sunlight filtering through a forest canopy. This enhanced awareness functioned as an antidote to the overstimulation of digital life, connecting Japanese spatial philosophies of impermanence with Italian approaches to beauty and environment.

Key components of the pavilions, such as the theatre, piazza, and rooftop garden, formed a triptych of experimental biophilia that all showcased the Italian pavilion’s focus on biophilic design that prioritized empathy and emotion, as much as ecological responsibility.

The pavilion illustrated harmonious integration of cultural and sustainable practices, despite some elements being misinterpreted; the pavilion still encapsulated Italy’s dedication to building a future that values ecological balance and cultural richness in urban architecture.

5. Conclusions

The researcher was drawn to the topic of sustainability, and in particular, took the four pavilions as the focal points of this study, analyzing them through the lens of circularity, biophilia, and culture. The architectural innovations displayed by official participants’ national pavilions at Expo Osaka demonstrated how sustainability must extend beyond technical performance, environmentally, to encompass broader social considerations. Each national pavilion at the Osaka Expo 2025 exemplified various aspects of sustainability. The Swiss pavilion showcased biophilia, the German pavilion demonstrated circularity, and the Italian and Chinese pavilions conveyed cultural symbolism, all of which evidently resonated with the visitors present. These design approaches can be inspirational for future research and design that focus on the notion of sustainability as a form of biophilia integration, circularity, and culture. The unstructured interviews with pavilion visitors at the Expo highlighted how the clarity of the architectural intentions plays a large part in ensuring they are conveyed effectively. In essence, the clarity of architectural intentions directly impacts and enhances the social effectiveness of sustainable spaces.

However, this study has several limitations: due to time constraints and the ongoing nature of the Expo, information was limited, and only four out of more than fifty pavilions were selected for analysis. Additionally, sustainability encompasses many more potential subcategories, beyond the three explored in this paper. Future research could examine other aspects of sustainability

that remain underexplored, for example, neuroarchitecture, innovative applications of technology, or additional social and cultural dimensions. Additionally, the researcher strongly recommends delving deeper into the architectural analysis of the relationships among design, communication, and sustainability in future research highlighted by the findings from the Italian pavilion.

As urban expansion in this century accelerates more and more and the SDGs deadline inches closer, the researcher hopes that the conclusions drawn from this paper's analysis can inform future global efforts to build not just sustainably but meaningfully with empathy and regeneration at the root of architectural practice. The most consequential takeaway from the Osaka Expo's pavilions is one of inspiration.

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