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Editorial

Dear Readers,

We are pleased to present the fifth issue of the *Journal of Technology, Architecture, Design and Planning (JTADP)*, an open-access journal published by the Faculty of Architecture at Istanbul University. Since its establishment in May 2023, JTADP has published two volumes and four issues, featuring a total of 23 peer-reviewed articles, all freely accessible to the global academic community.

Each new issue strengthens our commitment to fostering critical inquiry, interdisciplinary collaboration, and scholarly excellence in the fields of architecture, design, and planning. The present issue continues this trajectory with a diverse selection of articles that reflect the multifaceted nature of our disciplines and their relevance in contemporary discourse.

Among the featured contributions is *"Urban Agriculture as a Sustainable Development Strategy: Istanbul Yedikule and Ayvansaray Gardens"* by Banan Zanjeer and Halide Candan Zülfikar, which explores the significance of urban agriculture in Istanbul. In *"Comprehensive Evolution of Ornamentation in Medieval and Post-Seljuk Architecture,"* Zeynab Nazer and Peter Rabb provide a comparative analysis of ornamental practices across distinct periods of architectural history. Pelin Işık's article, *"The Meanings Attributed to Representation in Architecture,"* delves into meanings surrounding architectural representation. A multi-authored study by Lilian Chioma Obi-George, Oluchi Chinenye Ifebi, Saheed Adeyemi Adegoke, Nnamaka Udochukwu Nzewi, Chukwudum Jasper Eze, and Nkechi Maryann Maduka—*"Examining the Impact and Perception of Thermal Comfort on Students' Performance in Architectural Studios"*—investigates how environmental factors shape the studio experience and learning outcomes. Finally, *"A Methodological Approach to Historic Building Conservation: A DSS for Restoration Project Process Optimization"* by Eren Okar and Yüksel Demir offers a practical framework for restoration planning.

We are also proud to share that, as of this year, JTADP has begun to be indexed by several academic databases. This represents a significant step forward in our aim to enhance the journal's visibility and impact. We remain committed to achieving broader recognition in established citation indexes in the near future, further consolidating JTADP's position within the international scholarly landscape.

We extend our sincere gratitude to all the authors, reviewers, and editorial board members who have contributed to the growth and success of JTADP. Your dedication and scholarly rigor are what make this journal possible. As we look ahead, we remain enthusiastic about expanding the journal's scope, audience, and academic reach.

Prof. Dr. Kemal Kutgün EYÜPGİLLER, Editor-in-Chief

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Research Article

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Urban Agriculture as a Sustainable Development Strategy: Istanbul Yedikule and Ayvansaray Gardens

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Abstract The interest in urban agriculture practices is increasing around the world due to growing awareness at both local and global levels of achieving food security and sustainable development in urban areas. In fact, urban agriculture is not a single practice. The integration of ideas, designs, and applications with designers and users can form different practices of urban agriculture, which can be defined as a set of practices based on social practice theory. Therefore, understanding the social and environmental dynamics of urban agriculture, which have led to its integration into the city structure, is crucial. As a result, analyzing and evaluating the planning of urban agriculture practices in major urban cities can contribute to understanding how these practices are integrated into the urban fabric. In this regard, a study was conducted in Istanbul to analyze Yedikule and Ayvansaray Gardens, located in the historical Fatih district. This study aims to evaluate urban agriculture planning in Istanbul and study its impact on sustainable development and the formation of alternative food networks. "Social Practice Theory" was used as an analytical framework to understand how these practices impact the urban environment and how they interact with local communities. This study aims to explore how planned urban agriculture contributes to the UN's 2030 sustainable development goals, through analyzing the planning process of urban agriculture in both Yedikule and Ayvansaray gardens.

Keywords Urban agriculture · city planning · social practice theory · market gardens · Istanbul

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Introduction

Urban agriculture has been an essential component of the urban fabric since ancient civilizations such as Mesopotamia. Its location has changed over time, as it moved outside cities during the Middle Ages. In the modern era, neoliberal urbanization has pushed agriculture to the rural/urban fringes as part of global food systems. However, modern cities face significant challenges, including food insecurity and sustainability, making the reintegration of urban agriculture into cities an urgent priority for sustainable development. Today, urban agriculture plays a vital role in providing local food and enhancing food security and sovereignty in cities. This research aims to address these challenges by exploring how to exploit the potential of urban agriculture in city planning. In fact, global challenges such as food price fluctuations and climate change call for efficient solutions to enhance food security and local food systems. Urban agriculture could be an essential tool to achieve sustainable urban development in urban areas. It contains different practices and forms based on the context, goal, and legal framework. Therefore, there is a need to understand how these practices can be integrated into urban planning to address local and global challenges.

When exploring the global context, different agendas are found to control urban agriculture practices and planning in both developing and developed countries. Regional sustainable urban development agendas have begun to highlight the importance of global partnerships in addressing global urban issues. These guiding principles affect urban interventions at the local level as well. Literature of urban planning and environmental studies in developed countries has begun to emphasize the relationship between urban agriculture practices and food systems, sustainability, and food security (Mincyte & Dobernig, 2016; Mougeot, 2006; Siegner et al., 2018).

In 2022, approximately 29.6% of the global population experienced moderate to severe food insecurity (FAO, IFAD, UNICEF, WFP, & WHO, 2023). This fact highlights the urgent need to study how urban agriculture can be used as an effective strategy to address the challenges of food insecurity. The concern for food security through sustainable development strategies has become a global trend in urban planning and policy making fields. Many studies in related literature have used social practice theory to analyze urban agriculture within planning practices in developed countries (Dobernig et al., 2016; Jansma & Wertheim-Heck, 2022; Jansma & Van Der Valk, 2017; Kontothanasis, 2017; Stolwijk, 2023; Touliatos, 2011). Due to the complexity of urban systems such as urban agriculture, the use of social practice theory provides an analytical framework for analyzing the interconnected relationships between practices, actors, and social structures, helping to develop innovative and impactful solutions. In other words, there is a need to understand how urban agriculture practices have emerged and changed in a certain context over time to design sustainable urban agriculture initiatives. An analytical framework, such as social practice theory, which is considered a medium between practice, actors, and social structure, is needed for deconstructing and understanding the overlapping connections of elements within complex urban systems such as urban agriculture. This approach will allow urban agriculture to be analyzed not only as a tool for food production but also as a means of achieving social integration and promoting sustainable change.

Istanbul, the largest city in Turkey, is known for its historical market gardens, which were responsible for feeding the city in the past. These market gardens have cultural and historical importance. Today, different municipalities in the mega city focus on creating more green spaces to promote wellbeing, social integration, and environmental awareness. For example, Yedikule and Ayvansaray Gardens on the Fatih historical peninsula promote urban agriculture practices. Yedikule Garden, a part of the historical Yedikule Market Gardens, offers a socially and culturally accepted urban agriculture model that was also applied to Ayvansaray Garden.

Both Yedikule and Ayvansaray Gardens in Istanbul were chosen as a case study for research to examine how urban agriculture planning contributes to achieving the 2030 Sustainable Development Goals, focusing on the potential of urban agriculture planning in creating alternative food networks. This research will provide clear recommendations for how to integrate these practices into urban planning, emphasizing their impact on enhancing food security and sustainable practices locally and globally.

Further research is needed to understand the phenomenon of urban agriculture as a social practice that encourages the sustainable behaviors of individuals. The significance of this research is evident in its contribution to the fields of urban planning, sustainable development, and community engagement by highlighting the transformative potential of urban agriculture planning. The findings can inform urban policymakers, planners, and community organizations on how to harness the power of urban agriculture to create more sustainable, productive, and inclusive cities. The objectives of the research include the following points:

- Explore the evolution of urban agriculture practices to understand their dynamics and how they change over time in different contexts.
- Urban agriculture as a social practice is explored by analyzing the relationship between practices, actors, and social structure using social practice theory.
- Explore the potential of urban agriculture planning as a tool for achieving the 2030 Sustainable Development Goals (SDGs).
- An urban agriculture planning model in Istanbul was analyzed using Yedikule and Ayvansaray Gardens as a case study to understand their role in building sustainable food networks.
- Provide recommendations for policymakers and planners to adopt planning strategies and models that integrate urban agriculture into inclusive and sustainable cities while promoting local and sustainable food networks and encouraging community engagement.
- Integrating local and global contexts to understand the relationship between local interventions in Istanbul and global urban contexts provides a holistic approach toward effective solutions in urban agriculture planning.

Literature Review

To begin, sustainable urban development and the basic concepts and characteristics of urban agriculture were reviewed in the related literature in both developed and developing countries context. The literature review focuses on urban gardens, which is the main type of urban agriculture and the scope of this research.

Global and Local Sustainable Development Visions

In urban planning field, understanding global urban challenges is essential for taking effective actions at the local level. Different global agendas and frameworks for sustainable urban development have been founded since 1992, such as “Agenda 21”, the “Millennium Development Goals”, “The Johannesburg Summit”, “Rio+20” and “2030 Agenda for Sustainable Development”. The United Nations member states adopted UN 2030 Agenda for Sustainable Development in 2015. This initiative aims to create a roadmap to promote urgent actions to end poverty and deprivation while increasing peace and prosperity in the present and future (United Nations, 2015). After the announcement of development agenda, the issue of localizing sustainable development goals came to the fore. In this regard, Sweden developed a solid institutional framework and launched a Local Agenda 2030 in 2019 with civil society participation based on the principles of the 2030 agenda (Bostancı, 2021).

Strategic Planning in Turkey

Globalization has increased the need for strategic planning instead of traditional planning to provide a framework that guides a country's development and growth (Akman & Özaslan, 2018). Turkey, which is the main context of this research, has adopted different strategic plans for sustainable development. Turkey is a transcontinental country with geostrategic importance. According to the World Bank Economies List, Turkey has a population of 84.1 million and has reached upper middle income (World Bank, 2022a). In addition, according to the United Nations' World Economic Situation and Prospects, Turkey is considered a developing country (United Nations, 2021). In 2015, Turkey with 193 countries signed the UN 2030 Agenda which reflects the commitment of Turkey toward the global sustainable development. Development planning in Turkey is divided into three periods: the statist period (1923-1950), the liberal period (1950-1960) and the planned period starting in 1960 when the State Planning Organization was established. After 1980, a strategy-based approach was adopted in the development plans, and more targets were included. National development plans include priorities for a 5-year period to consider the sustainability of the development process. A total of 11 national development plans were prepared and implemented in Turkey from 1963 to 2022, focusing on economics, policies, and current issues throughout each period. The issue of regional development was included in the 2nd Five-Year Development Plan (1968-1972) (Toy & Çalışkan, 2016). Turkey has created a road map aligned with the 2030 Agenda through national development plans. High-level national documents guide the strategic management design of public institutions. Although sustainable development goals are accepted in strategic planning in Turkey, there is a need to effectively integrate these goals into the planning process and improve their implementation (Yereli & Ünal, 2022).

According to Article 41 of Municipality Law No. 5393, if the population of the municipality is over 50,000, it is obliged to prepare strategic plans in accordance with regional and zoning plans. Thus, Istanbul, Turkey's largest city and a major metropolis on a global scale, has undergone various strategic planning initiatives to address complex urban challenges, support sustainable development, and improve the overall quality of life of its residents. Istanbul is one of the four cities in Turkey with a strategic plan that includes the Sustainable Development Goals (Yereli & Ünal, 2022). A matrix was created in the Istanbul Strategic Plan (2020-2024) to establish a connection between the SDGs and the 2020-2024 Istanbul Metropolitan Municipality Strategic Plan. The strategic plan aims to address external challenges and opportunities by examining global urban trends. It focuses on adding value to economic, environmental, social, and governance aspects to promote sustainability and heritage preservation supporting urban agriculture and green areas (Istanbul Metropolitan Municipality, 2020). Different other documents such as the Istanbul Food Strategy and Istanbul Vision 2050 are prepared as well. These documents aim to determine the city's food strategy based on food security and food sovereignty as well as the city's future and goals. Istanbul Vision 2050 emphasizes the promotion of urban agriculture practices such as "Vertical Farming" and "Urban Gardens" as well.

Food Sovereignty and Food Security

In existing studies on urban and regional planning, the most important concepts used in urban agriculture are food security and food sovereignty. Many sustainable urban development agendas adopted the concept as a goal to achieve justice, capacity building, and sustainable cities. Therefore, this concept has emerged as one of the main goals to be achieved in modern urban development agendas. Food sovereignty goes beyond the concept of food security. Food sovereignty advocates that the feeding of nations is a matter of national security or sovereignty. When a country's people depend on the global economy for their next meal, on the goodwill of a powerful country not to use food as a weapon, or on the uncertain and high cost of

long-distance transportation, that country lacks real security, both nationally and in terms of food security (Rosset, 2003). The food sovereignty movement aims to guarantee people the space, ability, and right to define their own food patterns and to protect production, distribution, and consumption (Pimbert, 2009).

On the other hand, according to the Food and Agriculture Organization of the United Nations (FAO), "The State of Food Security and Nutrition in the World 2023" report highlights the complexity of food security and the increasing hunger situation in the world due to COVID-19 economic recovery efforts, the conflict in Ukraine, and high food prices. According to projections of food security, almost 600 million people could suffer from chronic malnutrition by 2030, and urbanization will reshape food systems. In 2022, approximately 29.6% of the global population faced moderate to severe food insecurity (FAO, IFAD, UNICEF, WFP, & WHO, 2023). FAO has emphasized the flexibility of the concept of food security, with nearly 200 definitions in publications, especially in the fields of research studies and policymaking. Food security as a concept began to emerge during the global food crisis in the mid-1970s (FAO, 2003). At the 1996 World Food Summit, the World Bank focused on four main dimensions of food security. The other three dimensions include the physical availability of food, economic and physical access to food, food use, and stability of the other three dimensions over time (World Bank, 2022b). In addition to the previous four dimensions of food security definition, FAO has highlighted two other dimensions of food security: agency and sustainability. In all conceptual definitions of the right to food, food security is evaluated on these 6 dimensions (FAO, 2020; FAO, IFAD, UNICEF, WFP, & WHO, 2021). In the field of environmental studies, many recent studies have begun to focus on urban agriculture as a main contributor to food security in different contexts, such as Armanda et al. (2019), while examining the relationship between food security and climate change in terms of its effects on food production, such as Amthor (2001), Führer (2003), Long et al. (2005), Walker et al. (1999).

The Concept of Urban Agriculture

Many studies in the literature have defined urban agriculture differently, depending on the purpose, context, and time (Aldington, 1997; Bailkey & Nasr, 2000; FAO, 1999; Mougeot, 2000; Smit, et al., 1996). Since urban agriculture has many dimensions, there is no single agreed-upon definition. Urban agriculture and peri-urban agriculture were initially used as a term by researchers and media. Later, it was adopted by United Nations (UN) organizations such as the United Nations Development Program (UNDP) and the Food and Agriculture Organization of the United Nations (FAO) (Mougeot, 2000). The defined concept of urban agriculture at the United Nations Habitat Conference in Istanbul in 1996 described the cultivation, processing, and distribution of food and other products through extensive plant cultivation and animal husbandry in and around cities (Butler & Maronek 2002, as cited in Akyol, 2011).

The FAO defines urban agriculture as follows;

"Urban and Peri-Urban Agriculture (UPA) occurs within and around the boundaries of cities worldwide and includes products obtained from crop and animal agriculture, fisheries, and forestry in urban areas." It also includes non-timber forest products and ecological services provided by agriculture, fisheries, and forestry. More than one farming and horticulture system is often found in and near a single city" (FAO, 1999, p. 9).

These definitions of urban agriculture answer the following questions: what, where, and why. Other definitions of urban agriculture include the motivations behind growing food for self-sufficiency, including production, exchange, and sale. These definitions distinguish between rural and urban agriculture for food production and other recreational agriculture (Belows, 2011, as cited in Akyol, 2011). Another definition of

urban agriculture is urban waste recycling and meeting daily urban needs (Smit et al., 1996). A comprehensive definition of urban agriculture should include all factors affecting urban agriculture in a way that can answer the questions of "what, where, why and who": This perspective was adopted in Baumgartner and Belevi (2001).

Examples of Urban Agriculture in Developed and Developing Countries

Each developed or developing country has a different urban agriculture model that is suitable for its own context. Community gardens, home gardens, commercial farms, individual gardens, institutional gardens, guerrilla gardens, controlled environment farms, and urban parks are the main forms of urban agriculture in developed countries. The most common forms of urban agriculture in developing countries are community gardens, home gardens, commercial farms, individual gardens, and guerrilla gardens (Wadumestrige Dona et al., 2021). Examples of collective and public urban agriculture practices are examined within the scope of this study.

A country's socioeconomic conditions can affect the characteristics of urban agriculture. Developed countries emphasize social interactions, recreation, and education through urban agriculture, ensuring social integration and environmental protection. Government support and policy interventions play critical roles in promoting urban agriculture in developed countries. For example, proximity is an important characteristic of urban agriculture and local food systems in developed countries. Canada and the USA defined the concept of "local" produce in their regulations. In Canada, local produce is defined as 50 miles across the border. In addition, it was defined as being within the state or territory. In the USA, local produce must be within a state or 400 miles from origin (Enthoven & Van den Broeck, 2021). In contrast, developing countries are focusing on the economic benefits of urban agriculture and exploring its potential for waste management and pollution reduction (Wadumestrige Dona et al., 2021). Recently, authorities in developing countries have started to include urban agriculture in their strategic plans, following developed countries. For example, since the 1990s, urban agriculture policies have been revised in Dar-es-Salaam, Tanzania, and urban agriculture has been included in land use planning. Additionally, both the governments of Uganda and Kenya are developing urban agriculture policies (Lee-Smith, 2010; Wadumestrige Dona et al., 2021).

Community gardens are known in developed countries as examples of urban agriculture. In Berlin, Germany, Allmende Kontor is a community garden that was planned through participatory planning that transformed the site of a former airport called Tempelhofer Freiheit (Schalk, 2014). In the United States and Canada, urban agriculture takes three primary forms: small commercial farms, courtyards, community-supported agriculture and community gardens. The purpose varies from selling fresh products to promoting food security in terms of accessibility, affordability and self-sufficiency (Mok et al., 2013). Moreover, city gardens in Vienna are generally created on the basis of public demand by municipalities and are organized by garden groups (Henden Şolt & Kaymak Heinz, 2017).

An innovative model of urban agriculture, such as vertical farming, has also been founded in developed countries. In Singapore, vertical farming is an important urban strategy to address limited space, increase food security, and promote sustainability through innovative techniques such as hydroponics and vertical towers (de Oliveira et al., 2020).

Libman, (2007), focused on the relationship between gardening, food awareness, and youth nutrition in Brooklyn, New York. The study found that growing food naturally not only increases understanding of food production and processing but also increases fresh produce consumption. The Brooklyn Botanic Garden

(BBG) Children's Garden is an example (Libman, 2007). Incorporating educational programs into urban gardens is another common approach in developed countries, such as Canada. The High Park Children's Garden is a community-based initiative in High Park, Toronto. It provides environmental education for children through gardening and learning about ecosystems (HighPark.org, n. d.). Similarly, the Royal Botanic Garden in Sydney, Australia, offers a variety of educational programs and initiatives, including the "Growing the Future" program that promotes sustainable gardening, environmental education, workshops, school programs, and community activities for children and women (Botanic Gardens of Sydney, n.d.).

On the other hand, there are many examples of different urban agriculture projects in developing countries, such as China. In Shanghai, China, a program focused on making the city self-sufficient in grain by producing 2 million tons of wheat annually (Yi Zhang & Zhangen, 2000). In Latin American countries such as Argentina, Brazil, and Cuba, governments have developed national policies and programs to support urban gardening. Meanwhile, in Africa, the Democratic Republic of the Congo has successfully established an institutional framework to advance national urban gardening development (Orsini et al., 2013). NGOs such as FAO also support many urban agriculture projects in developing countries such as Colombia and the Democratic Republic of Congo (Taguchi & Santini, 2019).

Research Methodology

Context

Istanbul is known for its green agricultural landscape, which has been used to feed the city since the Byzantine and Ottoman periods. Market gardens were used to play a vital role in supplying Istanbul's local food system, which is considered part of the Byzantine and Ottoman heritage. Most of the market gardens were founded within the city walls and later moved to other places outside the city walls with urban expansion (Figure 1). There were 344 market gardens within the walls of Istanbul. Nine of these 344 market gardens are located in the area, which is surrounded by walls, especially from the Yedikule Gate to the Silivri Gate (Shopov & Han, 2013, as cited in Kanbak, 2016). A historical document from the 1900s stated that there were over 1,200 orchards on both the Asian and European sides of Istanbul, effectively meeting the city's fruit and vegetable needs (Günçıkan, 1990, cited in Kanbak, 2016).

Figure 1

Market Gardens in Istanbul

Source: Durusoy & Cihanger, 2016

According to Henden Şolt and Kaymak Heinz, Yedikule Market Gardens contained architectural remains such as wooden annexes, barns, terracing systems and 5-m-diameter cisterns from the 19th century. These structures provide evidence that the gardens were integrated into Istanbul's urban planning over time. In 1939, the 6,650-meter Theodosian Walls were accepted as a protected area, and in 1985, the entire wall complex was added to the UNESCO World Heritage List as the Historic District of Istanbul (Henden Şolt & Kaymak Heinz, 2017). For this reason, Yedikule Market Gardens are considered an important part of the city's cultural identity (Figure 2).

Figure 2

Historical Yedikule Market Gardens

The phenomenon of market gardens, which represents the cultural identity of Istanbul, needs to be examined in terms of its potential in creating sustainable development strategies. Market gardens have enhanced food security by becoming a part of the local food system since the past. There is a need to measure the micro level of market gardens as part of urban agriculture practices. For this reason, Yedikule and Ayvansaray Gardens in Istanbul were chosen as a case study to examine urban agriculture practices (Figure 3).

Figure 3

Location of Yedikule and Ayvansaray Gardens and Historical Yedikule Market Gardens

Source: Google Earth, 2023

Launched by Fatih municipality, the project aims to promote urban agriculture education for children and women, which emphasizes a significant character. Yedikule Garden was opened in 2020 in the Yedikule Neighborhood (Figure 4 and Figure 5).

Figure 4

Map of Yedikule Garden

Source: Google Earth, 2023

Figure 5

Yedikule Garden before and after renovation

Source: Fatih Municipality Activity Report, 2020

Following the same model, Ayvansaray Gardens were opened in 2022 in the Ayvansaray Neighborhood (Figure 6 and Figure 7) (Fatih Municipality, 2020a; 2022b).

Figure 6

Map of Ayvansaray Garden

Source: Google Erath, 2023

Figure 7

Ayvansaray Garden Before Renovation

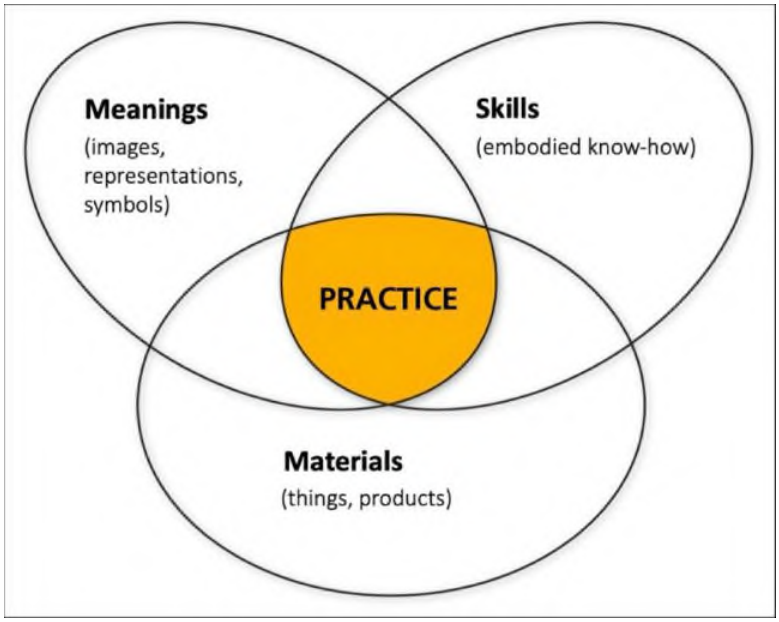
Source: Fatih Parks and Gardens Directorate, 2022

Methods

To analyze how urban agriculture planning contributes to the achievement of the UN's 2030 Sustainable Development Goals and the promotion of alternative food networks, the study adopted a qualitative research approach guided by the framework of social practice theory as an appropriate analytical approach for the case study. Qualitative methods included interviews with municipal employees, observation, and analysis of social media posts, municipal documents, brochures, YouTube videos, visual analysis, and online media articles. The data collected from Yedikule and Ayvansaray gardens were analyzed through the lens of social practice theory, which is based on three main elements: meaning, skills, and materials using thematic analysis (Figure 8) (Morgan et al., 2022). According to social practice theory, urban agriculture encompasses a set of activities that occur within a society, including practices, interactions, and information exchange between individuals and communities engaged in urban agriculture. Therefore, understanding these issues, along with other aspects of planning, is vital for developing future urban agriculture interventions. Examining an existing example of urban agriculture in Istanbul within the framework of social practice theory will help to deconstruct the dynamics of evolution and changing and mutual practices of an application in the city. This helps in integrating future planning for urban agriculture with sustainable development strategies that provide food security and better socio-economic status.

Figure 8

Social Practice Theory Elements of Shove et al. (2012),



Source: Morgan et al., 2022

In order to examine urban agriculture planning through the case study of Yedikule and Ayvansaray Gardens in Istanbul, interviews were held with Fatih Municipality Planning and Projects Directorate and employees from both gardens. The data obtained from the interviews aims to explore the dynamics that have changed urban agriculture practices in Istanbul over time. Interviews were conducted with 2 people from Fatih Municipality Planning and Projects Directorate, 4 employees from Ayvansaray Garden and 2 employees from Yedikule Garden. On Wednesday, September 13, 2023, an interview was held with both architects and planners working at Fatih Municipality Planning and Projects Directorate. This interview includes both open-ended and closed-ended questions to investigate the high-level strategic planning of Yedikule and Ayvansaray Gardens and the planning process, including the project's vision, goal, stakeholders, and land selection. On the other hand, on Thursday, September 14, 2023, an interview was held with Ayvansaray Garden Unit Manager and 3 other employees, and 2 employees at Yedikule Garden. The aim of this interview was to examine the management and operations of the two gardens.

In accordance with ethical considerations and confidentiality protocols, the Yedikule and Ayvansaray Gardens employees who participated in this study preferred anonymity. Therefore, generic identifiers were used consistently throughout this thesis to protect the identities and confidentiality of the interviewed participants. Employees at Ayvansaray Garden are part-time agricultural engineers defined as (Employee A1), part-time employees defined as (Employee A2), and full-time gardeners defined as (Employee A3). Employees at Yedikule Garden are agricultural engineers, defined as (Employee Y1) and landscape architects, defined as (Employee Y2). All employees at Ayvansaray and Yedikule Gardens were asked about urban agriculture practices in the gardens. The questions focused on technical information regarding the training workshops and the operational process in the gardens.

After collecting data from the interviews, data were refined using the thematic analysis method based on social practice theory elements: meaning, skills, and materials. This thematic outcome aims to study the relationship between practice, actors, and social structure using social practice theory to understand urban

agriculture as a social practice. After analyzing the obtained data according to social practice theory, a matrix was created to explore the relationship between urban agriculture planning in Yedikule and Ayvansaray Gardens, reflected through the analyzed themes, and the 2030 Sustainable Development Goals. This matrix guides a comparison between the characteristics of these gardens and urban agriculture practices in developed and developing countries to explain the role of urban gardens in achieving SDGs and to compare local interventions with the global context. The comparison used data collected through interviews with the Fatih Municipality Planning and Projects Directorate to explore the aim, location, spatial configuration, actors and legal framework of Yedikule and Ayvansaray Gardens. This study provides a thorough analysis of the urban agriculture planning model in Istanbul and its role in building sustainable food networks. Yedikule and Ayvansaray Gardens were also evaluated as an alternative food network. These findings provide insights for policymakers and city planners on how urban agriculture can be used as a strategic tool to promote sustainable development while enhancing food security.

Urban Agriculture in Yedikule and Ayvansaray Gardens: A Social Practice Theory

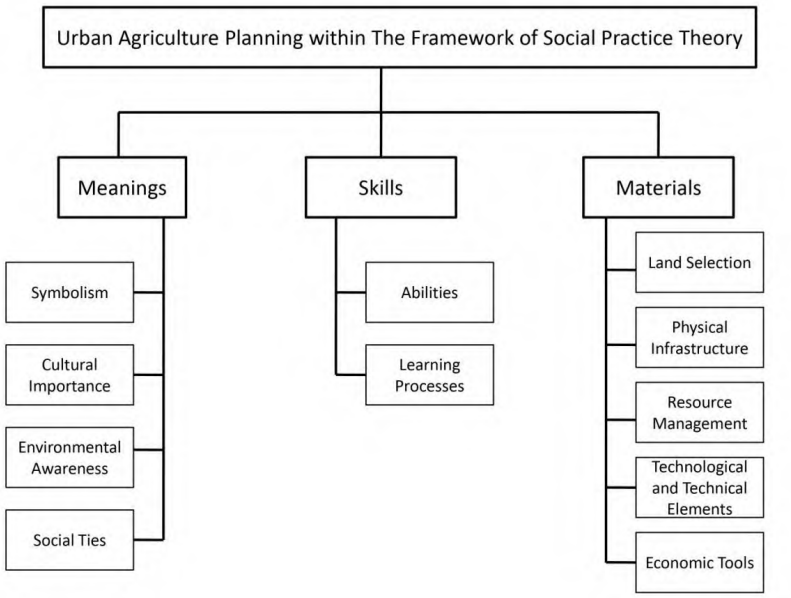
Many recent studies have used social practice theory as a framework to relate urban agriculture and local urban planning practices to national visions and to analyze urban agriculture in developed countries. Jansma and Wertheim-Heck (2022) analyzed the planning of urban agriculture in the Dutch city of Oosterwolde, using three elements of social practice theory as their main theme. Recent studies have focused on the social dimension as a major force that influences all systems in urban areas. When studying the evolution of global food systems and their replacement by local and alternative food systems, the social dimension appears to be a key factor in guiding this process, alongside the economic, cultural, and environmental dimensions. In the context of urban agriculture, the literature on food landscapes and urban planning considers it a social practice driven by actors such as supporters and users. This practice is dynamic and changes according to factors such as knowledge, desire, and ability to produce and consume. Therefore, understanding and analyzing urban initiatives requires an in-depth study of these dynamics.

The philosophical foundations of social practice theory are related to Marxism, existentialism, pragmatism, and analytical philosophy (Miettinen et al., 2009; & Reckwitz, 2002). Social practice theory is a group of theories that focus on social practices as a starting point for social change, rather than focusing on individual consumption patterns (Touliatos, 2011). Social practice theory includes three main elements: materials, meaning, and skills. Materials are the things that objects are made of, technologies, and tangible physical entities. Meanings denote the meanings of goals, ideas, and symbolism. Skills are knowledge, abilities, and techniques (Shove et al., 2012).

The data regarding urban agriculture planning obtained from the interviews with Fatih Municipality Planning and Projects Directorate and employees at both Yedikule and Ayvansaray Gardens were analyzed through the lens of social practice theory. The data obtained from the interviews about urban agriculture practice were decomposed into many smaller practices based on the three elements of social practice theory: meaning, skills, and materials, providing thematic analysis (Figure 9). This approach created a holistic approach to understanding Istanbul's urban agriculture planning model.

Figure 9

Social Practice Theory's Thematic Analysis of Yedikule and Ayvansaray Gardens



Urban Agriculture as "Meanings"

Meanings ensure that connections between verbal words and physical elements are established. Thus, four different themes were determined in the "meanings" section using the thematic analysis method: symbolism, cultural importance, environmental awareness, and social ties. According to Braun and others, thematic analysis is a method that identifies and analyzes stereotyped meanings. In addition, thematic analysis interprets these stereotypical meanings or themes through qualitative data (Braun et al., 2014). Fatih Municipality emphasizes some meanings related to Yedikule and Ayvansaray Gardens in its official discourse. These meanings are physically represented in the implementation of the Yedikule and Ayvansaray Gardens projects.

- **Symbolism:**

Yedikule and Ayvansaray Gardens symbolize the institutional commitment of Fatih municipality to green areas and sustainable living in Istanbul. Since the main character of Yedikule and Ayvansaray Gardens is "urban agriculture", it is not emphasized as a separate word in the strategic plan documents or even in the official discourse of the municipality. Rather, these gardens are described as "hobby gardens". Fatih Municipality focuses on increasing green spaces and improving social life by providing free agricultural education with appropriate spatial planning, diversity of spaces, and infrastructure. The aim for developing the food production process in the future is represented by adding a greenhouse in each garden for experiments (Figure 10). The topography and surrounding landscape were also considered during the planning process. The traditional arrangement of the market gardens in Yedikule Garden was well preserved. On the other hand, the "garden concept" in the Ayvansaray Garden's layout provides a friendly and well-planned space (Figure 11).

Figure 10

Greenhouse in Ayvansaray Garden

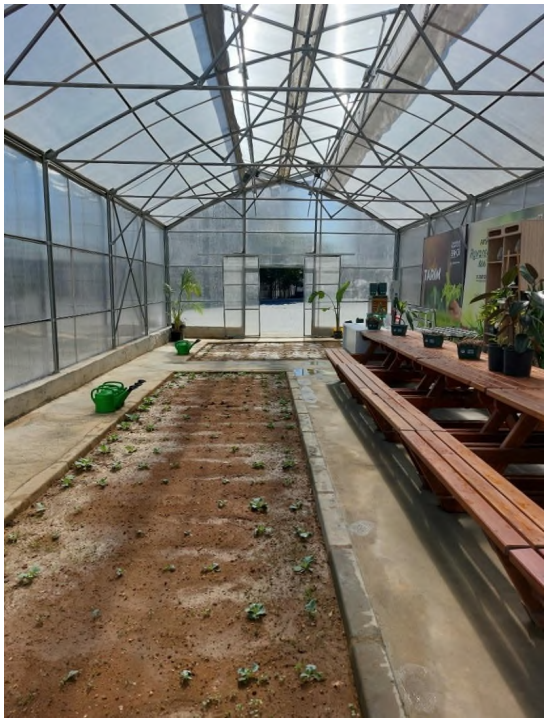


Figure 11

Ayvansaray Garden

- **Cultural Importance:**

The cultural significance of Yedikule and Ayvansaray Gardens represented in the selection of their location and agricultural education activities. Both land areas are agricultural within the zoning plan. The UNESCO-protected Yedikule Market Gardens, which extend along the walls of the historic Fatih Peninsula, form an important part of Istanbul's heritage. The historical Yedikule Market Gardens extend along the historical walls of Fatih's Historical Peninsula, from Yedikule, where Yedikule Garden is located, in the south, to Ayvansaray, where Ayvansaray Garden is located, in the north. The geographical location of both gardens creates a visual connection between them, enhancing the possibility of linking them together as a green belt with historic market gardens. In addition, the planning reflects the preservation of agricultural heritage through traditional practices such as growing seasonal crops and medicinal plants. The gardens celebrate Istanbul's agricultural traditions through harvest festivals and workshops that convey the importance of food culture to new generations.

- **Environmental Awareness:**

Fatih municipality uses urban agriculture as a strategy to raise environmental awareness among children through techniques such as organic farming and waste reduction, turning consumers into producers and creating alternative food networks that reduce the environmental footprint by shortening supply chains. Due to the dense population of children in the Yedikule and Ayvansaray neighborhoods, the project targeted children in these areas. The municipality reflects its commitment to environmental awareness in its implementation of the Avansaray Garden by preserving existing olive, mulberry, and walnut trees and planting medicinal and aromatic shrubs to protect agricultural production. In Yedikule Garden, the original agricultural function of the land was preserved and developed, again reflecting the municipality's environmental awareness.

- **Social Ties:**

Yedikule and Ayvansaray Gardens offer a space where neighborhood residents can come together, interact, and collaborate in collective activities. This project serves both environmental and social dimensions by providing common areas for children and families. Educational and social activities such as harvest festivals encourage social cooperation and shared ownership. During the field observation, it was noticed that each field was assigned to each school in the neighborhood. Since the names of each school are written on the signs in the field, the number of children belonging to the garden will be increased.

Urban Agriculture as "Skills"

- **Abilities:**

Practicing urban agriculture requires technical and practical skills. These skills range from cognitive skills to practical skills acquired through learning and experience. Professional teams of agricultural engineers, landscape architects and gardeners support agricultural activities in the gardens and convey their knowledge to children, women and families. This includes sustainable agriculture skills such as organic farming and seasonal farming. Professionals also conduct greenhouse experiments to develop new technologies using their coordination, organization and management skills. The garden staff work in harmony despite their different units in managing and planning agriculture.

- **Learning Processes:**

Knowledge about urban agriculture practices in Yedikule and Ayvansaray Gardens was acquired through hands-on learning and direct application. This is based on practical activities provided by professionals to acquire the required agricultural skills. These activities contribute to the dissemination and promotion of urban agriculture practices within the community. The professional staff also learn through their experiences in the workshops, where they undergo an experimental process to develop the content of the workshops. The short-term agricultural workshops combine both formal and informal learning and cover topics such as product cultivation, animal husbandry, and organic farming. Both sensory interaction with nature and theoretical information, presented through short videos on social media, enhance the learning experience in the workshops.

Urban Agriculture as "Materials"

Materials refer to the selection of land, physical infrastructure, material and resource management, technological and technical elements and economic tools to implement social practice. Urban agriculture was conceptualized as the main material in the planning of Yedikule and Ayvansaray Gardens. Accordingly, agricultural training workshops were the main means of initiating urban agriculture practices in both gardens. Infrastructure is another important tool for providing urban agriculture which was maintained in good way in both gardens. The gardens include all the necessary materials and tools for urban agriculture, such as compost fertilizers, seeds, seedlings, water supply, soil, vegetables, fruits, medicinal plants, and flowers.

- **Land Selection:**

The selection of suitable sites for the Yedikule and Ayvansaray Gardens project was the basis of the planning phase, and these two neighborhoods were prioritized based on a comprehensive analysis of the population and socioeconomic situation. Yedikule Garden land has historical and cultural significance as it is part of the historical Yedikule Market Gardens, reflecting the serious desire to preserve traditional urban agriculture. The selection of the Ayvansaray Garden land, an informal settlement, reflects an orientation toward urban rehabilitation. The different needs of each area to raise living standards and provide green spaces, drive the transformation of these lands into hobby gardens. In this way, Fatih Municipality could promote sustainability and environmental renewal.

- **Physical Infrastructure:**

The physical infrastructure includes physical elements that facilitate gardening and recreation practices. The infrastructure of Yedikule and Ayvansaray Gardens includes the layout, plant species, irrigation systems, agricultural tools, and urban furniture. This infrastructure aims to facilitate agricultural and recreational practices. Ayvansaray Garden has a larger public green space than Yedikule Garden and offers more recreational activities due to the need for recreational green spaces in the Ayvansaray neighborhood. Both gardens were designed to meet the needs of each neighborhood while considering the overall context. The municipality provides agricultural tools, water, and electricity free of charge and allows online reservations to register for workshops and activities. In other words, participation in different activities in both gardens is a controlled process that increases safety.

- **Resource Management:**

Resource management is an effective approach to developing existing resources. This approach ensures that existing resources are used efficiently while also reducing waste. This can save the municipality more time and budget. The resource management approach in Yedikule and Ayvansaray Gardens reflects the project management principles applied by the municipality. Developing resource management strategies can provide more efficiency and sustainability in terms of providing sufficient materials for agricultural practices. All the necessary resources are provided for the efficient implementation of urban agriculture with resource management in Yedikule and Ayvansaray Gardens. However, a problem encountered in Yedikule Garden is the inadequacy of the necessary materials for agricultural and social activities. Waste reduction strategies that recycle seeds and preserve them naturally to turn them into seedlings and reuse them in organic planting can ensure sufficient resource management. In addition, the irrigation systems in the gardens are sustainable and aim to reduce water waste.

- **Technological and Technical Elements:**

Technologies refer to all automation systems used in Yedikule and Ayvansaray Gardens to increase efficiency and function. The technology found in both Yedikule and Ayvansaray Garden is a soilless agriculture system. An automatic drip irrigation system is currently used in Ayvansaray Gardens and is planned to be added to Yedikule Gardens. In addition, because it is a public area, an automatic monitoring system is available for security purposes. There are no advanced active sustainable technologies such as solar panels or rainwater collection systems. However, such technologies are planned to be integrated in the future. Techniques refer to simple techniques used in agriculture. In both Yedikule and Ayvansaray Gardens, different sustainable planting and irrigation techniques are used. In addition, some methods are used in both gardens for sustainable waste management.

- **Economic Tools:**

Economic tools include the management of budget, financial and human resources by the municipality. The diversity of activities has created various jobs, providing employment opportunities for residents of Istanbul. All workshops and activities are free of charge; agricultural products are not sold but are given as gifts to participants, used in cooking workshops, or distributed among employees. Due to the increased demand for fresh produce in the gardens, selling fresh produce was included in the future development plan of the project (Figure 12). In this way, new income streams can strengthen the financial situation of the project ensuring efficient project management while supporting the local economy. The project aims to expand to other neighborhoods and thus have the potential to create alternative food networks.

Figure 12

First Sales Point in Yedikule Garden

Results

The relationship between Yedikule and Ayvansaray Gardens and Alternative Food Networks

Yedikule and Ayvansaray Gardens Project was not initially planned for commercial purposes, but rather as a model focused on social and environmental development in Fatih neighborhoods. This model is expected to be applicable in any urban context. However, during the operation of the project, employees noticed an increase in demand for organic produce from the gardens. Although there is no direct relationship between the project and alternative food networks, some features of alternative food networks are reflected in the project, which opens the door to possibilities for the formation of alternative food networks in the future.

First, the short distance between producers and consumers is a key feature of alternative food networks (Enthoven and Van den Broeck, 2021; & Reckinger, 2022). Yedikule and Ayvansaray Gardens provide easily accessible agricultural production activities due to their location within neighborhoods and near schools.

Second, unlike industrial agribusinesses, alternative food networks are small-scale farming practices that use organic production methods (Enthoven & Van den Broeck, 2021). Organic production methods are adopted in agricultural practices in Yedikule and Ayvansaray Gardens, such as using natural compost, recycling waste, and using the existing historical well in Yedikule Garden for irrigation.

Third, commitment to sustainable food production and consumption is another characteristic of alternative food networks. Yedikule and Ayvansaray Gardens were primarily planned to increase the environmental awareness of children. Free agricultural education workshops aim to transform the habits and mentality of children toward the environment when making consumption decisions. However, further research on the participants and their perceptions of the project is recommended.

Fourth, the socialization of agricultural activities is another important feature of community gardens and community-supported agriculture, which are the main types of alternative food networks. Social integration with agricultural activities was reflected in both Yedikule and Ayvansaray Gardens.

Finally, food producers are also considered consumers in both gardens, a model found in alternative food networks. In other words, if Yedikule and Ayvansaray Gardens start selling fresh produce and similar gardens are opened in different neighborhoods of Fatih, there will be great potential in creating a local organic agricultural food production network. This potential can contribute to sustainable urban development. The potential of Yedikule and Ayvansaray Gardens to create an alternative food network can serve as an example of strengthening sustainable food strategies in both Istanbul and Turkey. Increasing local food systems in Turkey can improve food security, sustainability, and the economy by creating a green circular economy.

The relationship between Yedikule and Ayvansaray Gardens and their Sustainable Development Goals

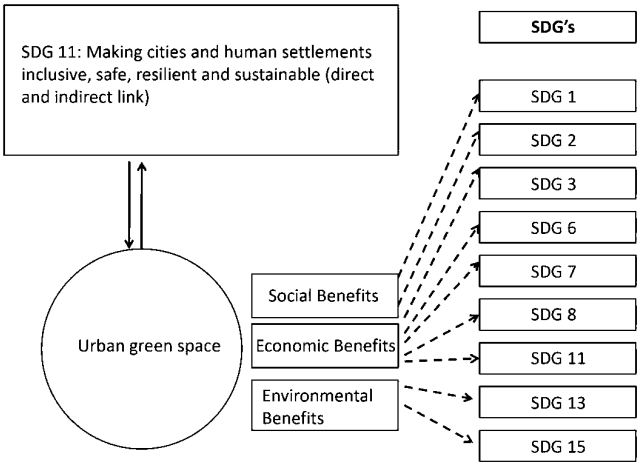
Urban agriculture in Yedikule and Ayvansaray Gardens is compatible with many Sustainable Development Goals (SDG 1,2,3,8,11,12,13,15).

A comprehensive analysis and matrix were created to evaluate the links between each theme and the SDGs. This evaluation is based on the theory of social practice to understand how urban agriculture in Yedikule and Ayvansaray Gardens relate to the SDGs and how they contribute to improving the efficiency of future planning of these initiatives. In an interview with the Fatih Municipality Planning and Projects Directorate, it was emphasized that all projects should consider the 2030 SDGs. The United Nations 2030 Agenda for Sustainable Development and the New Urban Agenda are the main reference sources for the municipality when making any decision.

Through deconstructing the planning process of the gardens into smaller applications when analyzed through the lens of social practice theory, the complexity of urban agriculture system was well understood, revealing the relationship between the project and the 2030 Sustainable Development Goals of the UN. In this regard, Hyder and Haque (2022), in their study, established links between urban green spaces and the 2030 Sustainable Development Goals of UN were founded using empirical evidence and examples (Figure 13).

Figure 13

Urban Green Space and Related 2030 Sustainable Development Goals Adapted from



Source: Hyder & Haque, 2022

This study was conducted to determine the relationship between Yedikule and Ayvansaray Gardens and the 2030 Sustainable Development Goals specified in this study. A matrix of the relationship between the United Nations Sustainable Development Goals and the objectives of the 2020-2024 Strategic Plan prepared by Istanbul Metropolitan Municipality was used as a reference point for the findings in this evaluation (Figure 14).

Figure 14

Matrix of Municipal Goals and Sustainable Development Goals in the Istanbul Strategic Plan

Subject	Purpose	The eradication of all forms of poverty everywhere	End hunger, achieve food security and improved nutrition, and support sustainable agriculture	Ensuring healthy lives and promoting well-being at all ages	Ensuring inclusive and equitable quality education and promoting lifelong learning for all	Achieving gender equality and empowering all women and girls	Ensuring accessibility and sustainable management of water and sanitation for all	Ensuring everyones access to affordable, reliable, sustainable and modern energy	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	Building resilient infrastructures, supporting inclusive and sustainable industrialization and fostering innovation	Reducing inequalities within and between countries	Making cities and human settlements inclusive, safe, resilient and sustainable	Securing sustainable consumption and production patterns	Immediate action to combat climate change and its effects	Conservation and sustainable use of oceans, seas and marine resources for sustainable development	Conservation, development and promotion of the sustainable use of terrestrial ecosystems, sustainable management of forests, combating desertification, halting and restoring terrestrial degradation and preventing biodiversity loss	Promoting peaceful and inclusive societies for sustainable development, ensuring access to justice for all and building effective, accountable and inclusive institutions at all levels	Strengthening the means of implementation and reviving the Global Partnership for Sustainable Development
1	Building a durable city by qualified and functional living areas						x			x		x						
2	Development of urban transportation in the scope of sustainable mobility									x		x						
3	Strengthening sustainable environment and energy management						x	x						x	x	x		
4	Contributing to the rising economic value of the city				x	x			x	x			x					x
5	Building a shared city by welcoming social needs by equal and inclusive means	x	x	x		x			x		x		x				x	
6	Creating a living city by increasing social life opportunities			x														
7	Preserving and improving cultural, architectural and natural city inheritance															x		
8	Ensuring financial stability																	x
9	Developing our institutional structure and business model by fair, participant and innovative methods																x	x

Source: Istanbul Strategic Plan 2020-2024, 2020

According to Hyder and Haque (2022), urban green spaces include functional green spaces, such as productive and institutional green spaces. Since the functional green areas are similar to those of Yedikule and Ayvansaray Gardens, the connections created in the study were used as a reference to find similar connections. The sustainable development goals regarding green space determined by Hyder and Haque (2022) were checked with the matrix contained in the 2020-2024 Strategic Plan of Istanbul Metropolitan Municipality. This control synthesizes similar and different goals related to urban agriculture. In the study of Hyder and Haque (2022) determined that sustainable development goals 6 and 7 did not include a relationship with urban agriculture or green areas in the Istanbul Strategic Plan matrix. Therefore, SDGs 6 and 7 are excluded. SDG 12 is not included in the work of Hyder and Haque (2022), but it is related to urban agriculture and green spaces in the Istanbul Strategic Plan matrix. Thus, SDG 12 was added to the other Sustainable Development Goals of Hyder and Haque (2022).

Since urban agriculture is used as a strategy for sustainable urban development in the Fatih Historical Peninsula, there are some connections between some sustainable development goals of the United Nations and the Yedikule and Ayvansaray Gardens project. These connections have also been strengthened in the local development objectives of the Istanbul 2020-2024 Strategic Plan. To achieve the 2030 sustainable development goals, it is important to consider a local framework. Istanbul Metropolitan Municipality devel-

opment goals that match the sustainable development goals of urban agriculture (1,2,3,8,11,12,13,15) were extracted from the municipality matrix (Figure 6). The municipal goals include the following:

Goal 1: To build a resilient city by developing qualified and functional living spaces

Goal 2: Improving urban transportation within the scope of sustainable mobility

Goal 3: Strengthen sustainable environmental and energy management

Goal 4: Contributing to the Increase of the economic value of the city

Goal 5: To create a shared city by meeting social needs in an equal and inclusive way

Goal 6: Imagine a living city by improving social life opportunities

Goal 7: Protecting and developing cultural, architectural, and natural city heritage

It is recommended that urban agriculture strategies for the effective realization of the 2030 sustainable development goals focus on the previous objectives of the Istanbul 2020-2024 Strategic Plan. Although Yedikule and Ayvansaray Gardens currently meet these objectives, attention should be paid to improving energy management in the gardens. After matching the 2030 Sustainable Development Goals of the UN regarding green areas with the Istanbul Strategic Plan, a matrix was created to evaluate the urban agriculture themes analyzed within the scope of social practice theory in Yedikule and Ayvansaray Gardens. The aim of this study is to evaluate how each goal under the theme relates to each sustainable development goal of green spaces, based on an in-depth understanding of urban farming practices in Yedikule and Ayvansaray Gardens. A scale of 1-5 was used in the evaluation (Table 1).

Table 1

Scale Indicators for the evaluation of the Yedikule and Ayvansaray Gardens Urban Agriculture Goals with Sustainable Development Goals

Score	Indicator	Explanation
1	Incompatible	There is no clear evidence that urban agriculture ambition is compatible with the stated 2030 sustainable development goal.
2	Limited Fit	Note that compatibility is not clearly defined.
3	Moderate Compatibility	There is some evidence of fit for purpose, but there may be shortcomings.
4	Solid Fit	The goal demonstrates significant alignment with the stated sustainable development goal and provides clear and robust evidence to support it.
5	Perfect Fit	The goal demonstrates outstanding alignment with the established 2030 sustainable development goal and provides comprehensive and robust evidence to support it.

This evaluation is subjective, and the scores are based on an analysis of urban agriculture practices in Yedikule and Ayvansaray Gardens within the framework of social practice theory. This is based on interpretation. The subjective interpretation arises from the time and scope limitations of the study. A matrix was created to evaluate the relationship between the Sustainable Development Goals and the urban agriculture goals in Yedikule and Ayvansaray Gardens (Table 2).

According to the matrix, within the theme of meanings: the first axis of symbolism (promoting green areas), social ties, and within the theme of materials: physical infrastructure, resource management, and economic tools received the lowest ratings in relation to achieving the 2030 SDGs, such as poverty reduction (SDG 1), hunger (SDG 2), good health (SDG 3), decent work (SDG 8), climate action (SDG 13), and life on land (SDG 15). The linkage of these goals and urban agriculture is weak and needs to be developed.

In contrast, under the theme of meanings: the second axis of symbolism (agricultural education), social ties, and under the theme of skills: abilities and learning processes, and under the theme of materials: land selection, physical infrastructure, resource management, technology, and economic tools received the highest ratings in relation to the goals of sustainable cities (SDG 11), decent work (SDG 8), responsible consumption (SDG 12), and life on land (SDG 15). Therefore, it is necessary to develop other strategies regarding urban agriculture practice that focus on the themes of (meanings) and (materials) to achieve the 2030 SDGs more effectively and to enhance the integration between urban agriculture goals and the SDGs.

Table 2

A Matrix for the Evaluation of Yedikule and Ayvansaray Gardens' Urban Agriculture Goals in Terms of 2030 Sustainable Development Goals

		Sustainable Development Goals for 2030							
Theme of Urban Agriculture	The purpose of urban agriculture	SDG 1: Elimination of all forms of poverty	SDG 2: End hunger, ensure food security and improved nutrition, and support sustainable agriculture.	SDG 3: Ensuring healthy lives and promoting well-being among all ages	SDG 8: Promoting sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all	SDG 11: Making cities and human settlements inclusive, safe, resilient, and sustainable	SDG 12: Securing sustainable consumption and production patterns	SDG 13: Urgent action to combat climate change and its effects	SDG 15: Protecting, developing, and supporting the sustainable use of terrestrial ecosystems, sustainable management of forests, combating desertification, stopping and improving terrestrial degradation, and preventing biodiversity loss
	1) Symbolism: *A) Promoting green areas through harmonization of municipal strategic goals*	**2**	**3**	**3**	**2**	**4**	**4**	**4**	**4**
Theme 1: Meanings	*B) Agricultural education*	**4**	**4**	**3**	**2**	**4**	**5**	**4**	**4**
	2) Cultural Importance	**3**	**4**	**4**	**3**	**4**	**4**	**3**	**4**
	3) Environmental Awareness	**3**	**4**	**4**	**3**	**4**	**4**	**4**	**4**
	4) Social Ties	**3**	**2**	**4**	**3**	**5**	**3**	**2**	**3**
Theme 2: Skills	1) Abilities	**3**	**4**	**4**	**5**	**4**	**4**	**4**	**4**
	2) Learning Processes	**3**	**4**	**4**	**4**	**5**	**4**	**3**	**4**
Theme 3: Materials	1) Land Selection	**3**	**3**	**4**	**3**	**5**	**4**	**4**	**5**
	2) Physical Infrastructure	**2**	**2**	**3**	**4**	**5**	**4**	**4**	**4**

		Sustainable Development Goals for 2030							
Theme of Urban Agriculture	The purpose of urban agriculture	SDG 1: Elimination of all forms of poverty	SDG 2: End hunger, ensure food security and improved nutrition, and support sustainable agriculture.	SDG 3: Ensuring healthy lives and promoting well-being among all ages	SDG 8: Promoting sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all	SDG 11: Making cities and human settlements inclusive, safe, resilient, and sustainable	SDG 12: Securing sustainable consumption and production patterns	SDG 13: Urgent action to combat climate change and its effects	SDG 15: Protecting, developing, and supporting the sustainable use of terrestrial ecosystems, sustainable management of forests, combating desertification, stopping and improving terrestrial degradation, and preventing biodiversity loss
	3) Resource management	**3**	**4**	**2**	**4**	**4**	**5**	**4**	**5**
	4) Technological and Technical Elements	**3**	**4**	**4**	**3**	**4**	**5**	**4**	**5**
	5) Economic Tools	**4**	**3**	**3**	**5**	**4**	**4**	**2**	**2**

Comparison of Yedikule and Ayvansaray Gardens with Urban Agriculture in Developed and Developing Countries

Due to the differences in economic, social, cultural, legal, and environmental situations, countries are classified in the international system as developed or developing, which affects urban development agendas and sustainable development goals that can be achieved. In 1996, the classification of "developed" and "developing" regions by the United Nations was introduced into the Standard country codes, known as (M49), for statistical purposes only. There was no intention to distinguish the developmental stage in each region. Later, the distinction between “developed” and “developing” regions has become irrelevant over time because of the dynamic evolution of many countries classified as “developing”. Since 2017, the Sustainable Development Goals report has adopted geographic classifications instead of developing and developed regions distinction. Based on consultations with international and regional organizations, this classification was removed from the M49 codes in December 2021. Accordingly, agencies may select appropriate groupings for their own purposes and update them as necessary. For example, the term “developing countries” is still used in some Sustainable Development Goals indicators, with its composition varying depending on the mandate, membership, or analytical objectives of the agency (United Nations, 2023).

In cooperation with the United Nations Conference on Trade and Development (UNCTAD), the Development Policy and Analysis Division (DPAD) of the Department of Economic and Social Affairs of the United Nations Secretariat (UN/DESA) and five United Nations Regional Commissions: the Economic Commission for Africa (ECA), the Economic Commission for Europe (ECE), the Economic Commission for Latin America and the Caribbean (ECLAC), the Economic and Social Commission for Asia and the Pacific (ESCAP), and the

Economic and Social Commission for Western Asia (ESCWA), countries were classified as developing and developed based on different standards. Accordingly, the World Economic Situation and Prospects report is a publication reflects not only the net economic status of countries around the world, but also the geographic location, temporal criteria, and level of development measured by gross national income (GNI) per capita determined by the World Bank. This classification includes three main categories of economies: developed, transition, and developing economies. Countries are classified based on geographic conditions. For example, developing regions include Africa, East Asia, South Asia, West Asia, the Caribbean, and Latin America. Countries are also classified based on ad hoc criteria. Accordingly, major developed economies are classified based on their membership in the Group of Seven. Among developing and transition economies, regions are classified based on fuel exports and imports. The level of development measured by gross national income (GNI) per capita grouped the countries as high-income, upper-middle-income, lower-middle-income, and low-income, which is used by the World Bank. For analytical purposes, the classifications are updated periodically, while data are collected from national and private sources such as the World Bank, the Organization for Economic Cooperation and Development (OECD), the International Monetary Fund (IMF), and the United Nations World Tourism Organization (UNWTO) (United Nations, 2014).

Developed countries are stable countries with high incomes, advanced infrastructure and technology. In contrast, developing countries face challenges such as low incomes, structural problems, and dependence on fluctuating agricultural exports. The situation where countries rich in natural resources experience higher rates of corruption, lower income levels, and lower development indicators compared to countries with less resources is known as the "natural resource curse" or "paradox of plenty." Developing countries are dependent on agricultural exports and raw materials at fluctuating prices, which negatively affect their economies. Furthermore, because industrialization is not yet at an advanced level, financial capital cannot be provided for machinery and technological investments in developing countries (Kowalski, 2020).

The comparison of the characteristics of urban agriculture between developing and developed countries is complicated due to differences in many factors, such as motivations, context, and legal frameworks of urban agriculture. This section compares urban agriculture in these two types of countries (developed) and (developing) in terms of purpose, location, spatial configuration, actors, and legal framework. These factors were chosen because they can affect food systems, production, and consumption patterns. The aim is to understand how these countries in the international system approach urban agriculture according to their development agendas, geographical locations, and economic situations. This realization aims to explore the opportunities for urban agriculture development through case studies (Table 3). After analyzing urban agriculture as a strategy for achieving some SDGs in Yedikule and Ayvansaray Gardens, their characteristics are compared with urban agriculture practices in developed countries, revealing similarities and differences in urban development agendas, while emphasizing that urban agriculture varies according to the complex local context of each region.

Table 3

Characteristics of Urban Agriculture in Turkey and Abroad, E.g. Yedikule and Ayvansaray Gardens

Comparison Theme	Characteristics of Urban Agriculture in Turkey, E.g. Yedikule and Ayvansaray Gardens	Characteristics of Abroad Urban Agriculture	Example from abroad
Aim	• There is no direct relationship between urban agriculture and food security. • It is used as a strategy to improve social status and environmental awareness. • It is used as a strategy to increase quality of life by creating green areas.	• In developed countries: 1)It is related to local food production and food security, such as alternative food systems. 2)Urban agriculture and peri-urban agriculture are a single entity and a strategy for sustainable development. 3) It has many purposes, including educational	• Social and educational agriculture in the Royal Botanic Garden in Sydney, Australia. • Brooklyn Botanical Garden, USA. • High Park Children's Garden, Toronto, Canada.

Comparison Theme	Characteristics of Urban Agriculture in Turkey, E.g. Yedikule and Ayvansaray Gardens	Characteristics of Abroad Urban Agriculture	Example from abroad
	• It is planned as a model to be implemented on a larger scale.	purposes. • In developing countries: It is a coping strategy to reduce hunger and poverty.	
Location and Spatial Configuration	• Proximity to markets and city centers in busy districts, such as the Fatih historical peninsula. • Despite its small-scale and location within dense neighborhoods, there is an interest in R&D and advanced agricultural techniques. • Urban transformation is occurring in the land selection process for Yedikule and Ayvansaray Gardens.	In developed countries: • Proximity to markets and city center. • Innovative applications, generally small-scale, and located in dense neighborhoods. • Used as an urban transformation strategy for slums and brownfields in industrial or commercial sites. • Common ownership in the form of (community gardens, hobby gardens or corporate gardens, etc.). In developing countries: • Marginalized/unplanned areas far from city centers. • Larger sclae in unplanned areas • Property rights issues, limiting access to land for urban agriculture.	• In the USA, local is within 400 miles or state of origin; in Canada, it is within the province/territory or 50 km beyond the border. • Technological innovations in food security in Singapore, such as vertical farms. • Allmende Kontor was built on the site of a former airport called Tempelhofer Freiheit in Berlin.
Actors	There is diversity among actors, including the municipality, NGOs, professional landscapes, and agricultural engineers.	There is diversity among actors, including partnerships between the public and private sectors, civil society, and NGOs.	City Gardens in Vienna.
Legal Framework	• Yedikule and Ayvansaray Gardens is a municipality-led initiative that promotes inclusivity and social solidarity. • Cultural and heritage value. • It can be a strategy to achieve the 2030 sustainable development goals. • Not stated as a clear strategy in food or urban development documents.	• Municipality- and community-led initiatives. • Cultural and heritage value. • It is planned from regional to local levels. • Integration into food development strategies.	• Urban Food Policies Framework of Milan Pact food policies. • Urban agriculture policies were reorganized and reviewed in Dar-es-Salaam, Tanzania, in collaboration with NGOs such as the Urban Management Program (UMP) and UN-Habitat. Both the Ugandan and Kenyan governments are developing urban agriculture policies.

First, developed countries have adopted local food strategies and urban agriculture within their sustainable development agendas, while developing countries consider urban agriculture as a hunger and poverty deviation strategy, with challenges related to hygiene and expertise (Taguchi & Santini, 2019). Developed countries consider urban and peri-urban agriculture as one entity used as a tool to enhance food security and local food systems by diversifying the objectives of urban agriculture, such as environmental and educational purposes. The different motivations for urban agriculture practices enhance long-term sustainable development achievement. Some of these objectives overlap with the objectives of the Yedikule and Ayvansaray Gardens initiative; it aims for social, environmental development and an increasing qulaity of life, focusing on scalability and the ability to expand as a model. Food security is not recognized which is a characteristic found in developing countries. However, there is the potential to create an alternative food network in the city if the model is expanded and more similar gardens are opened.

Second, urban agriculture practices are located near city centers and markets in developed countries, whereas they are also found in informal and marginalized areas in developing countries (Davies et al., 2020; Opitz et al., 2015). Urban agriculture is an innovative small-scale practice located in dense neighborhoods with common ownership, and it is being used as a transformation strategy for brownfields. On the other hand, urban agriculture is larger in scale and far from city centers, as people are facing property rights issues that limiting accessibility to urban agriculture practices in developing countries. Both Yedikule and Ayvansaray Gardens share some similarities with urban agriculture characteristics in developed countries; their locations are within dense neighborhoods near the city center, with small-scale practices. Innovation and sustainable urban agriculture practices, such as soilless and seasonal agriculture techniques, are also practiced in gardens due to expertise, hygiene, and resource availability, which is similar to the

characteristics of urban agriculture in developed countries. Yedikule and Ayvansaray Gardens are based on a transformative approach to agriculturally repurposed abandoned lands in original zoning plans. This approach of renovation and rehabilitation of slums aims to increase green spaces and quality of life.

Third, urban agriculture in developed countries is characterized by a diversity of stakeholders and a clear legal framework, whereas developing countries use a more centralized, top-down approach (Opitz et al., 2015; Wadumestrige Dona et al., 2021). The actors of urban agriculture in developed countries include the public and private sector, educational institutions, non-governmental organizations, and individuals, whereas in developing countries, the main actors of urban agriculture are generally individuals and NGOs. Yedikule and Ayvansaray Gardens have various actors and stakeholders similar to those in developed countries.

Finally, the legal framework of urban agriculture in developed countries generally regulates urban agriculture practices, starting from the regional level and extending to the local level. For example, the Milan Pact on Urban Food Policies provides a framework for such policies. However, the measurement system needs to be expanded and improved. Unlike developing countries, measures for the development of food and urban agriculture policies are given more importance (Opitz et al., 2015). Additionally, government officials are allowing bottom-up urban development initiatives, including urban agriculture, which opens the door to civil society participation in decision-making processes. This legal agriculture model in developed countries enables innovation, social participation, and human capital support in urban agriculture practices. In developed countries, individuals, innovative entrepreneurs and non-governmental organizations manage urban agriculture (Opitz et al., 2015). Since municipalities are solely responsible for the opening of gardens, the management and operation of these green spaces is usually performed by members of the public, such as garden groups.

In Yedikule and Ayvansaray Gardens, the entire project is carried out by the municipality, and all employees are hired by the municipality. Measures related to urban agriculture policies are recommended to be developed in projects such as Yedikule and Ayvansaray Gardens, and deeper research into urban agriculture planning, sustainable development, and food policies in the context of developing countries is needed. However, several initiatives have been launched to develop global urban agriculture policies, including the Urban Agriculture and Food Security Resource Centers, the International Development Research Center, the Urban Management Programme and the United Nations Human Settlements Programme (UN-Habitat). They seek to promote sustainable urban strategies and support research on urban agriculture (Lee-Smith, 2010).

Discussion

Urban agriculture in Istanbul, particularly in Yedikule and Ayvansaray gardens, is a social practice with cultural and historical value that serves as urban heritage for the city. This heritage reflects the social acceptance of urban agriculture as a source of local food production and a recreational tool that promotes community engagement. Data from interviews with employees at both Yedikule and Ayvansaray gardens confirmed that urban agriculture is divided into sub-practices that are categorized under meanings, skills, and materials. The data show that the relationship between urban agriculture and actors, such as the municipality, residents, and employees, and the social structure represented by the cultural and historical context of Istanbul reflects the complexity of the urban agriculture system. Analyzing this relationship using social practice theory enabled an understanding of the interaction between actors and social structures, providing a holistic view for more effective planning of urban agriculture. Data collected from interviews with

employees at Yedikule and Ayvansaray Gardens are vital to understanding how urban agriculture impacts the social and cultural context of Istanbul. These data form a fundamental basis for analysis, providing valuable insights into the relationship between urban agriculture and actors and helping to draw accurate conclusions about its role in achieving the Sustainable Development Goals.

An in-depth analysis of data obtained from interviews guided the evaluation of urban agriculture practices within social practice themes in accordance with the UN's 2030 Sustainable Development Goals. Accordingly, there are practices in planning urban agriculture that show weak links to SDGs, such as green space promotion and resource management, which need to be developed to strengthen their link to goals such as eradicating poverty and hunger. In contrast, there are practices that are strongly linked to SDGs, such as sustainable cities and responsible consumption, including agricultural education and land selection, which demonstrate strong potential to support sustainable development. On the other hand, there is a need to strengthen urban agriculture strategic planning practices to achieve greater alignment between local and regional plans, especially in the context of alternative food networks and food security.

Data obtained from interviews with Fatih Municipality Planning and Projects Directorate explored the planning process of such an urban agriculture initiative in Istanbul by exploring the aim, location, spatial configuration, actors and legal framework, as these factors affect food systems, including production and consumption. This exploration revealed the municipal approach to urban agriculture planning to achieve environmental awareness, agricultural educational purposes and green space enhancement. However, there has been a lack of consideration of urban agriculture as an alternative food network to enhance food security and sovereignty. There was no direct consideration of food security by the municipality when they planned the gardens, yet the gardens' potential enhances food security and their ability to create alternative food networks. A comprehensive comparison between Istanbul's experience in urban agriculture planning and similar initiatives in different global contexts could be conducted. Such comparisons support the development of sustainable urban policies that consider the interrelationship between actors and social structure and encourage the implementation of effective environmental policies that contribute to positive social change toward sustainable behaviors and a long-term vision for urban agriculture. Next, recommendations are provided for policy makers and planners to adopt planning strategies and models that integrate urban agriculture into inclusive and sustainable cities while promoting local and sustainable food networks and encouraging community engagement.

Focusing on urban agriculture as a tool to achieve the 2030 Sustainable Development Goals is recommended to ensure sustainable urban agriculture practices. Moreover, an effective planning process for urban agriculture, alignment with global and local guiding frameworks is crucial. It is recommended to set vision and purpose for urban agriculture practices, while considering it more seriously in zoning plans to tackle several problems related to random practices by individuals. It is important to consider urban agriculture as a catalyst for environmental awareness and education while activating this role. Many developed countries have started to find initiatives to educate children about agricultural practices and the environment through urban agriculture. This can increase individuals' environmental awareness through sustainable behavioral changes.

Urban agriculture plays a vital role in enhancing food security and sovereignty in any context. Therefore, providing an efficient legal framework for urban agriculture practices through planning, zoning, and proper urban policies while enhancing social integration and participation in decision-making processes regarding operational processes can ensure the sustainability of urban agriculture practices. The collaboration

between municipalities and civil communities highlights a participatory approach to governance and fair resource management. This is evidence in developed countries, where local governments plan and support community gardens and agricultural practices, while NGOs and civil communities manage them. In developing countries more centralization is dominant, which affects democratic governance.

Finally, it is important to consider the viability and dynamics of urban agriculture practices, including social, economic, environmental, spatial, technological dynamics, and policy and governance dynamics. Therefore, the process of managing and planning such practices is also dynamic and continuous. For example, Yedikule and Ayvansaray Gardens adopted organic agricultural production methods through an operational process that provides an opportunity to develop local agriculture and improve food security. Flexibility in planning urban agriculture initiatives as a model that can be applied in different contexts resembles an opportunity for upscaling urban agriculture practices, such as the project of Yedikle and Ayvansaray Gardens.

Conclusion

In conclusion, urban agriculture has gained increasing importance in academic research owing to the environmental, economic, and social challenges facing large cities. The literature has previously focused on urban agriculture in the context of developing countries but has recently expanded to developed countries, such as the United States, England, Canada, and Europe. This shift reflects a more serious approach to managing development strategies, focusing on food security and sustainability in these countries. Urban agriculture plays an important role in creating alternative food networks that are part of local food systems. Alternative food networks contribute to sustainable development strategies by enhancing food security and social justice, while providing sustainable food sources in response to the food crisis. In this context, developed countries have adopted sustainable food strategies, focusing on urban agriculture as a key component.

Recent literature has shown that urban agriculture is no longer just a response to the food crisis or low-income situations; it has become an effective tool for achieving sustainable development goals at various environmental, social, and economic levels. This research is based on data collected from interviews with employees of Yedikule and Ayvansaray Gardens and the Fatih Municipality Planning and Projects Directorate. These data reveal the complex dynamics that govern urban agriculture practices in Istanbul, including strategic planning, operational management, and social connections. The data obtained from the interviews enhances clear understanding of the role urban agriculture plays in achieving social development, food security, and environmental sustainability. Interviews with Yedikule and Ayvansaray Gardens employees revealed that these gardens are not only sites for food production but also educational and social spaces that contribute to building communities and strengthening social connections.

The results indicate the importance of urban gardens with agricultural practices as key components of sustainable development strategies because they contribute to improving food security, raising environmental awareness and promoting sustainable agricultural practices. Yedikule and Ayvansaray Gardens provide agricultural education and aim to raise environmental awareness among children and women, encouraging the adoption of similar projects to support the urban agriculture movement in Istanbul. Expanding the model of these gardens to other neighborhoods and cities is recommended to enhance alternative food networks and food security.

This study analyzes urban agriculture planning in Yedikule and Ayvansaray Gardens through social practice theory while examining how these gardens are compatible with sustainable development goals and the Istanbul Strategic Plan 2020-2024. Data from interviews with employees at these gardens show that urban agriculture is not just about food production but also about fostering social connection and building communities, which contribute to social well-being. This provides insights into the dynamics of urban agriculture practices and future planning processes. There is a need for in-depth analysis that conceptualizes urban agriculture as a micro-scale social practice in any context due to its complexity. Therefore, this research aims to fill this gap in this regard. The social practice analysis of urban agriculture shows the importance of promoting sustainable development strategies. It is recommended to consider urban agriculture in land use plans and urban policies due to its importance to the development process. It is also recommended that comprehensive strategies that include local community participation in planning and implementing urban agriculture projects be developed to ensure sustainability.

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References

Akman, Ç., & Özaslan, A. (2018). Türkiye'de stratejik planlama: Büyükşehir belediyelerinin stratejik planları ne söylüyor? *Avrasya Uluslararası Araştırmalar Dergisi, 6*(14), 55–90. https://doi.org/10.33692/avrasyad.510613

Aldington, T. (1997). Urban and peri-urban agriculture: Some thoughts on the issue. *Land Reform, Land Settlement and Cooperatives, 2,* 42-50.

Amthor, J. S. (2001). Effects of atmospheric CO2 concentration on wheat yield. *Field Crops Research, 73*(1), 1–34. https://doi.org/10.1016/S0378-4290(01)00179-4

Armanda, D.T., Guinée, J.B., & Tukker, A. (2019). The second green revolution: Innovative urban agriculture's contribution to food security and sustainability–A review. *Global Food Security, 22,* 13–24. https://doi.org/10.1016/j.gfs.2019.08.002

Akyol, M. (2011). *Evolution of urban agriculture concept and determination of design criteria* [Master's thesis, Istanbul Technical University], Polen. https://polen.itu.edu.tr/bitstreams/1cbb80cb-5f62-43cc-bad3-f9ae19a0fe3d/download

Bailkey, M., & Nasr, J. (2000). From brown fields to green fields: Producing food in North American cities. *Community Food Security News, Fall 1999/Winter 2000,* 6-8. https://foodsecurity.org/uploads/BrownfieldsArticle-CFSNewsFallWinter1999.pdf

Bostancı, S. (2021). Yerel gündem 21'den yerel gündem 2030'a geçiş ne tür yenilikler getiriyor?. *JOEEP: Journal of Emerging Economies and Policy, 6*(1), 114–123, https://dergipark.org.tr/en/pub/joeep/issue/60112/888002

Botanic Gardens of Sydney. (n. d.). *About us.* https://www.botanicgardens.org.au/about-us

Braun, V., & Clarke, V. (2014). What can 'thematic analysis' offer health and wellbeing researchers?. *International Journal of Qualitative Studies on Health and Well-being, 9*(1), https://doi.org/10.3402/qhw.v9.26152

Davies, J., Hannah, C., Guido, Z., Zimmer, A., McCann, L., Battersby, J., Evans, T. (2020). Barriers to urban agriculture in Sub-Saharan Africa. *Food Policy,* 101999. https://doi.org/10.1016/j.foodpol.2020.101999

de Oliveira, F.B., Forbes, H., Schaefer, D. & Syed, J.M. (2020). Lean principles in vertical farming: Case study. *Procedia CIRP, 93,* 712–717. https://doi.org/10.1016/j.procir.2020.03.017

Dobernig, K., Veen, E., & Oosterveer, P. (2016). Growing urban food as an emerging social practice. In Routledge eBooks, *Practice Theory and Research* (pp. 26). https://doi.org/10.4324/978131565690-21

Durusoy, E., & Cihanger, D. (2016). Historic landscape vs. urban commodity? The case of Yedikule urban gardens, Istanbul. *MEGARON / Yıldız Technical University, Faculty of Architecture E-Journal*, https://doi.org/10.5505/megaron.2016.48343

Enthoven, L., & Van den Broeck, G. (2021). Local food systems: Reviewing two decades of research. *Agricultural Systems, 193,* 103226. https://doi.org/10.1016/j.agsy.2021.103226

Food and Agriculture Organization of the United Nations. (1999). *Urban and peri-urban agriculture (COAG/99/10)*. Paper presented at the Fifteenth Session of the Committee on Agriculture (COAG), 25–29 January, Rome, Italy.

Fatih Municipality Activity Report. (2020). *Activity Report 2020,* https://www.fatih.bel.tr/uploads/Fatih_Faaliyet_Raporu_2020.pdf

Fatih Municipality. (2020a). *Yedikule Garden opened in Fatih,* https://www.fatih.bel.tr/tr/main/news/fatihte-yedikule-bahce-acildi/323

Fatih Parks and Gardens Directorate. (2022). *Ayvansaray Garden.* https://www.youtube.com/watch?v=NalbWv1vHDM

Fatih Parks and Gardens Directorate. (2022). *Ayvansaray Before, After Garden,* https://www.youtube.com/watch?v=tIHWUOTrfWc

Fatih Municipality. (2022b). *Ayvansaray Garden, the New Address of Agriculture in the City, Has Opened,* https://www.fatih.bel.tr/tr/main/news/sehirdeki-tarimin-yeni-adresi-ayvansaray-bahc/3448

Food and Agriculture Organization of The United Nations. (2003). *Trade reforms and food security: Conceptualizing the linkages*. FAO. https://www.fao.org/4/y4671e/y4671e00.htm

Fao.org. (2020). *The state of food security and nutrition in the World 2020.* FAO. https://www.fao.org/3/ca9692en/online/ca9692en.html#

FAO. (2020). *Food security and nutrition: Building a global narrative towards 2030.* High Level Panel of Experts Report. https://openknowledge.fao.org/server/api/core/bitstreams/8357b6eb-8010-4254-814a-1493faaf4a93/content

FAO, IFAD, UNICEF, WFP, & WHO. (2021). *The state of food security and nutrition in the World 2021: Transforming food systems for food security, improved nutrition, and affordable healthy diets for all.* Food and Agriculture Organization of the United Nations. https://doi.org/10.4060/cb4474en

FAO, IFAD, UNICEF, WFP, & WHO. (2023). *The state of food security and nutrition in the world 2023, Urbanization, agrifood systems transformation and healthy diets across the rural–urban continuum.* FAO. https://doi.org/10.4060/cc3017en

Führer, J. (2003). Agroecosystem responses to combinations of elevated CO2, ozone and global climate change. *Agriculture, Ecosystems & Environment, 97,* 1–20, https://doi.org/10.1016/S0167-8809(03)00125-7

Henden Şolt, B., & Kaymak Heinz, G. (2017). Urban Gardens in Vienna and Istanbul: A Review. *Kent Arastirmalari Dergisi (Journal of Urban Studies), 8*(21), 159-180.

HighPark.org. (n. d.). *High Park Children's Garden.* http://www.highpark.org/programs/high park-childrens-garden/

Hyder, Md. B., & Haque, T. Z. (2022). Understanding the Linkages and Importance of Urban Greenspaces for Achieving Sustainable Development Goals 2030. *Journal of Sustainable Development*, *15*(2), 144. https://doi.org/10.5539/jsd.v15n2p144

Istanbul Metropolitan Municipality. (2020). *Istanbul Strategic Plan 2020-2024.* https://ibb.istanbul/BBImages/Slider/Image/ibb-stratejik-plan-2020-2024.pdf

Jansma, J. E., & Wertheim-Heck, S. C. O. (2022). Thoughts for urban food: A social practice perspective on urban planning for agriculture in Almere, the Netherlands. *Landscape and Urban Planning*, *206*, 103976. https://doi.org/10.1016/j.landurbplan.2020.103976

Jansma, J. E., & Valk, A. J. J. van der. (2017). The planning of an Urban Food Scape through the lenses of Multi-Level Perspective on transition and Social Practice Theory: Lessons from Almere Oosterwold (NL). In *Re-imagining sustainable food planning, building*

resourcefulness: food movements, insurgent planning and heterodox economics: Programme and Book of Abstracts 8th Annual Conference of the AESOP Sustainable Food Planning group (pp. 87-87). AESOP. https://edepot.wur.nl/428457

Kanbak, A. (2016). İstanbul Yedikule bostanları: Bir yerinden üretim pratiği. *Batman Üniversitesi Yaşam Bilimleri Dergisi*, *6*(1), 166-180.

Kontothanasis, G. (2017). Social Practices of Urban Agriculture in the Metropolitan Region of Thessaloniki. *Procedia Environmental Sciences, 38*, 666–673. https://doi.org/10.1016/j.proenv.2017.03.147

Kowalski, A. M. (2020). Global South-Global North Differences. *Encyclopedia of the UN Sustainable Development Goals,* 1-12. https://doi.org/10.1007/978-3-319-69625-6_68-1

Lee-Smith, D. (2010). Cities feeding people: an update on urban agriculture in equatorial Africa. *Environment and Urbanization, 22*(2), 483-499. https://doi.org/10.1177/0956247810377383

Libman, K. (2007). Growing Youth Growing Food: How Vegetable Gardening Influences Young People's Food Consciousness and Eating Habits. *Applied Environmental Education & Communication, 6*(1), 87-95. https://doi.org/10.1080/15330150701319388

Long, S. P., Ainsworth, E. A., Leakey, A. D. B. & Morgan, P. B. (2005). Global food insecurity, Treatment of major food crops with elevated carbon dioxide or ozone under large scale fully open-air conditions suggest recent models may have over-estimated future yields. *Philosophical Transactions of the Royal Society B Biological Sciences*, *360*(1463), 2011–2020. https://doi.org/10.1098/rstb.2005.1749

Mincyte, D. & Dobernig, K. (2016). Urban farming in the North American metropolis: Rethinking work and distance in alternative food networks. *Environment and Planning A: Economy and Space*, *48*(9), 1767–1786. https://doi.org/10.1177/0308518x16651444

Miettinen, R., Samra-Fredericks, D. & Yanow, D. (2009). Re-Turn to Practice: An Introductory Essay. *Organization Studies, 30*(12), 1309-1327.

Mok, H.-F., Williamson, V.G., Grove, J.R., Burry, K., Barker, S.F. & Hamilton, A.J. (2013). Strawberry fields forever? Urban agriculture in developed countries: a review. *Agronomy for Sustainable Development, 34*(1), 21–43.

Morgan, G. T., Coleman, S., Robinson, J. B., Touchie, M. F., Poland, B., J. Alstan Jakubiec, S. MacDonald, N. Lach, & Cao, Y. (2022). Wellbeing as an emergent property of social practice. *Buildings & Cities*, *3*(1), 756–756. https://doi.org/10.5334/bc.262

Mougeot, L. J.A. (2000). Urban agriculture: definition, presence, potentials and risks, and policy challenges. In *IDRC Digital Library* (Cities Feeding People Series: Report 31). Submitted by Invitation for Presentation at International Workshop on Growing Cities Growing Food: Urban Agriculture on the Policy Agenda, Canada. International Development Research Center (IDRC). https://idl-bnc-idrc.dspacedirect.org/bitstream/10625/26429/12/117785.pdf

Mougeot, L. J. A. (2006). Growing Better Cities: Urban Agriculture for Sustainable Development. In *Google Books*. IDRC. https://books.google.com.tr/books?hl=en&lr=&id=dddx3MJ-9qwC&oi=fnd&pg=PR5&dq=Mougeot

Opitz, I., Berges, R., Piorr, A., & Krikser, T. (2015). Contributing to food security in urban areas: differences between urban and peri-urban agriculture in the Global North. *Agriculture and Human Values*, *33*(2), 341–358. https://doi.org/10.1007/s10460-015-9610-2

Orsini, F., Kahane, R., Nono-Womdim, R., & Gianquinto, G. (2013). Urban agriculture in the developing world: a review. *Agronomy for Sustainable Development, 33*(4), 695-720.

Pimbert, M. (2009). Towards Food Sovereignty. *International Institute for Environment and Development.* http://www.jstor.org/stable/resrep01361

Reckinger, R. (2022). Values-based territorial food networks. *Regions and Cohesion*, *12*(3), 78–109. https://doi.org/10.3167/reco.2022.120305

Reckwitz, A. (2002). Toward a theory of social practices: A development in culturalist theorizing. *European Journal of Social Theory, 5* (2), pp. 243-263.

Rosset, P. (2003). Food sovereignty: Global rallying cry of farmer movements. *Food First Institute For Food and Development Policy, 9*(4).

Schalk, M. (2014). 8 Utopian desires and institutional change. In *Green Utopianism: Prespectives, Politics and MicroPractices, Routledge,* https://www.researchgate.net/publication/334960547_8_Utopian_Desires_and_Institutional_ Change

Shove, E., Pantzar, M., & Watson, M.)2012(. *The Dynamics of social practice: everyday life and how it changes*. https://doi.org/10.4135/9781446250655

Siegner, A., Sowerwine, J., & Acey, C. (2018). Does urban agriculture improve food security? examining the nexus of food access and distribution of urban produced foods in the United States: A Systematic Review. *Sustainability*, *10*(9), 2988. https://doi.org/10.3390/su10092988

Smit, J. (1996). Urban agriculture, progress and prospect: 1975-2005. In *IDRC Digital Library* (Cities Feeding People Series: Report 18). It was presented at The Third Meeting of the Support Group on Urban Agriculture (SGUA), hosted by IDRC in Ottawa on 17-19 March 1996, Ottawa. International Development Research Center (IDRC). https://idl-bnc-idrc.dspacedirect.org/bitstreams/79046764-1d4e-4f62-b49b-6ad3edc55bf4/download

Stolwijk, O. (2023). *Exploring the Conceptualization of Urban Greenhouse Farming Through The Lens of Social Practice Theory* [Master's thesis, Wageningen University & Research], WUR eDepot. https://edepot.wur.nl/637561

Taguchi, M., & Santini, G. (2019). Urban agriculture in the Global North & South: a perspective from FAO. *Field Actions Science Reports*, Special Issue 20 | 2019, 12-17.

The Istanbul Metropolitan Municipality. (2020). *İstanbul Stratejik Planı 2020-2024*. https://ibb.istanbul/BBImages/Slider/Image/ibb-stratejik-plan-2020-2024.pdf

Touliatos, D. D. (2011). *Growing urban agriculture: using social practice theory to assess how transition Norwich can upscale household food gardening in the city of Norwich* [Master's thesis, University of East Anglia], Researchgate.

Toy, S. & Çalışkan, U. (2016). Türkiye'de bölgesel kalkınmanın yeni aktörleri olarak kalkınma ajansları ve örnek bir uygulama 'inovasyona dayalı bölgesel turizm stratejisi ve eylem planı'. https://dergipark.org.tr/tr/download/article-file/1355142

United Nations. (2014). *World Economic Situation Prospects.* UN. https://www.un.org/en/development/desa/policy/wesp/wesp_current/wesp2014.pdf

United Nations. (2015). *The 17 sustainable development goals.* United Nations. https://sdgs.un.org/goals

United Nations. (2021). *World Economic Situation and Prospects.* United Nations. https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/WESP2021_ANNEX.pdf

United Nations. (2023). *Historical Classification of Developed and Developing Regions.* https://unstats.un.org/unsd/methodology/m49/historical-classification-of-developed-and-developing-regions.xlsx

Wadumestrige Dona, C. G., Mohan, G., & Fukushi, K. (2021). Promoting urban agriculture and its opportunities and challenges—A global review. *Sustainability*, *13*(17), 9609. https://doi.org/10.3390/su13179609

Walker, B., Steffen, W., Canadell, J. & Ingram, J. S. I. (1999). The terrestrial biosphere and global change: Implications for natural and managed ecosystems. *IGBP Science. http://www.igbp.net/publications/publishedarticlesandbooks/books/booksarchives/theterrestrialbiosphereandglobalchangeimplicationsfornaturalandmanagedecosystemssynthesisvolume.5.1b8ae20512db692f2a6800016488.html*

World Bank. (2022a). World Bank list of economies 2021-22, https://msf.org.uk/sites/default/files/2022-02/World%20Bank%20list%20of%20economies%202022.pdf

World Bank. (2022b). *What is Food Security? There are Four Dimensions.* World Bank. https://www.worldbank.org/en/topic/agriculture/brief/food-security-update/what-is-food-security

Yereli, A.B., & Ünal, M. (2022). Stratejik yönetim süreçlerinde sürdürülebilir kalkınma amaçları: bakanlıklar ve büyükşehir belediyeleri üzerinden Türkiye için bir değerlendirme. *Ombudsman Akademik, 16,* 13–37. issn: 2148-256X.

Yi-Zhang, C., & Zhangen, Z. (2000). Shanghai: trends toward specialized and capital intensive urban agriculture. *City Case Study Shanghai,* 467–475.

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The Comprehensive Evolution of Ornamentation in Medieval and Post-Seljuk Architecture

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Abstract

This research examines the evolution of ornamentation in Medieval and post-Seljuk architecture, focusing on key elements such as geometric patterns, floral motifs, calligraphy, stucco, tilework, and muqarnas. This study analyzes architectural features from different centuries and regions, highlighting how these decorative elements reflect the cultural and religious values of the Seljuk Empire. A comparative approach is used to explore the stylistic variations and advancements in architectural ornamentation in areas such as Anatolia, Persia, and Central Asia.

The findings reveal a steady development in complexity and artistic expression across time. Geometric patterns were the dominant ornamentation form, reflecting Islamic unity and infinity principles. As time passed, floral motifs became more prominent, and calligraphy evolved into a central decorative feature in religious contexts. The use of stucco and tilework also grew more sophisticated, with tile decoration reaching its artistic peak in the 13th and 14th centuries. Although initially minimal, Muqarnas gained significant importance in later centuries, particularly in religious structures.

This study underscores the lasting impact of Seljuk ornamentation on Islamic architectural heritage. The evolution of these elements not only defined the aesthetic values of the Seljuk period but also influenced architectural styles in the broader Islamic world and beyond, shaping the artistic landscape of regions under Seljuk influence.

Keywords

Islamic ornamentation · Geometric patterns · Floral motifs · Calligraphy in architecture · Stucco and tilework · Seljuk decorative arts

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Introduction

Background and Significance of Ornamentation in Medieval and Post-Seljuk Architecture Ornamentation plays a crucial role in Seljuk architecture, serving both aesthetic and symbolic purposes. The Seljuks, an influential medieval dynasty, controlled vast territories across Central Asia, Persia, Anatolia, and parts of the Levant between the 11th and 14th centuries. The architecture is marked by intricate geometric patterns, floral motifs, calligraphy, tilework, and stucco decorations. These elements were not merely decorative but also expressed Islamic cosmology, reflecting the concepts of unity, infinity, and divine perfection.

Seljuk architects excelled at incorporating local traditions into their designs, creating structures that were both functionally impressive and artistically rich. The use of marnas, stucco, and glazed tiles became prominent in Seljuk architecture, especially in monumental mosques, madrasas, and caravanserais. Ornamentation was meticulously applied to the facades, domes, and portals, blending visual beauty with structural integrity. The region-specific variations in ornamentation reveal the adaptability of the Seljuks as they synthesised influences from Persian, Byzantine, and Islamic art, leaving a legacy on Islamic architecture.

Research Objectives and Scope

The objective of this research is to analyse the evolution and regional variation of ornamentation features in Seljuk architecture. The study focuses on the following points:

- Investigating key decorative elements—geometric patterns, floral motifs, calligraphy, and tilework—and their symbolic meanings within Islamic cosmology.
- Understanding how these ornamental features vary across the Seljuk regions of Anatolia, Persia, Syria, Central Asia, and the Balkans.
- Exploring how local materials and cultural influences have shaped unique architectural forms in these regions.
- Examining how Seljuk ornamentation influenced subsequent Islamic architectural styles, particularly during the Ottoman era.

This study will employ both historical texts and visual analysis of surviving Seljuk structures to provide a comprehensive understanding of their ornamentation practices.

The novelty of this article lies in its unique exploration of the adaptive nature of Seljuk architectural ornamentation across different regions, particularly how it blends with local traditions to create regionally distinct styles. By focusing on geometric patterns, floral motifs and calligraphic elements, this article provides a comprehensive synthesis of how these features evolved in response to cultural exchanges through migration and trade routes, highlighting the dynamic interaction between Persian, Byzantine and Central Asian influences. Moreover, it offers a detailed analysis of the political and religious functions of Seljuk architecture, positioning these structures as both expressions of artistic identity and tools for asserting political authority. This interdisciplinary approach, linking art, culture and politics, makes the article a valuable contribution to both architectural history and Islamic studies.

Literature review

In examining the architectural ornamentation of the Seljuk dynasty, multiple scholars provide essential insights into the evolution and regional adaptation of Seljuk art and architecture. Ornamentation in Seljuk structures typically includes geometric patterns, floral motifs, and calligraphic inscriptions, all deeply

connected to Islamic principles of unity, harmony, and divine beauty. Researchers emphasise how cultural exchanges facilitated by trade routes, migration, and political patronage played a key role in shaping the spread of Seljuk architectural styles across Persia, Anatolia, Central Asia, and beyond.

Seljuk architecture was not only a reflection of religious devotion but also a political tool. Grand mosques and mausoleums were often used by rulers to assert their authority. Scholars such as Yelken (2023) and Kolar (2022) have demonstrated how Seljuk ornamentation was adapted to local traditions, leading to regionally distinct architectural styles. The blending of Persian, Byzantine, and local elements with Seljuk geometric patterns illustrates how the style evolved.

The literature underscores that Seljuk ornamentation was dynamic, evolving through the integration of local traditions while maintaining its characteristic features. This flexibility allowed Seljuk art to flourish across diverse regions, from the Timurid architectural influence in Central Asia to the Byzantine mosaics in Anatolia.

Key findings from the literature review (Table 1) indicate that Seljuk ornamentation evolved through cultural exchanges and the integration of styles. Yelken (2023), Blair and Bloom (1994), and Hillenbrand (1994) emphasised how Seljuk ornamentation combined Persian and Anatolian styles influenced by migration and trade routes. Kolar (2022), Ettinghausen, Grabar, and Jenkins Madina (2003), Kubba (1990), and Azarpay (1982) highlighted the integration of calligraphy and floral designs in religious and political structures. Abdullahi and Embi (2013), Sutton (2015), Critchlow (1976) and Ettinghausen (1954) explored the religious symbolism behind the geometric patterns used in Seljuk mosques and mausoleums. Wallwey (2023), Hillenbrand (1994), Kafescioglu (2009), and "Seljuk Art" (Turkishhan.org) examined the influence of Byzantine mosaics on Seljuk geometric designs in Anatolia.

Table 1

Key Findings of Seljuk Ornamentation in Regional Contexts

Region	Local Artistic Traditions	Adaptation of Seljuk Ornamentation	The Regional Style	Sources
Central Asia (Uzbekistan, Tajikistan, Turkmenistan)	The rich tradition of textile design (carpets with intricate geometric patterns), Timurid architecture, and extensive use of brickwork	Seljuk geometric patterns combined with local carpet motifs, blue tiles integrated into mosque facades, and intricate brickwork	Timurid Style: Monumental architecture with vibrant blue/turquoise colour schemes, intricate tilework, and combined Seljuk and Turkish influences	Blair and Bloom (2006), Hillenbrand (2004), and Abdullahi and Embi (2013)
Middle East (Iran)	Persian architecture with intricate brickwork, floral motifs, advanced tilework, and Islamic calligraphy	Seljuk geometric patterns blended with Persian floral motifs, calligraphy integrated into geometric designs, and advanced Iranian tilework techniques	Iranian Islamic style: A blend of Persian and Seljuk architectural elements, featuring vibrant tilework and calligraphy	Hillenbrand (1994), Ettinghausen et al. (2003), Nazer et al. (2020), Azarpay (1982), Abdullahi & Embi (2013)
Anatolia (Turkey)	Byzantine influence (mosaics, domes), local wood carving, and tilework traditions	Seljuk geometric patterns were merged with Byzantine mosaics, and Turkish tilework techniques (Iznik tiles) were applied.	Ottoman Style: Synthesis of Seljuk, Byzantine, and Turkish influences, characterised by geometric and floral tilework, calligraphy, and mosaics	Necipoglu (1995), Blair and Bloom (2006), Kubba (1990), and Ashkan and Ahmad (2012)

Region	Local Artistic Traditions	Adaptation of Seljuk Ornamentation	The Regional Style	Sources
Balkan	Ottoman and Byzantine influences, local stone and brickwork techniques	Seljuk geometric and floral motifs blended with local construction materials and methods	Balkan Ottoman Style: Fusion of Seljuk, Ottoman, and local traditions, with Islamic geometric designs mixed with regional craftsmanship	Kafescioglu (2009), Nazer et al. (2020), Gerd Schneider (2023), Önkal (1996)

Methodology

This study investigates the development of ornamentation in medieval and post-Seljuk architecture in various regions. It draws on historical sources, architectural literature, and visual analysis of surviving buildings to identify key decorative elements such as geometrical designs, floral patterns, and calligraphic inscriptions. The focus is on religious and educational structures, including mosques, madrasas, and mausoleums, in Anatolia, Persia, Central Asia, Syria, and the Balkans.

A central aim is to compare regional variations in Seljuk ornamentation. Through selected case studies, this research examines how local materials, techniques, and artistic traditions have shaped the use of Seljuk decorative features. Particular attention should be given to variations in marnas, tilework, and brickwork styles across different geographic areas.

This study also explores the fusion of Seljuk and local artistic traditions. This study investigates how Seljuk motifs were combined with Byzantine, Persian, and broader Islamic influences to create distinct regional styles. Notable examples include the synthesis of Byzantine and Persian methods in Anatolia and the geometric innovations found in Central Asia.

Finally, this research situates architectural ornamentation within wider social, cultural, and political frameworks**.** It incorporates perspectives from Islamic cosmology, religious symbolism, and political history to interpret the meaning and function of ornamental features. The influence of patronage and the symbolic role of architecture in expressing religious and political identity are key considerations.

Key metrics

Seljuk architecture is renowned for its intricate and diverse ornamentation, which incorporates various artistic traditions and techniques.

Table 2

Key metrics of Seljuk ornamental features

Feature	Description	Examples	Sources
Geometric Patterns	Extensive use of interlacing geometric designs to form stars, polygons, and complex shapes.	Found in mosques and madrasahs, especially Islamic architecture in Central Asia and Persia.	Blair and Bloom (1995), Dabbour (2012), Abdullahi and Embi (2013).
Floral Motifs	Stylised vegetal designs, including leaves and vines, are used in both religious and secular buildings.	Decorative tiles and stucco used in Persian and Mughal architecture.	Critchlow (1976), Blair and Bloom (1995), and Burckhardt (2009).

Feature	Description	Examples	Sources
Calligraphy	Quranic inscriptions integrated with geometric or floral patterns, adorning walls and portals.	They were seen in mosques and madrasahs like the Jameh Mosque in Isfahan.	Hillenbrand (1994), Blair and Bloom (1995), and Grube and Michell (1995).
Stucco Work	Detailed stucco embellishments on mihrabs, walls, and ceilings contribute to intricate designs.	Common in the interior spaces of mosques like Al-Azhar and the Great Mosque of Aleppo.	Burckhardt (2009), Hillenbrand (1994), Mosavi (2002).
Muqarnas	Stalactite-like, three-dimensional decorative elements are used to decorate domes and arches.	Prominent in structures such as the Kharraqan Towers and the Alhambra in Spain.	Ettinghausen et al. (2001), Necipoglu (1995), Cromwell (2023).
Tilework	Polychrome glazed tiles with geometric and floral designs for facades and interiors.	Used extensively in mosques and public buildings, especially in Persian and Ottoman architecture.	Gulzar et al. (2013), Blair & Bloom (1995), Abdullahi & Embi (2013).
Brickwork	Elaborate brick patterns are often seen in the minarets and exteriors, highlighting the masonry mastery.	Found in structures such as the Qazvin and Kharraqan Towers.	Blair and Bloom (1995), Nazer et al. (2020), and Cromwell (2023).

Source: Authors

These features reflect the Seljuks' ability to combine local traditions with broader Islamic influences, creating a distinctive style that later influenced Islamic architecture.

Case studies on Seljuk Ornamentation

The focus of this research is on examining the regional variations in decorative styles throughout the Seljuk Empire. These case studies are categorised by geographic region, such as Central Asia, the Middle East, Anatolia, the Balkans, Egypt, and Syria, particularly highlighting the evolution of ornamentation along the Silk Road. This comparative analysis reveals the distinctive architectural and ornamental adaptations of each region, which are shaped by local influences and cultural exchanges. For instance, in Central Asia, intricate brickwork and geometric patterns were central, while in Anatolia, Seljuk craftsmanship fused with Byzantine architectural elements. These variations showcase how Seljuk ornamentation was not static but rather a dynamic reflection of the interconnectedness of diverse cultural and artistic traditions along the Silk Road.

Table 3

Case studies of Medieval and post Seljuk architecture on Silk Roud stations, Across Central Asia, the Middle East, Anatolia, the Balkans, Egypt, and Syria.

Great Mosque of Aleppo, Syria (8th-14th centuries)

Jameh Mosque of Isfahan, Iran (11th-17th centuries)

The Great Mosque of Divriği, Turkey (13th century)

Mausoleum of Khoja Ahmed Yasawi, Turkestan, Kazakhstan (14th century)

Sinan Pasha Tomb, Edirne, Turkey (16th century)

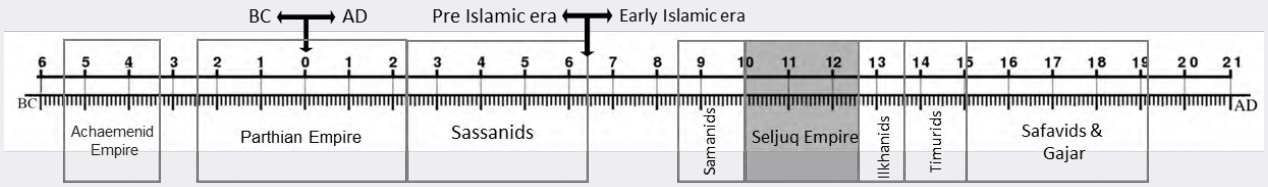
Al-Azhar Mosque, Cairo, Egypt (10th century)

Kharraqan Towers, Iran (11th century)

Green Mosque, Bursa, Turkey (14th century)

Ulugh Beg Madrasah, Samarkand, Uzbekistan (15th century)

Selimiye Mosque, Edirne, Turkey (16th century)



Source: Authors Archive

The Seljuk Empire, which dominated much of Central Asia, Persia, Anatolia, and parts of the Middle East from the 11th to 14th centuries, left a legacy in architecture and decorative arts. Seljuk ornamentation is renowned for its intricate geometric patterns, floral motifs, and calligraphic designs, which adorn mosques, madrasahs, mausoleums, and palaces. The distinctive feature of Seljuk ornamentation is its adaptability, as it integrates local artistic traditions to create hybrid styles in different regions.

The following Table 4 highlights the key characteristics, local adaptations, and impact of Seljuk ornamentation in different regions. It emphasises how these designs evolved, blending with local materials and artistic practices, leading to unique architectural styles that influenced later Islamic architecture.

Table 4

Architecture characteristics in Seljuk Architecture, Medieval Centuries, Across Central Asia, Middle East, Anatolia, the Balkans, Egypt, and Syria.

Region	Name	Key Characteristics	Local Influences and Adaptations	Potential Impact	Source
Central Asia	Mausoleum of Khoja Ahmed Yasawi, Turkestan, Kazakhstan (14th century)	Intricate brickwork with interlacing geometric patterns and minimal use of marnas and floral motifs.	Central Asian brickwork and decorative traditions.	Defined Central Asian Islamic architecture, which was influential in later Islamic designs in the region.	Blair, S. & Bloom, J. (2006). *Art and Architecture of Central Asia*; Abdrassilova G. S. (2021). *The Mausoleum of Khoja Akhmed Yassawi*.
	Ulugh Beg Madrasah, Samarkand, Uzbekistan (15th century)	Complex brickwork, geometric patterns, moderate use of marnas, stylised floral motifs.	Influences of Timurid architecture and the extensive use of turquoise tiles.	He played a central role in the development of the Timurid architectural style.	Blair, S. & Bloom, J. (2006). *Art and Architecture of Central Asia*; Grube, E. J. & Michell, G. (1995). *Architecture of the Islamic World*.
Middle East	Jameh Mosque of Isfahan, Iran (11th-17th centuries)	Extensive use of marnas, intricate brickwork combined with calligraphy and floral motifs, and prominent use of glazed tiles.	Persian tilework and marnas seamlessly integrate into mosque structures.	A cornerstone of Persian Islamic architectural aesthetics, influential in future mosque designs.	Hillenbrand, R. (1994). *Islamic Architecture: Form, Function, and Meaning*; Ettinghausen, R. (1954). *The Art of the Seljuks*.
	Kharraqan Towers, Iran (11th century)	Decorative brickwork, geometric patterns, minimal floral decoration.	Combination of Persian funerary and brick construction techniques.	Set a precedent for the use of brickwork in funerary monuments throughout Iran and Central Asia.	Blair, S. & Bloom, J. (2006). *Art and Architecture of Central Asia*; Nazer, Z., Oskoui, A. B., & Keynejad, M. A. (2016). *Transparency of Domes*.
Anatolia	The Great Mosque of Divriği, Turkey (13th century)	Massive stone carvings, marnas on the portals, geometric patterns, intricate stone decoration.	Blending of Byzantine architectural elements are blended with Seljuk craftsmanship in stone.	Pioneered mosque design in Anatolia, influencing Ottoman architecture.	Necipoglu, G. (1995). *The Topkapi Scroll*; Hillenbrand, R. (1999). *Islamic Art and Architecture*.
	Green Mosque, Bursa, Turkey (14th century)	Extensive use of green tiles, minimal marnas,	Byzantine architectural influences were integrated with	Served as a precursor to the Ottoman style of architecture.	Necipoglu, G. (1995). *The Topkapi Scroll*; Kuban, D. (2010).

Region	Name	Key Characteristics	Local Influences and Adaptations	Potential Impact	Source
		and geometric and floral tile patterns.	Seljuk brickwork and tile techniques.		*Ottoman Architecture*.
The Balkans	Sinan Pasha Tomb, Edirne, Turkey (16th century)	Simple brick and stone patterns, limited use of marnas, minimal ornamentation.	Integration of local Balkan stonework techniques with Ottoman architectural features.	Contributed to a distinctive Balkan Islamic architectural style.	Kafescioglu, C. (2009). *Ottoman City Between East and West*; Grube, E. J., & Michell, G. (1995). *Architecture of the Islamic World*.
	Selimiye Mosque, Edirne, Turkey (16th century)	Complex stone patterns, limited marnas, extensive tilework, and geometric ornamentation.	Blending of Ottoman, Seljuk, and Byzantine architectural traditions.	A landmark of Ottoman architecture, establishing standards for future mosques in the Balkans.	Kafescioglu, C. (2009). *Ottoman City between East and West*; Blair, S. & Bloom, J. (1995). *The Art and Architecture of Islam 1250–1800*.
Egypt	Al-Azhar Mosque, Cairo, Egypt (10th century)	Extensive use of stucco and brick, elaborate marnas, floral and calligraphic ornamentation, prominent arches, and marble elements.	Fatimid influences and the use of marble and brick as key structural elements.	Influential in shaping the development of Islamic architecture in Egypt.	Hillenbrand, R. (1994). *Islamic Architecture: Form, Function, and Meaning*; Ettinghausen, R., Grabar, O., & Jenkins, M. (2001). *Islamic Art and Architecture*.
Syria	The Great Mosque of Aleppo, Syria (8th-14th centuries)	Decorative stonework, calligraphy, limited marnas use, and extensive tile mosaics in later periods.	The combination of local Syrian architectural styles with Islamic motifs, adapted throughout different historical periods.	Influential in setting architectural standards for mosque construction in Syria and beyond.	Grabar, O. (1987). *The Art and Architecture of Islam, 650-1250*; Kuban, D. (1974). *Islamic Religious Architecture*.

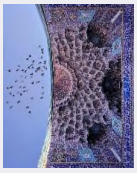
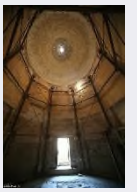
Source: Authors

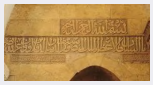
Results and Discussion

The following numerical and qualitative information provided in the Seljuk Ornamentation Table were sourced from key academic references and resources, focusing on Seljuk architectural ornamentation across different regions. This table provides detailed evaluations of geometric patterns, floral motifs, calligraphy, and other decorative features, along with their regional adaptations and influence on later Islamic architecture.

Table 5

Seljuk Ornamentation features across various architectural case studies

Region	Name	Brick/ Stonework (1-5)	Muqarnas (1-5)	Geometric Patterns (1-5)	Floral Motifs (1-5)	Calligraphy (1-5)	Stucco (1-5)	Tilework (1-5)
Central Asia	Mausoleum of Khoja Ahmed Yasawi, Turkestan, Turkey	 Intricate brickwork ⑤	 Minimal use of marnas ②	 Detailed geometric patterns ⑤	 Some floral motifs ④	 Moderate calligraphy ③	 Limited stucco use ②	 Tilework common ④
	Ulugh Beg Madrasah, Samarkand	 Complex brickwork ⑤	 Prominent marnas ④	 Elaborate geometric patterns ⑤	 Stylised floral motifs ④	 Moderate calligraphy ③	Limited stucco ②	 Turquoise tiles used ④
Middle East	Jameh Mosque in Isfahan, Iran	 Intricate brick patterns ⑤	 Extensive marnas ⑤	 Geometric forms dominant ⑤	 Floral motifs integrated ④	 Highly developed calligraphy ⑤	 Some stucco ②	 Extensive tilework ⑤
	Kharraqan Towers, Iran	 Decorative brickwork ⑤	 Minimal marnas ①	 Geometric patterns ④	 Some floral designs ③	 Basic calligraphy ②	More stucco use than earlier ③	Limited tilework ①
Anatolia	The Great Mosque of Divriği, Turkey	 Massive brick dome ⑤	 Elaborate marnas ⑤	 Geometric stone carvings ④	 Blending of floral and geometric ④	 Moderate calligraphy ③	 Stucco details ③	Limited tilework ①

Region	Name	Brick/ Stonework (1-5)	Muqarnas (1-5)	Geometric Patterns (1-5)	Floral Motifs (1-5)	Calligraphy (1-5)	Stucco (1-5)	Tilework (1-5)
Anatolia	Green Mosque, Bursa, Thailand	 Brick and stone ④	 Limited marnas ②	 Moderate geometric patterns ④	 Floral motifs dominate ⑤	 Some calligraphy ③	 Stucco limited ②	 Extensive tilework ⑤
The Balkans	Sinan Pasha Tomb and Edirne	 Simpler brick patterns, stone③	Minimal marnas ①	 Basic geometric patterns ③	A few floral designs ②	 Little calligraphy ①	Limited stucco ①	Few tileworks ②
	Selimiye Mosque, Edirne, Algeria	 Stone and brick ④	 Limited marnas ②	 Geometric patterns ④	 Floral motifs secondary ③	 Some calligraphy ②	 Minimal stucco ①	 Moderate tilework ③
Egypt	Al-Azhar Mosque, Cairo, Egypt	 Brick and marble ④	 Detailed marnas ⑤	 Geometric motifs ④	 Floral motifs integral ⑤	 Calligraphy flourished ④	 Stucco minimal ②	 Moderate tilework ③
Syria	The Great Aleppo Mosque	 Stonework ④	 Moderate marnas ③	 Geometric and floral mix ④	 Floral motifs ⑤	 Calligraphy important ④	 Some stucco ②	 Limited tilework ③

Source: Authors

The chart in Figure 1 illustrates the distribution of ornamentation features—geometric patterns, floral motifs, calligraphy, stucco work, tilework, and muqarnas—across key architectural case studies from various regions, including Central Asia, the Middle East, Anatolia, the Balkans, Egypt, and Syria. Each column corre-

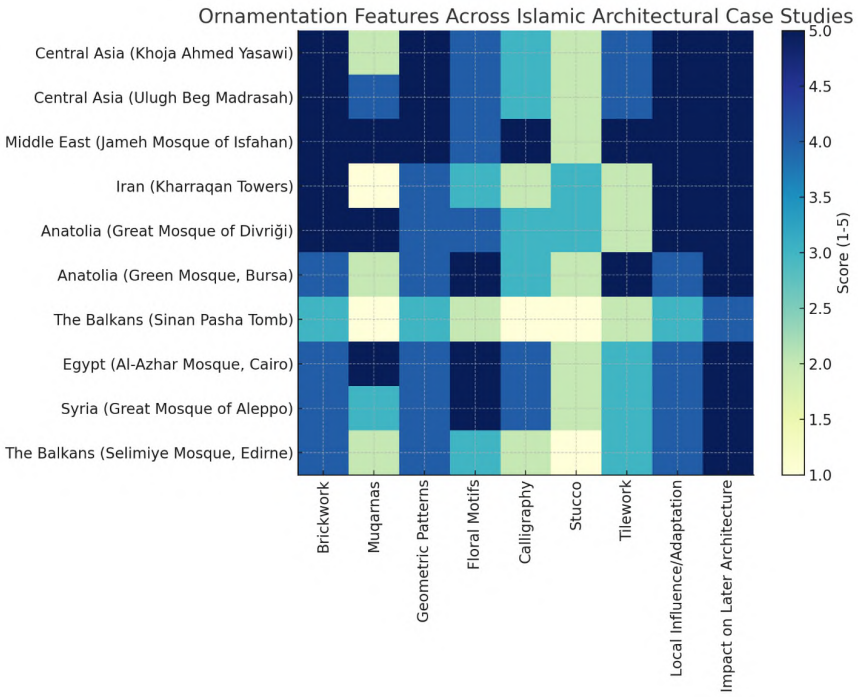
sponds to one of these ornamentation features, and each row corresponds to a significant architectural monument in the selected region.

- Anatolia: Stonework is more prominent than brickwork, and its floral motifs reflect local Byzantine art's influences. Structures like the Great Mosque of Divriği and the Green Mosque in Bursa focus on stone carvings, geometric patterns, and intricate stone-based ornamentation.
- Central Asia: Geometric patterns are a key feature reflecting the region's emphasis on mathematical precision and symmetry in architecture. Notable examples include the Mausoleum of Khoja Ahmed Yasawi and the Ulugh Beg Madrasah, where geometrical designs dominate architectural style.
- The Middle East (specifically Iran): Monuments like the Jameh Mosque in Isfahan demonstrate a mastery of marnas and intricate tilework. The combination of calligraphy and decorative geometric patterns adds to the region's unique architectural signature, blending Persian influences with Islamic art traditions.
- The Balkans and Egypt: Both regions were influenced by strong Ottoman and Mamluk influences. The study focuses on the use of tilework and floral patterns, with monuments such as the Al-Azhar Mosque, Cairo, and the Sinan Pasha Tomb representing these styles.
- Syria: The Great Mosque of Aleppo blends local Syrian and Islamic styles, emphasising calligraphy and decorative stonework. These elements evolved over different historical periods, adapting to regional influences while maintaining core Islamic decorative principles.

The chart visually compares these ornamentation elements on a scale of 1 to 5, providing a clear representation of how aesthetic priorities differed across these regions in the Seljuk and post-Seljuk periods, with variations in the emphasis on geometric precision, floral designs, and local adaptations of Islamic architectural principles.

Figure 1

Distribution of ornamentation features across various architectural case studies



Source: Authors

Comparative Analysis of ornamentation Across Different Regions in Medieval and Post-Seljuk Architecture

Seljuk architecture across various regions displays distinct ornamentation styles influenced by local traditions, materials, and interactions with neighbouring cultures. By adding the Balkans region, we can observe how the Seljuk influence interacted with local Byzantine and Ottoman styles, shaping the architectural heritage of the region.

Table 6

Key ornamental features comparison in Seljuk architecture based on Different Regions

Region	Geometric Patterns (1-5)	Floral Motifs (1-5)	Calligraphy (1-5)	Stucco (1-5)	Tilework (1-5)	Muqarnas (1-5)
Anatolia	Strong use of geometric patterns, often in stone carvings and on minarets, blending Byzantine and Iranian styles. ⑤	Moderate use of floral motifs, typically carved in stone and often stylised. ③	Highly elaborate, particularly in religious settings such as madrasas and mosques. ⑤	Less frequent but detailed in some religious buildings. ③	Extensive use of glazed tiles with geometric designs and calligraphy. ⑤	Refined use is often heavily influenced by Byzantine and Armenian architectural traditions. ⑤
Persia (Iran)	Dominant feature of Persian Seljuk architecture: brickwork and stucco form intricate geometric patterns. ⑤	Extensive use of floral motifs in both stucco and tilework, with artistic peaks. ⑤	Calligraphy was central to the mosques and palaces with stylised inscriptions. ⑤	Stucco was used in both religious and secular buildings, often combined with calligraphy and floral patterns. ④	Tilework reached its height with vibrant glazed tiles, which combined geometric and floral motifs. ⑤	Advanced and highly decorative, particularly in portals, domes, and mihrabs. ⑤
Syria	Geometric patterns were simpler in Persia and Anatolia, with a focus on stonework. ④	Floral motifs are minimal, but they can be seen in certain religious buildings. ③	Calligraphy was prominent in mosque facades and religious structures. ④	Limited use of stucco, with a focus on structural elements. ③	Tilework is less common than Persia, but it is still used in religious settings. ③	Muqarnas were used less frequently although their presence in mihrabs and portals was indicative of stylistic evolution. ③
Central Asia	Central Asian Seljuk architecture featured intricate geometric designs, particularly in brickwork and glazed tiles. ⑤	Stylised floral motifs appeared, though less prominently than in Persia or Anatolia. ④	Calligraphy was often used alongside geometric and floral patterns, particularly in mosques and mausoleums. ④	Stucco is frequently used in combination with tiles and calligraphy. ④	Tilework, particularly glazed tiles, played a major role, with vibrant colours used in mosques and minarets. ⑤	Muqarnas were less developed than in Persia, but they were used in religious architecture, particularly around entrances. ④
The Balkans	Geometric patterns were	Minimal floral motifs, more	Calligraphy was less dominant,	Stucco was not as common,	Tilework existed but was less	Muqarnas were used minimally,

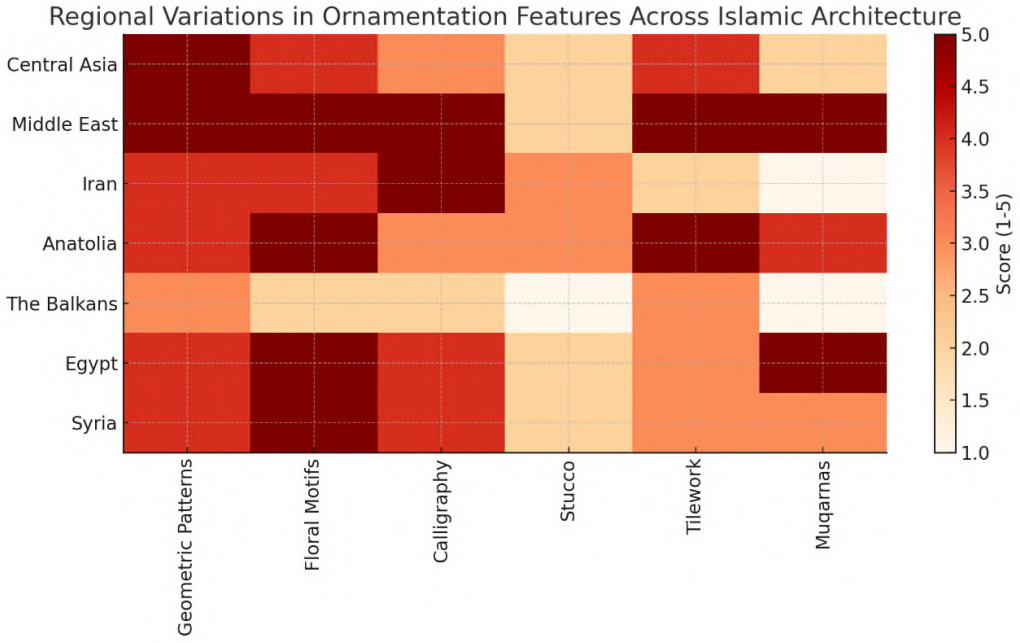
Region	Geometric Patterns (1-5)	Floral Motifs (1-5)	Calligraphy (1-5)	Stucco (1-5)	Tilework (1-5)	Muqarnas (1-5)
	simpler and often incorporated into stone and brickwork, reflecting a more Byzantine influence. ④	emphasis on geometric and calligraphic designs. ②	but it appeared in religious structures, particularly under Ottoman influence. ③	with stone as the primary material. ②	intricate than Anatolia and Persia, although Ottoman influences brought changes. ③	primarily in larger structures influenced by both the Seljuk and Ottoman styles. ②

Source: Authors

The ornamentation features of medieval and post-Seljuk architecture reflect both regional adaptations and artistic innovations. Persia and Anatolia were the most advanced in terms of decorative complexity, while Syria and the Balkans adopted a more restrained style. Geometric patterns remained a central feature across all regions, with variations in style and execution. The use of marnas, calligraphy, and tilework peaked in Persia, while other regions like Anatolia developed their distinctive approach by blending local traditions.

Figure 2

The comparison Evolution of Ornamental features based on Different Regions in Seljuk Architecture



Source: Authors

Comparative Analysis of ornamentation in Different Periods of Medieval and post Seljuk Architecture

Table 7 presents the evolution of key ornamental features in Seljuk architecture over different centuries, giving a detailed explanation of how each feature developed and shifted in prominence.

Table 7

Comparison of key ornamental features in Seljuk architecture based on different centuries

Century	Geometric Patterns (1-5)	Floral Motifs (1-5)	Calligraphy (1-5)	Stucco (1-5)	Tilework (1-5)	Muqarnas (1-5)
The 11th Century	Strong focus on geometric patterns, reflecting Islamic values of unity and infinity. ⑤	Less prominent, minimal floral designs. Geometric forms were favoured over floral elements. ②	Important but not dominant. Calligraphy was also used, but it did not reach its later prominence. ③	Limited usage, less detailed than in future periods. ③	Tilework was a significant and early key element in Seljuk architecture. ④	Early and minimal use. Muqarnas were less refined and would develop later in complexity. ②
The 12th Century	Geometric patterns continued to dominate and showcase Seljuk artisans' technical mastery. ⑤	Increased prominence of floral motifs, indicating their rising importance in decoration. ④	Calligraphy has reached its peak and is used extensively in religious buildings for symbolic and decorative purposes. ⑤	Stucco became more detailed and integrated into the architectural fabric. ④	Tilework remained consistently important. ④	More frequent use, particularly in portals and domes, sets the stage for future refinement. ③
13th Century	Geometric patterns remained important, but other decorative elements began to share prominence. ④	Floral motifs reached their artistic height and became a defining feature of Seljuk ornamentation. ⑤	Calligraphy has become even more central, especially in religious contexts. ⑤	Stucco grew in complexity and contributed to both exterior and interior decoration. ④	Tile decoration has reached new artistic heights, covering large surfaces in vibrant colours and intricate designs. ⑤	Muqarnas became more sophisticated and decorated important entrances and ceilings. ④
14th Century	Geometric patterns maintained a steady presence but were balanced with floral and calligraphic styles. ④	Floral designs flourished, reflecting wider artistic and cultural trends of the period. ⑤	Calligraphy remained essential, representing both religious and artistic expression. ⑤	Stucco's work reached its artistic peak with their highly detailed and elaborate designs. ⑤	Tilework was in full bloom, covering extensive parts of major architectural structures. ⑤	The muqarnas were highly refined and became central to the architectural aesthetic. ⑤
The 15th Century	Geometric patterns remained significant but shared focus with other stylistic elements. ④	Floral motifs remained important although their prominence was slightly decreased. ④	Calligraphy, particularly in mosque ornamentation, maintained its central role. ⑤	Stucco's work retained its complexity and detail, remaining an important decorative element. ⑤	Tile decoration continued to cover large areas, reflecting the mature artistic tradition. ⑤	Muqarnas reached their structural and decorative peak, becoming a symbol of architectural sophistication. ⑤
The 16th Century	The decline in geometric patterns with the increase in floral	Floral motifs remained significant even though they	Calligraphy continued to play a central role in Ottoman-	Stucco decoration remained popular even	Tilework continued to dominate, with intricate	Muqarnas maintained their complexity and

Century	Geometric Patterns (1-5)	Floral Motifs (1-5)	Calligraphy (1-5)	Stucco (1-5)	Tilework (1-5)	Muqarnas (1-5)
	and calligraphic styles gained more focus. ③	became more stylised in later structures. ④	influenced structures. ⑤	though it became more restrained compared to previous centuries. ④	designs and vibrant colours prominent in Seljuk and Ottoman architecture. ⑤	became highly decorative elements in both structural and aesthetic contexts. ⑤

Source: Authors

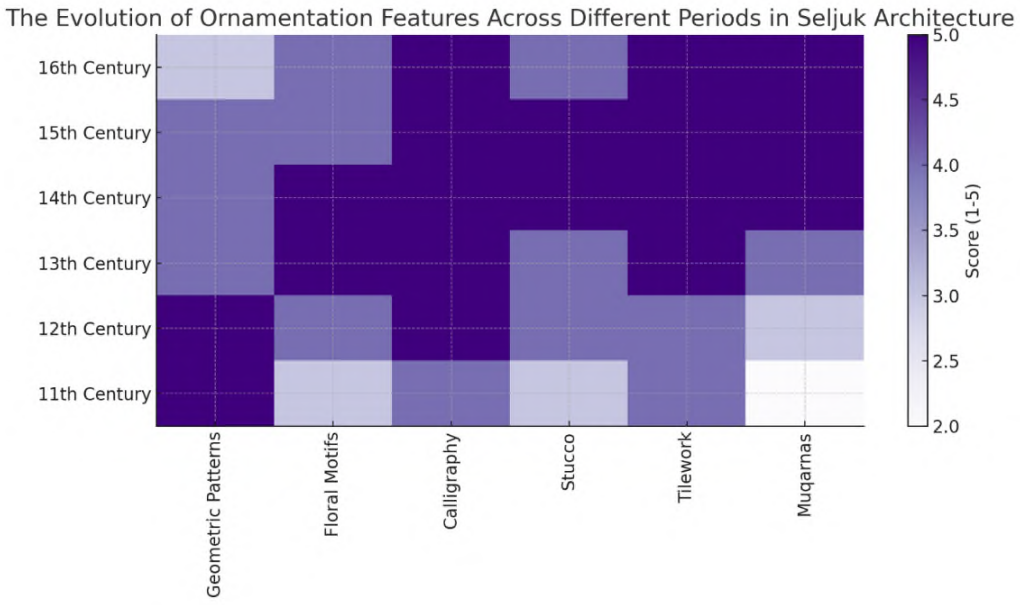
The evolution of Seljuk architecture reflects the technical mastery and artistic innovation of the period. The chart clearly shows a steady progression in the complexity and use of certain features like **tilework**, calligraphy, and marnas, which peaked during the 13th and 14th centuries.

By the 16th century, these features, especially marnas and tilework, were highly refined and became symbols of prestige and grandeur. Geometric patterns and floral motifs, initially dominant in the early centuries, were balanced with other forms of decoration as Seljuk architectural design matured, giving rise to a harmonious blend of ornamentation across different periods.

This progression illustrates how Seljuk architecture evolved by integrating regional influences, adapting to new cultural contexts, and contributing to the wider canon of Islamic architectural heritage.

Figure 3

Comparison of the evolution of ornamentation in Different centuries of Seljuk architecture



Source: Authors

Conclusion

In conclusion, this article explored the evolution of ornamentation across different regions and periods in Medieval and post-Seljuk architecture, highlighting the intricate balance between geometric patterns, floral motifs, calligraphy, stucco, tilework, and muqarnas. These decorative elements not only define the aesthetic identity of Seljuk structures and reflect the cultural, religious, and artistic developments of the

time. Each region, from Anatolia to Persia, Syria, Central Asia, and the Balkans, demonstrated unique adaptations of these ornamental features shaped by local influences and artistic traditions. Over time, the role of ornamentation in Medieval and post-Seljuk architecture evolved from a purely decorative purpose to one that embodied deeper symbolic meanings and cultural significance.

This research underscores the importance of geometric patterns and calligraphy as central components of Seljuk art, while also noting the increasing complexity of floral motifs, tilework, and stucco throughout the centuries. Furthermore, the use of marnas became more sophisticated, contributing to both the structural and decorative richness of Seljuk buildings. These findings contribute to a broader understanding of Islamic architectural heritage and its enduring influence on subsequent periods of design, particularly in the Ottoman Empire and beyond.

In conclusion, this study not only provides insight into the ornamentation features of Medieval and post Seljuk architecture but also emphasises the relevance of these artistic traditions in shaping future architectural movements. Future research could delve deeper into comparative analyses between Seljuk ornamentation and other Islamic dynasties to further enrich the discourse on Islamic art and architecture.

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References

Abdullahi, Y., & Embi, M. R. B. (2013). Evolution of Islamic geometric patterns. *Frontiers of Architectural Research, 2*(3), 243-251. https://doi.org/10.1016/j.foar.2013.03.002

Abdrassilova, G. S. (2021). The Mausoleum of Khoja Akhmed Yassawi. *Central Asian Architectural Heritage.*

Ahmad, M., Rashid, K., & Naz, N. (2018). Study of the ornamentation of Bhong Mosque for the survival of decorative patterns in Islamic architecture. *Frontiers of Architectural Research, 7*(2), 122–134. https://doi.org/10.1016/j.foar.2018.03.004

Ashkan, M., & Ahmad, Y. (2012). Significance of conical and polyhedral domes in Persia and surrounding areas: Morphology, typology, and geometric characteristics. *Nexus Network Journal, 14*(2), 275–290. https://doi.org/10.1007/s00004-012-0112-x

Azarpay, G. (1982). Islamic tomb tower: A note of its genesis and significance. In A. Daneshvari (Ed.), *Essays in Islamic Art and Architecture in Honour of Katharina Otto-Dorn* (pp. 9–12). Malibu.

Blair, S. and Bloom, J. M. (1995). *Islamic art and architecture of Islam, 1250–1800.* Yale University Press.

Blair, S. S., & Bloom, J. M. (1994). *Islamic art and architecture of Islam, 1250–1800.* Yale University Press.

Burckhardt, T. (2009). *The art of Islam: Language and meaning.* World Wisdom, Inc.

Cromwell, P. R. (2023). Geometric architectural ornament of the Seljuks in Asia Minor. https://doi.org/10.13140/RG.2.2.35205.52969

Critchlow, K. (1976). *Islamic patterns.* Thames and Hudson.

Dabbour, L. M. (2012). Geometric proportions: Underlying structure of design process for Islamic geometric patterns. *Frontiers of Architectural Research, 1*(4), 380-391. https://doi.org/10.1016/j.foar.2012.08.005

Ettinghausen, R. (1954). The art of the Seljuks. *Ars Orientalis, 1*, 1–16.

Ettinghausen, R., Grabar, O., & Jenkins, M. (2001). *Islamic art and architecture, 650-1250.* Yale University Press.

Grube, E. J., & Michell, G. (1995). *Architecture of the Islamic World: Its history and social meaning.* Thames and Hudson.

Gulzar, S., Wörle, M., Burg, J.-P., Chaudhry, M. N., Joseph, E., & Reusser, E. (2013). Characterisation of 17th-century Mughal tile glazes from the Shahdara complex, Lahore-Pakistan. *Journal of Cultural Heritage, 14*(2), 174-179. https://doi.org/10.1016/j.culher.2012.06.006

Hill, D. R., & Al-Hassan, A. Y. (1992). *Islamic technology: An illustrated history.* Cambridge University Press.

Hillenbrand, R. (1994). *Islamic architecture: Form, function, and meaning.* Columbia University Press.

Hillenbrand, R. (1994). The Seljuk architecture of Anatolia. *Muqarnas, 11*, 1–18.

Hillenbrand, R. (1999). *Islamic art and architecture.* Thames and Hudson.

Hillenbrand, R. (2004). *Islamic architecture.* Edinburgh University Press.

Hillenbrand, R. (2010). Islamic art and architecture. In *The Oxford Handbook of Islamic Art and Architecture.* Oxford University Press.

Kafescioglu, C. (2009). *Ottoman city between East and West.* Yale University Press.

Khodadadi, D. (2017). Iranian Seljuk Architecture with a Emphasis on Decorative Brickwork in the Qazvin Kharaqan Towers. *J History Cult Art Res*, 5(4), 384-394.

Kubba, A. (1990). The role of Seljuks in the development of Anatolian architecture. *Journal of the Society of Architectural Historians, 49*(2), 134–149.

Kuban, D. (1990). Ottoman architecture. *Islamic Architecture Series, 17*, 210-225.

Mosavi, Z. (2002). Mogharnas in architecture. *Ketab-e Mah-e Honar 45–46, 348–346.*

Nazer, Z., Kovács, G. M., & Rabb, P. (2020). Comprehensive revelation on the tomb towers architecture; Persia and Anatolia. *ICONARP International Journal of Architecture and Planning, 8*(2), 801–820. https://doi.org/10.15320/ICONARP.2020.137

Nazer, Z.; Oskoui, A. B., & Keynejad, M. A. (2016). A study of transparency behaviour of domes in an Islamic Mosque with emphasis on the notion of spiritual lighting. *Journal of Research in Islamic Architecture, 4*(3), 94–112. http://jria.iust.ac.ir/article-1-549-en.html

Necipoglu, G. (1995). *The Topkapi Scroll: Geometry and ornaments in Islamic architecture.* Getty Publications.

Önkal, H. (1996). *Anadolu Selçuklu Türbeleri* [Anatolian Seljuq Shrines]. Atatürk Kültür, Dil ve Tarih Yüksek Kurumu, Atatürk Kültür Merkezi Yayını, and Ankara.

Schroeder, E. (1938). Islamic architecture: F: Seljuq Period. In A. U. Pope and P. Ackerman (Eds.), *A survey of Persian art* (Vol. 8, pp. 930–966).

Shekofteh, A., Ahmadi, H., & Oudbashi, O. (2015). Seljuk Brickwork Decorations and Their Sustainability in Khwarezmid and Ilkhanid Deco-rations. *Iran Univ Sci Technol*, 3(1), 84-104.

Sutton, R. (2015). *Patterns and symbolism in Islamic art.* Harvard University Press.

Wallwey, H. (2023). Byzantine and Seljuk artistic exchange: The influence of mosaics in Anatolia. *Art History Review, 45*(3), 350-372.

Yelken, H. (2023). Seljuk ornamentation and its evolution. *Journal of Islamic Architectural Heritage, 29*(2), 145-180.

Schneider, G. Geometric architectural ornament of the Seljuks in Asia Minor. https://www.researchgate.net/publication/374870194_Geometric_Architectural_Ornament_of_the_Seljuks_in_Asia_Minor

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The Meanings Attributed to Representation in Architecture

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Abstract

Architectural representation has been an essential aspect of architecture throughout history. All the tools involved in design, project planning, and narration contribute to the creation of these representations. Architectural products are no longer defined solely as constructed buildings; instead, all drawings and narratives, whether realised or not, gain meaning through architectural representation.

With modernisation, the perception of a chaotic world led to the emergence of structured systems of order and representation-conceptual and visual frameworks rooted in Enlightenment rationalism and later formalised in architectural modernism. These systems aimed to universalise perception by standardising meaning, form, and spatial organisation, often based on the assumption of a shared human experience. This pursuit of coherence produced a trans-temporal design logic that claimed objective validity while also embedding ideological constraints within architectural thinking.

Beyond merely serving as tools for architects to materialise their ideas, architectural representation has evolved into a means of creating envisioned worlds-sometimes utopian, sometimes dystopian, and occasionally feared. Thus, the production of perception and representation in architecture has become a mechanism for establishing universal reality and asserting power.

However, power structures cannot fully suppress the diversity of meaning within perceptions and representations. This study critically examines the classical conception of representation in architecture, particularly how new meanings were added to representation during the 1960s. By exploring these shifts, this study seeks to understand the evolution of architectural representation and how contemporary practices have diverged from traditional models, embracing more diverse and individualised forms of expression.

Keywords Architectural Representation · Perception and Power · Universalism in Architecture · Interpretive Frameworks · Individual Expression

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Introduction

The rise of modernism caused transformative changes across numerous facets of life, including social, political, and cultural dimensions. Modernism emphasised progress, technological innovation and a departure from traditional norms and historical precedents. This shift has led to rapid developments in economic systems, transportation networks, communication technologies, and intellectual discourse. As these advancements introduced a level of complexity and fragmentation, a sense of disorder emerged, challenging established ways of thinking. In response, architects and designers sought to impose order, structure, and coherence, not only within the physical environments they created and through the methods and tools used to represent their designs (Frampton, 2007).

Architectural representations-including drawings, models, diagrams, and conceptual narratives-have played a pivotal role in this quest for structure and clarity. These representations are far more than mere visual aids; they are vital instruments through which architects conceptualise, develop, and communicate their ideas. They serve as a bridge between abstract concepts and the tangible reality of built environments. Robin Evans (1995) argued that architectural drawings are not just depictions of buildings; they are fundamental in the process of "constituting" architecture. These drawings help in translating and materialising abstract ideas into physical forms, thus playing a central role in the architectural process.

This study investigates how architectural representations acquire meaning and serve as tools for shaping societal ideals. By examining specific historical examples, this study explores how architects have utilised these representations not only to bring their design concepts to life but also to engage in broader cultural and philosophical debates. The inquiry will be guided by theoretical frameworks from scholars such as Jacques Rancière (2009), who focused on the role of the "spectator" in the creation of meaning, and Michel Foucault (1970), who examined the interplay between power, knowledge, and visual representation. Additionally, the study incorporates the philosophical lens of Deleuze and Guattari, particularly their concepts of virtual, rhizomatic structure, and multiplicity, to explore how architectural imagery can exceed deterministic frameworks and generate nonhierarchical, nomadic possibilities of meaning-making (Deleuze, 1968; Deleuze & Guattari, 1983).

Methodologically, this work adopts a qualitative, interpretive approach. This study focuses on analysing historical architectural representations in dialogue with architects' own narratives and reflections. Representations are not examined in isolation but are situated within broader symbolic and historical contexts, offering a richer view of how meaning is shaped by both form and discourse. Inspired by Clifford Geertz's concept of "thick description"-an approach that aims to capture not just behaviour or artefact but the complex web of meaning surrounding it-the research attends closely to the cultural, historical, and ideological frameworks in which representations are created and received (Geertz, 1973). Representations are shaped by the positionality of both the creator and the viewer and are best understood through constructivist and critical lenses that highlight their role in the production of meaning (Denzin & Lincoln, 2018). Similarly, Pink (2007) emphasised that visual materials-whether photographs, architectural drawings, or models-are constructed within systems of power and are actively involved in shaping social knowledge. Through this interpretive lens, this study aims to uncover how architectural representations serve as spaces where intention, narrative, and cultural meaning come together.

The study will focus on notable figures such as Le Corbusier, who used architectural representations to articulate and justify his vision of ideal living environments, and groups like Archigram, known for their innovative and provocative approaches to representation that expanded the horizons of architectural

discourse (Cook 1999; Le Corbusier, 2013a; 2013b). In addition, this study addresses the concept of "Unlimited Production" and its relationship with the viewer of architectural representations. This concept refers to the dynamic and open-ended nature of how architectural ideas are produced and interpreted. Specifically, the work of architects like Daniel Libeskind will be examined to illustrate how contemporary architectural representations invite active engagement from viewers (Libeskind, 1994; 2001).

Through this lens, this study seeks to uncover the ways in which architectural representation, as both a process and a product, has evolved from a technical tool to a powerful medium for cultural and ideological expression. This will shed light on how architects have historically used representations not only to construct buildings but also to influence societal structures, behaviours, and perceptions.

What is Representation?

The concept of representation is complex and has evolved significantly . At its most basic level, "representation" can mean "acting on behalf of someone or a group," "reflecting something with specific features", or "symbolising" (Oxford English Dictionary, 2023). For Henri Lefebvre, representation is not just symbolic depiction but a means of producing and shaping social space. It operates through both conceptual systems-maps, plans, and architectural designs (representations of space)-and lived, symbolic experiences (representational spaces). These representations reflect and reinforce dominant power structures by masking the social relations that underlie cultural and ideological codes. In this way, representation is not neutral; it is a tool through which space is controlled, perceived, and made meaningful within society (Lefebvre, 1991).

Michel Foucault offers a deep and influential perspective on how knowledge and representation have evolved, particularly through the frameworks of knowledge known as "epistemes," which emerged in the 17th and 18th centuries. Foucault introduced the concept of epistemes to describe the underlying conditions of possibility for knowledge in a given historical era - the deep, often invisible rules that govern what is thinkable, sayable, and representable in a particular way and concept. For example, during the Classical Age, representation was governed by a system of resemblance and classification-signs were seen as directly referring to a stable reality. However, as the modern episteme emerged, representation became more abstract and systematised, privileging taxonomies, rational order, and empirical observation (Foucault, 1970).

Foucault's analysis focuses on the evolving relationship between the "signifier"-the physical form of a sign such as a word or image-and the "signified," the concept or meaning it represents. This distinction is central to how knowledge is constructed and communicated. For example, the word "tree" (signifier) points to the mental concept of a tree (signified). Foucault argued that this relationship plays a key role in shaping systems of knowledge, particularly as societies began to value ideas like absoluteness, universality, and shared understanding-principles that suggest that knowledge can be stable, universally applicable, and commonly agreed upon. Before the 17th century, the interpretation of signs was more fluid and less formalised; meanings were often context-dependent and shaped by immediate experience rather than fixed categories. With the rise of Enlightenment thinking, there was a shift towards order, classification, and a systematic approach to knowledge, resulting in what Foucault calls a "common ground of representation". This marked a move towards standardised frameworks for organising meaning, reinforcing the separation between signifier and signified and contributing to the development of modern epistemes (Foucault, 1970).

Building on Foucault's ideas, Jacques Rancière offers a critical perspective in his work The Emancipated Spectator. Rancière expands the concept of representation beyond simple imitation to discuss how it constructs "regimes of meaning." According to Rancière, representation is not merely about copying or depicting

something but involves creating frameworks that shape how people understand and interpret information. In this context, representation includes any form of communication-whether visual (like images), textual (like written words), or auditory (like sounds)-that conveys specific ideas or meanings. The "sign" refers to these forms of representation. The "spectator," or viewer, is not just a passive receiver of this information but actively engages with it based on their own experiences and perspectives. This interaction between the sign and the spectator is crucial because it influences how meaning is created and understood (Rancière,2009).

Rancière argues that this process is not neutral. Instead, it establishes a particular "regime of representation," which is a set of rules and conventions that guide how reality is perceived. When a regime of representation is in place, it often presents a singular, dominant interpretation of truth that the audience is expected to accept. This fixed interpretation limits individuals' engagement with the work and often restricts their ability to form their own independent views. In other words, the regime of representation dictates a specific way of seeing and thinking, which can make it difficult for alternative perspectives. In addition, he critiqued the idea of "consensus," which he describes as the dominant understanding within a society. This consensus is shaped by the prevailing social and cultural ideologies and often excludes or marginalises viewpoints that challenge the status quo. By promoting a particular vision of society and maintaining existing power structures, consensus creates a sense of unity, but it also suppresses dissenting voices. This means that the dominant representational regime reinforces existing power structures and prevents alternative perspectives from gaining traction (Rancière, 2009).

John Berger, in his influential work Ways of Seeing, redefined the concept of representation by drawing attention to the deep ties between looking, power, and meaning. For Berger, representation is not merely about displaying what exists, but about shaping how and what we are taught to see. He famously argued that in visual culture-whether in classical oil paintings or modern advertisements-images do not just depict reality; they instruct us how to interpret that reality. A female nude, for instance, often exists not for the woman's own identity or experience but to satisfy the male gaze. In this way, representation becomes a political act-it determines that is visible, how they are framed, and whose perspectives are prioritised or erased. Berger emphasised that what is deemed worthy of being seen and how it is shown is shaped by systems of power that reinforce social norms, stereotypes, and inequalities. Thus, representation is not passive; it is an active process that governs perception and reinforces dominance-making the act of looking itself an exercise of control (Berger, 1972).

Following Berger's insights into Deleuze and Guattari, we shift our focus away from fixed representations towards a more dynamic and open-ended way of thinking. For them, meaning is not simply represented-it is continuously produced through processes of difference and transformation (Deleuze, 1994). In Difference and Repetition, Deleuze emphasised that repetition is not about sameness but variation-each recurrence carries creative potential. Their concept of the ritornello, or refrain, refers to repeated patterns-whether in music, behaviour, or design-that help create a sense of order, familiarity, or belonging. However, these patterns are not fixed; they can be broken apart, reassembled, or transformed, becoming starting points for new directions. In this way, repetition becomes a creative force. Similarly, their idea of the rhizome challenges linear, hierarchical models by proposing a fluid, decentralised system where meaning emerges from any point and grows in multiple directions. Rather than reproducing fixed images, their mapping idea encourages invention, experimentation, and the constant re-creation of meaning-offering tools to resist dominant narratives (Deleuze & Guattari, 1987).

These ideas have important implications for architectural representation. Architecture is influenced by the cultural, social, and political contexts of its time. Through the lens of thinkers, architecture can be seen not only as a physical creation but also as a reflection of the dominant ideologies of its era. Analysing architectural representations critically can reveal how they reinforce or challenge these dominant ideologies and reveal opportunities for resistance or alternative interpretations.

Architectural Representation: An Exploration

Architectural representation refers to the array of tools and methods architects use to communicate their design ideas. These representations are central to the entire design process, starting from the earliest conceptual stages, continuing through the final stages of production, and often evolving even after a project is completed. In modern thought, architectural representation has experienced significant transformation. It is no longer viewed solely as a system of geometric tools and technical directives designed to communicate the details of a building-whether built or not-to stakeholders involved in the architectural dialogue. Rather, architectural representation is now increasingly understood through the lens of language, encompassing both verbal and written signs that enable communication among people. In this sense, representation functions not only as a technical communication tool among architects but also as a social and cultural dimensions (Robbins, 1994).

Architectural representations are pivotal not only in shaping the physical design but also in reflecting the social and cultural inputs that are intertwined with the architect's role. They carry and shape the culture and knowledge of architecture, assuming an independent status comparable to that of architectural theory (Tanyeli, 1994). This shift in perspective emphasises that representations are not mere by-products of design; they are active agents that guide and inform the design process while also interacting with broader social, historical, and cultural contexts. These representations also establish a network of communication with society-or more specifically, with the audience-conveying, sharing, and often creating collective experiences and understandings of space, form, and function (Tanyeli, 2017).

One critical aspect of architectural representation is its dynamic nature. Representations are not static depictions; they are living, evolving entities that speak to and provoke dialogue among their viewers, both within and beyond the architectural community. Over time, they have embodied the meanings ascribed to them, influenced by the conditions and ideologies of their period. As Kester and Rattenbury (2002) suggested, architectural representations can take on mythological significance, making the invisible visible and invoking something greater than the representation itself. This mythological function allows representations to transcend their role as simple illustrations, embedding broader worldviews and cultural narratives into their form and meaning.

Architectural representations often acquire a sense of authenticity, shaping perceptions and beliefs about architecture and its role in society. By constructing and reflecting on their system of architectural perception, they not only communicate the architect's ideas but also select their audience, determining how and by whom these ideas are received. This dynamic interaction between representation and audience helps to construct a unique architectural authenticity that resonates with both contemporary thought and the timeless aspirations of the built environment (Tanyeli, 1994). Representations such as drawings, models and photographs can attain critical agency, operating independently of the built form. In certain institutional and curatorial settings-such as exhibitions or publications-these representations may even displace the built object as the primary site of architectural meaning. By challenging the binary between reality and

representation, this view acknowledges that architectural knowledge is equally mediated through visual and discursive forms, not merely through construction (Tanyeli, 2017).

In addition, architectural representations are not limited to depicting the final product. They extend into the realms of speculation, exploration, and theoretical projection, allowing architects to imagine possibilities that transcend what is physically realisable at any given moment. This speculative dimension of representation opens the door for architecture to engage with utopian ideals, challenge existing conventions and inspire new ways of thinking about space, form and human interaction. Through this process, representations help architecture evolve, continually pushing the boundaries of what is possible while remaining deeply rooted in the cultural, social, and philosophical contexts of their time (Kester & Rattenbury, 2002).

In summary, the role of architectural representation has expanded beyond its initial function as a technical tool. It is now recognised as a critical component in the shaping of architectural ideas, a medium through which architects communicate with society and a dynamic force that evolves alongside cultural and historical shifts. By examining specific examples of architectural representation, a deeper understanding emerges of how these representations both reflect and shape the worldviews of their time while contributing to the ongoing evolution of architecture as a cultural and social practice.

The Classical Conception of Representation in Architecture: Bauhaus, Le Corbusier

The discourse on architectural representation can be traced to the Renaissance, a pivotal era that revolutionised various domains of culture and knowledge. In the 15th century, Leon Battista Alberti pioneered a system of representation that laid the foundation for subsequent developments in architecture. The rationalist ideas of Viollet-le-Duc concerning Gothic architecture, coupled with the rationalist paradigms of the 18th century, propelled architecture into a phase characterised by the production of distinct styles, orders, and modes of representation. Panofsky articulated this progression as a methodical approach to conceptualising architecture within objective and universal frameworks. A system of representation was established that regarded society as a cohesive entity governed by a unified artistic vision and architectural philosophy, defined by clear limitations and determinations (Panofsky, 1991). Based on the premise of a standardised mode of perception, efforts were made to develop a timeless system of thought. This system presumed that the same perceptual standards could be universally applied, asserting that any alternative forms of perception were inconceivable. Human perception is framed within a conceptual structure rooted in nature and articulated through specific representations (Panofsky, 1991; Rancière, 2009).

Figure 1

Model of One of the Twin Houses.

Figure 2

Perspective Study for the Bauhaus Masters' Houses, Colour Scheme Study.

Source: Tanyeli & Köksal, 2002

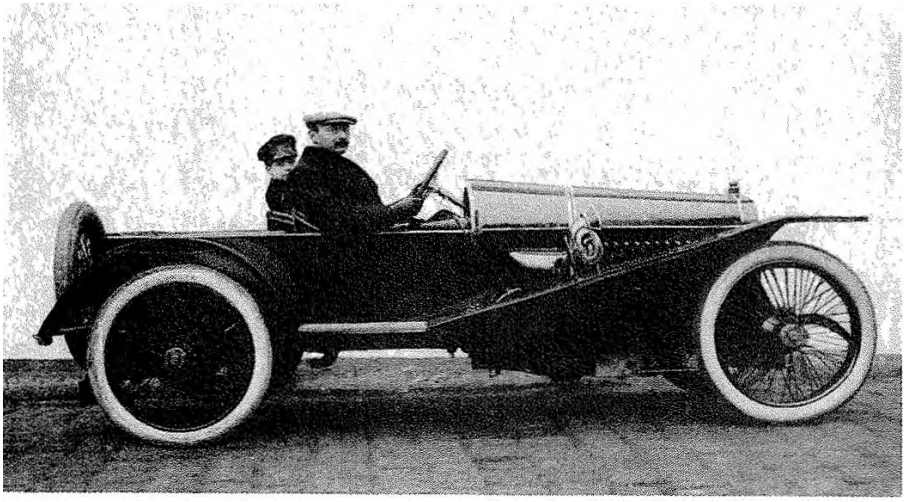
In the context of modern architecture, the conservative Baukunst philosophy, which viewed the coexistence of different styles as problematic, advocated representations that were more precise and unambiguous. The Bauhaus school, instrumental in shaping the ideals and principles of modern architecture, cultivated a discourse and system of representation that appealed to a particular audience. Walter Gropius envisioned the Bauhaus as a hub for developing a design philosophy grounded in the fundamental needs of human life, capable of addressing the requirements of all members of a civilised society. Through a narrative that embraced industrial production, the Bauhaus promoted representations marked by simplicity, where objects were not diluted by romantic embellishments, and where the utility of standardised forms in everyday life was emphasised (Gropius, 2002). As Lefebvre (1991) argued, architectural representations are not merely visual abstractions but are linked to the production of social space-they shape, regulate, and naturalise everyday spatial practices in ways that align with some ideological structures. These representations, confined to specific forms and colours, are exemplified by the Bauhaus buildings in Dessau, including the school and the master houses (Figures 1 and 2).

In the context of modern architectural representation, Le Corbusier played a pivotal role by developing representations that encapsulated the symbolic meanings of modern architecture. As an architect committed to forging a new epistemology of architecture in the 20th century, Le Corbusier sought to redefine the discipline within the framework of the rapidly evolving temporal and spatial conditions of the modern era. His work aimed to break from tradition and establish a new architectural essence through innovative representations (Le Corbusier, 2013a; 2013b)

Le Corbusier distilled the complexities of modern life into a unified and meaningful architectural language. He characterised his time as an era of rapid transformation driven by the machine, which he saw as a force reshaping all aspects of life. To navigate these profound changes, Le Corbusier argued that traditional habits, tools, and practices had become obsolete, necessitating the creation of a new architectural paradigm. In his representations, he prominently featured machines-such as ships, aeroplanes, and automobiles (Figure 3)-as symbols of modernity. These machines served as instruments for experimentation and calculation, guiding the search for optimal architectural forms (Le Corbusier, 2013a).

Figure 3

Automobile Models for Standardised Production.



Source: Le Corbusier, 2013b

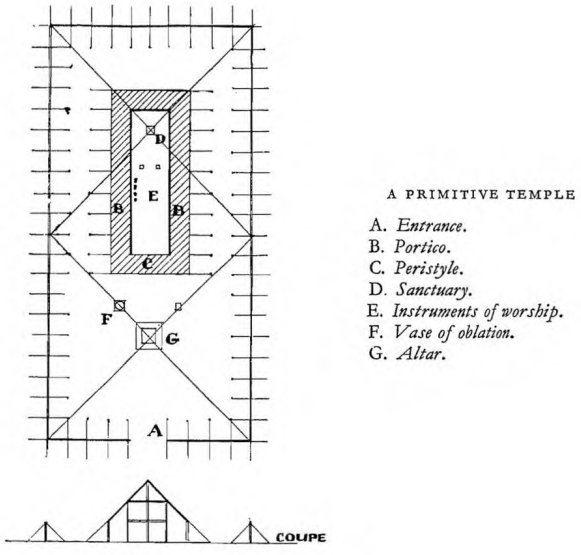
Le Corbusier developed his Modulor measurement system-a mathematical framework he devised-by tracing its origins to the construction of primitive tribal huts. He illustrated the concept of lines regulation through these early architectural forms. Le Corbusier argued that throughout history, humans have used specific measurements to ensure the stability and functionality of structures, with these measurements derived from the innate proportions and movements of the human body. He proposed that primitive people intuitively employed right angles, axes, squares, and circles when determining the dimensions of elements such as fences, huts, and the placement of altars and furnishings (Le Corbusier, 2013b).

The emphasis on measurement as a means of imposing architectural order was central to his design philosophy. To develop his ideal system, he studied the practices of primitive humans, drawing conclusions about their movements and spatial arrangements, which informed the creation of the Modulor system (Figure 6). This representation of scale and geometric order, beginning with the primitive hut, extended to more complex structures such as the Piraeus Arsenal, Persian domes, Notre-Dame Cathedral, and Capitoline Hill (Figures 4-7). The principles of measurement that Le Corbusier expressed through these representations were integrated into his own architectural projects. By employing and communicating these representations, Le Corbusier sought to establish an architecture characterised by purity, orderliness, and nobility-qualities he referred to as "regulating lines" (Le Corbusier, 2013b).

However, the effectiveness of these representations depends on the capacity of the audience to interpret them. Le Corbusier described his audience as possessing "unseeing eyes," underscoring a disconnect between universal human needs and the audience's reluctance to acknowledge these needs. He criticised this audience for being confined to traditional architectural practices, which he believed hindered their understanding of modern architectural principles. In contrast, he praised those who responded thoughtfully to his representations as cultured and discerning elite-individuals who truly appreciated and understood art. For Le Corbusier, effective communication of artistic expression was a fundamental element of architectural practice (Le Corbusier, 2013a). This approach reflects his ideal of an audience that deeply engages with and values his representations and narratives.

Figure 4

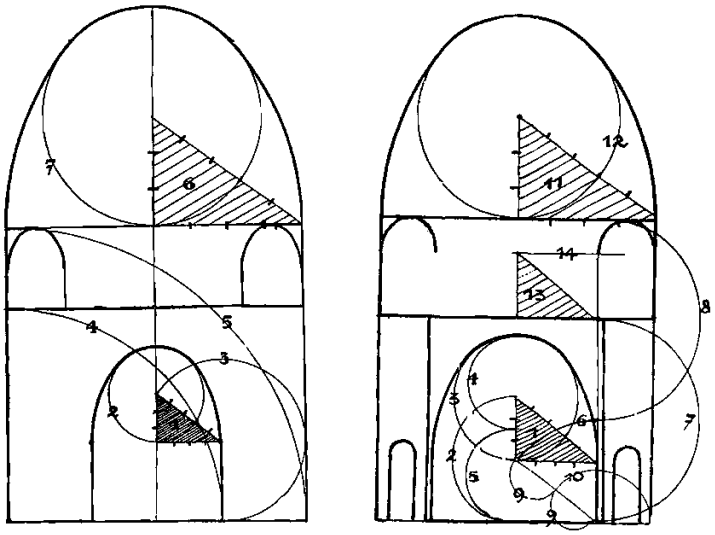
Measured Primitive Templ.



Source: Le Corbusier, 2013b

Figure 5

Persian Domes, 550-330 BC.

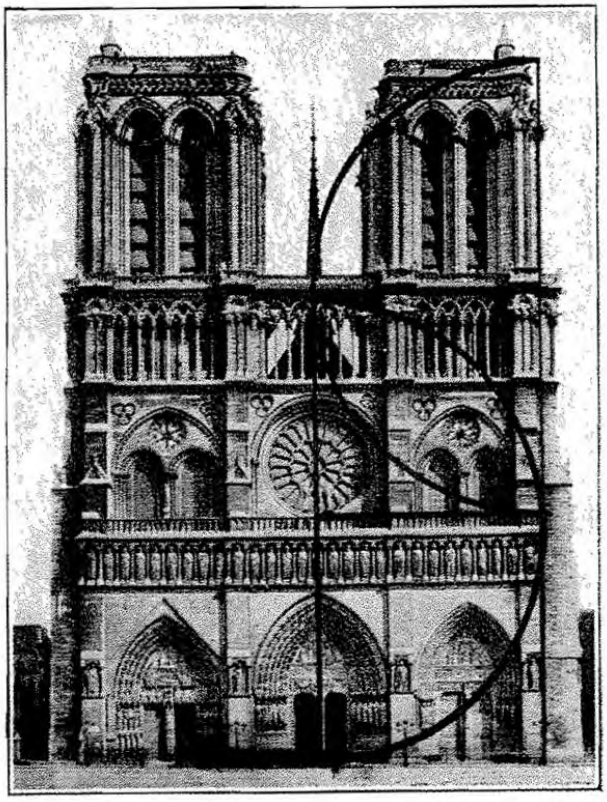


ACHÆMENIAN CUPOLAS

Source: Le Corbusier, 2013b

Figure 6

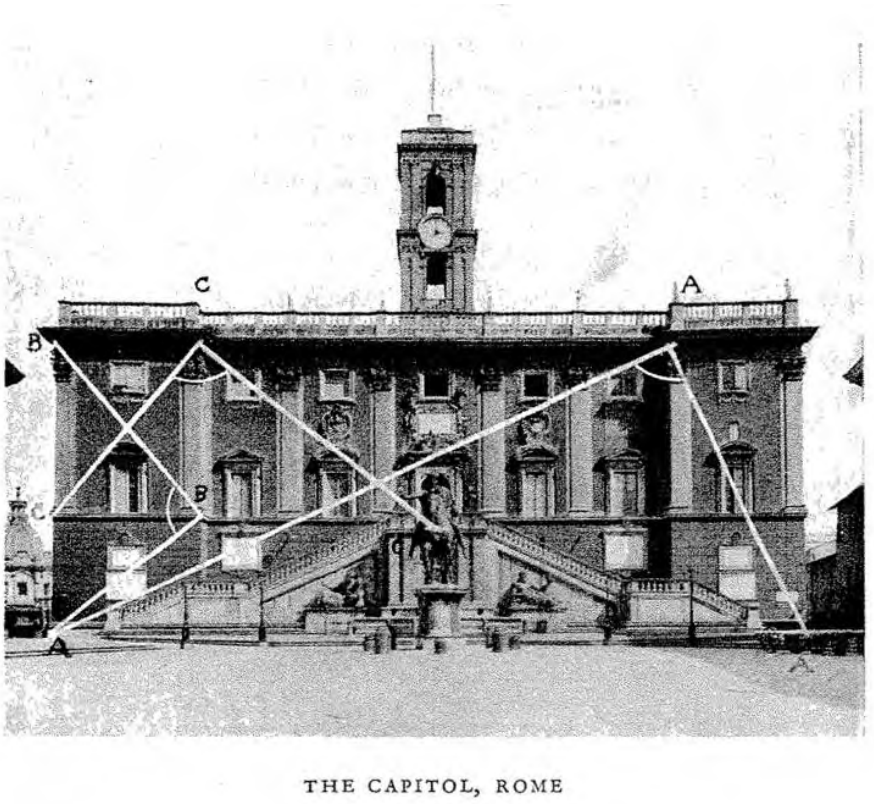
Notre-Dame Cathedral, Paris.



NOTRE DAME, PARIS

Source: Le Corbusier, 2013b

Figure 7
Capitoline Hill, Rome.



Source: Le Corbusier, 2013b

The classical conception of architectural representation, as exemplified by the works of the Bauhaus and Le Corbusier, laid the foundation for a system emphasising clarity, order and the expression of universal principles (Le Corbusier, 2013a; 2013b). Under the leadership of Walter Gropius, the Bauhaus advocated a precise and utilitarian approach, where architectural representations were shaped by industrial production and standardised forms, reflecting the essential needs of a modern, civilised society (Gropius, 2002). Le Corbusier's representations, while visually innovative, prioritised control, rationality, and the construction of an idealised modern subject-the "man-machine"-over the richness of lived human experience (Lefebvre, 1991). Such modernist representations functioned not only as design principles but also as mechanisms of knowledge that defined what was visible, thinkable, and permissible within a given historical moment. They served as instruments of power, structuring the perception and organisation of representations according to dominant ideologies (Foucault, 1980). However, this system of representation was limited by its rigid, universalist ideals, which eventually prompted movements like Archigram to introduce playful, speculative interpretations that challenged traditional narratives and opened new possibilities for architectural representation.

Adding New Meanings to Representation: Archigram

In the 1960s, a period marked by a significant departure from conventional modern architectural representations, avant-garde movements emerged, challenging established norms. This era of intense rebellion against prevailing perspectives opened new avenues for innovative forms of representation. The advent of photography, cinema, and technology has accelerated this shift, pushing architectural thought beyond

rational constraints and broadening its conceptual scope. Among the most influential of these movements was the Archigram group, whose radical visions and publications redefined architecture as a medium of speculation, imagination, and mobility (Cook, 1999).

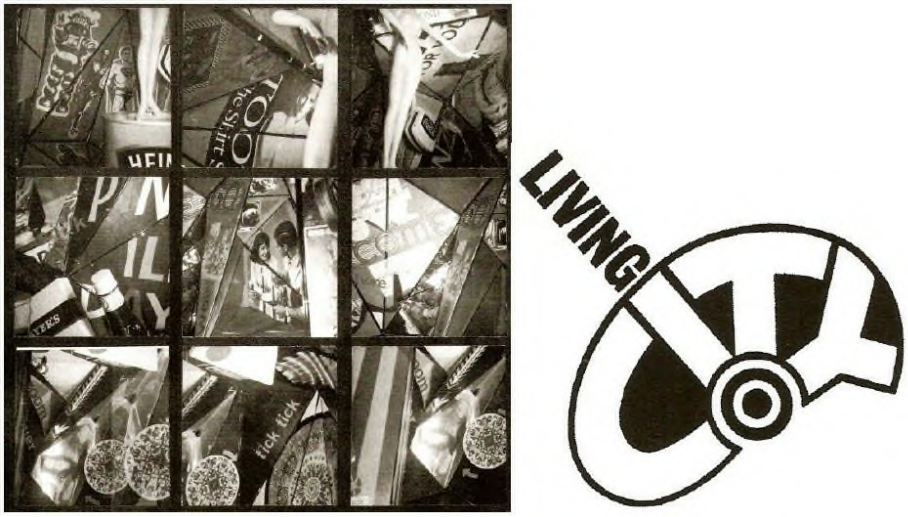
Archigram was born out of a desire to move beyond the limitations of artistic protests that were largely confined to the bourgeois sphere. The group, composed of members referred to as "arthropods," sought to disrupt the traditional centrality of architecture in shaping urban environments. They proposed a new paradigm that challenged the dominance of individual architects over the authenticity and clarity of urban life, advocating for a decentralised approach to architectural authority. Their work introduced a form of representation that encouraged collective production and sought to expand the audience's understanding of architectural discourse. Initially targeting architecture students, Archigram's influence eventually extended beyond academic circles, becoming a significant force in long-term societal change (Sadler, 2005). The group's approach, characterised by brief yet impactful messages, led them to coin the term "archi(tecture)-(tele)gram," reflecting their commitment to the immediacy and reach of their ideas (Cook, 1999).

Active from 1961 to 1974, the Archigram group made significant contributions to architectural thought, though most of their projects remained unbuilt, existing primarily as visual concepts. Archigram aimed to push the boundaries of architecture beyond traditional bureaucratic constraints and elitist aesthetic norms. By incorporating elements from popular culture and leveraging technological advancements, Cook sought to liberate architecture from restrictive formal disciplines and artistic conventions (Cook, 1999). Their exploration of the "free form" concept led to the development of a representational style that emphasised form as much as, if not more than, content, challenging conventional architectural narratives.

One of Archigram's notable works, the "Living City" project, first exhibited in London in 1963, is of particular significance. This project, a collaborative effort by the entire group, was groundbreaking in illustrating that a city is not merely an accumulation of architectural elements but is fundamentally constituted by life itself. The exhibition catalogue emphasised that architecture constitutes only a minor portion of the urban environment, with the broader environment as the primary focus. The project sought to capture the city's dynamic vitality and the influence of the environment on human conditions (Figure 8). Archigram argued that cities should not be viewed simply as a series of plans but should be understood through their emotional and experiential dimensions (Cook, 1999). However, while exploring the phenomena of life, there is a risk of creating representations that systematise and constrain life within a controlled framework. "Living City" offered a utopian vision of urban life, in which the city was designed to transform individual experiences by detaching people from their everyday routines and providing a formative environment. As seen in Figure 9, the city was envisioned as an organism crafted by individuals outside traditional hierarchical structures, with a strong emphasis on placing humans at the centre of their environment and giving them control over all aspects of it (Cook, 1999).

Figure 8

Archigram, 'Living City' Exhibition, 1963. Photographs of the exhibition space and the exhibition's logo.



Source: Sadler, 2005

Figure 9

Peter Taylor, Montage for Man Gloop from the Living City Exhibition, 1963.

Source: Sadler, 2005

Archigram proposed a democratic techno-utopia built around the principles of consumption, emphasising concepts such as movement, speed, organic growth, disposability, and a "use-and-dispose" mentality (Pawley, 1998). Rather than glorifying objects, Archigram focuses on their rapid obsolescence and constant change. They envisioned a new culture in which consumption objects perpetually evolved-not through historical continuity but by disappearing and being replaced by new forms. Their designs were framed as forward-looking visions of urban futures, aimed at fostering a heightened sense of urban consciousness through their unique perspective (Cook, 1999).

By employing these concepts, Archigram's innovative approach to architectural representation-characterised by its challenge to traditional norms and embrace of dynamic, techno-utopian visions-marked a significant departure from established practices. They emphasised fluidity and collective engagement over static, individualistic ideals (Sadler, 2005). This avant-garde movement not only redefined the parameters of architectural discourse and laid the groundwork for future explorations of how representations interact with their viewers. While appearing radically open, such approaches may still produce their own form of consensus-a dominant mode of seeing shaped by futuristic aesthetics and technological optimism-those risks marginalising dissenting or alternative interpretations (Rancière, 2009). As the discourse on architectural representation continues to evolve, the next phase will explore how the concept of unlimited production interacts with the viewer's experience and perception, addressing the implications for both the creator and the audience in contemporary architectural practice.

Unlimited Production with the Viewer of the Representations

The process of creating meaning through representation becomes particularly intriguing when it moves beyond the traditional relationship between the signifier (the form of representation) and the signified (the concept or object it represents). When representations avoid fixating on established entities or a singular quest for origins or reality, they generate diverse and evolving experiences. This approach challenges the assumption that all viewers interpret representations uniformly. Instead, it continuously deconstructs and redefines meanings, encouraging new interpretations and transforming viewers from passive observers into active participants. In this way, the search for absolute knowledge and the reliance on rigid, fixed systems of communication have become less important and increasingly outdated (Barthes, 1977).

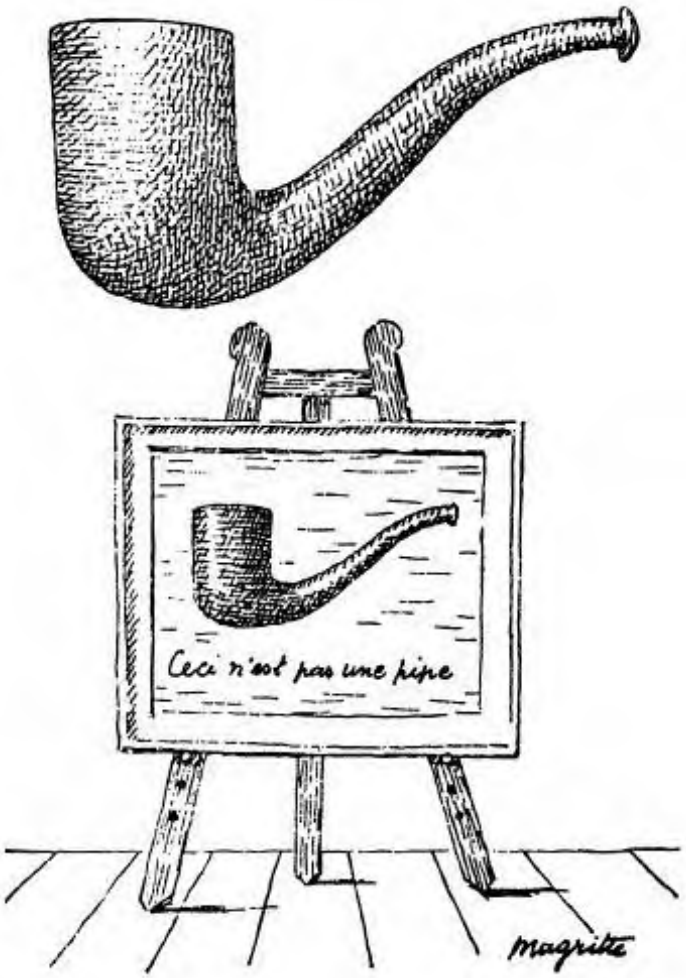
Michel Foucault explored this concept by examining how meaning attached to representations are influenced by prevailing power structures. He uses René Magritte's The *Treachery of Images* to illustrate his point. In this painting (Figure 10), Magritte presents an image of a pipe with the caption "This is not a pipe." This seemingly paradoxical statement creates semantic disruption that challenges the viewer's perception (Foucault, 1983). Rather than providing a stable representation of a pipe, the painting raises questions about the nature of representation itself.

Foucault elaborates on this disruption by posing a series of questions that highlight the complexities of representation: *"Is this a mere slip of the pen (a 'miswriting' similar to a misinterpretation) that will dissipate like a puff of white smoke?" This is the smallest of the uncertainties. Here are others: Are there two pipes? Would it be more accurate to say that there are two designs of the same pipe? Or is there only one pipe and one design of a pipe? Or are there two designs, each representing two different pipes? Or is one a design of a pipe while the other does not represent a pipe?"* (Foucault, 1983, p. 16). By addressing these questions, Foucault emphasised that the meaning of representation is not fixed but is subject to ongoing interpretation

and debate. This perspective underscores the dynamic nature of representations and their role in shaping and reshaping our understanding of the world (Foucault, 1983).

Figure 10

René Magritte's painting The Treachery of Images.



Jacques Rancière compared artistic productions that exist outside traditional representation frameworks with those that are mimetic or ethical adaptations designed for specific social purposes. Mimetic adaptations focus on realistic or conventional portrayals of subjects, while ethical adaptations are geared towards addressing social or moral issues through their content and form. According to Rancière, works that do not conform to these conventional frameworks resist having fixed meanings imposed by established representational systems. Instead, they create a barrier against such systems through their unique qualities and their detachment from the traditional mechanisms of interpretation. This disassociation from established norms introduces a level of ambiguity and opens the door to new interpretations. Such works often defy easy categorisation and challenge viewers to engage with them on a deeper, more personal level, rather than relying on predefined meanings or traditional aesthetic values. Consequently, representations, which are typically expected to convey fixed meanings and be presented uniformly to viewers, are disrupted. This disruption results in an ongoing process of change and reinterpretation, where meanings are continually

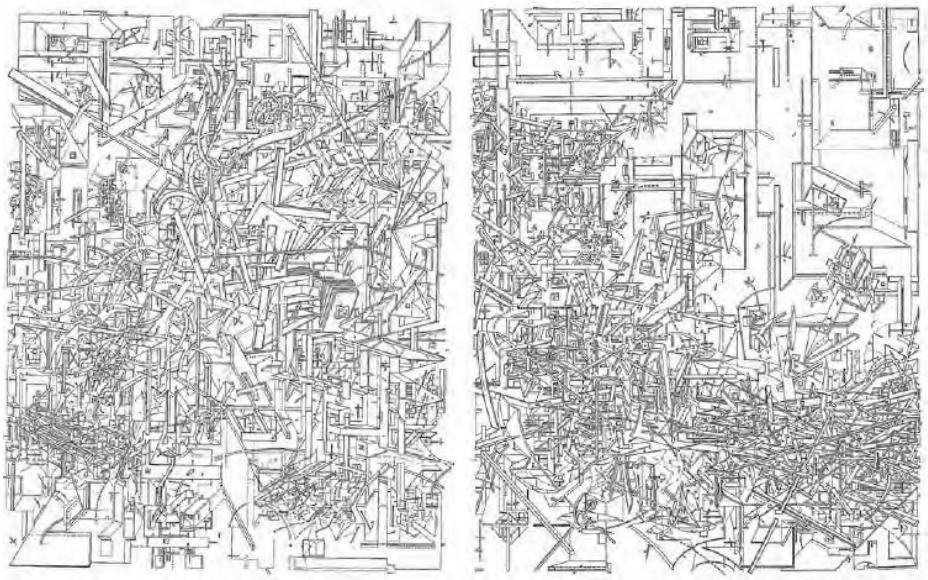
negotiated and reshaped, reflecting the evolving nature of both the artworks and the contexts in which they are experienced (Rancière, 2009).

Daniel Libeskind's approach to architectural representation reflects a deep belief in the potential of drawings to transcend their conventional, functional roles. He sees representation not only as a means of conveying technical information but also as a medium capable of expressing layered, symbolic meanings. For Libeskind, architectural drawings are embedded within a historical tradition in which they signify more than static or objective data. He views the act of drawing as a process that transcends its material form-the signifier-to uncover an inner reality. In this view, even when representation is reduced to a formal system, it does not become empty or redundant. Rather, such a system begins to act as an extension of reality, with its structure communicated through symbolic language. This perspective positions representation as a dynamic and interpretive act, one that allows architecture to engage with abstract, philosophical, and emotional dimensions beyond its physical manifestation (Libeskind & Crichton, 2004).

Libeskind's prospective highlights how architectural drawings, often viewed as purely functional or technical documents, can serve as powerful vehicles for conveying deeper, more abstract ideas. His "End Space" series (Figure 11) exemplifies this approach. In these drawings, Libeskind does not intend to depict a specific utopian, fantastical, or idealised vision of the future. Instead, the drawings evoke a sense of absolute reality that defies conventional expectations, offering an unpredictable and often unsettling view of space (Libeskind & Crichton, 2004).

Figure 11

Daniel Libeskind, Small Bigs: The Maldoror Equation and Polar Flowers, 1979.



Source: Libeskind, 1991

In this series, the use of geometric and technical tools does not result in static or easily recognisable representations. Rather, it fosters a dynamic and evolving dialogue between the viewer and the drawing. The viewer is encouraged to actively engage with the images, promoting an interpretive process that transcends traditional constraints. Instead of simply providing a fixed vision of space or technology, the drawings invite multiple interpretations, creating a fluid interaction between representation and meaning (Tanyeli, 2001).

As demonstrated by thinkers like Barthes (1977) and Foucault (1983), the meanings attached to representations are not fixed but are influenced by power structures and open to constant reinterpretation. René Magritte's The Treachery of Images exemplifies this dynamic by questioning the nature of representation itself. Rancière further emphasises that artistic productions outside traditional frameworks resist imposed meanings, allowing for greater freedom in interpretation. This notion is reflected in Libeskind's architectural drawings, which defy fixed, predictable outcomes and invite viewers to actively participate in the interpretative process. Through these perspectives, representation is seen not as a static, definitive construct but as an ongoing dialogue that transforms both the work and the viewer (Rancière, 2009).

Magritte's pipe disrupts the hierarchy between signifier and signified, just as Libeskind's drawings dissolve traditional architectural hierarchies, replacing functional clarity with a web of dynamic, nonlinear potentials. In both cases, representation becomes an evolving process rather than a conclusive statement-mirroring Deleuze's concept of the rhizome, which allows connections to form at any point, resists centralisation, and generates new possibilities through rupture (Deleuze & Guattari, 1987). Libeskind's architectural gestures embody Deleuze and Guattari's idea of the Body without Organs-a conceptual space where organisation emerges from minor, relational flows rather than fixed structures. Likewise, Magritte's semantic dissonance exemplifies the Deleuzian virtual: not something unreal but a reservoir of latent potential whose actualisation is always contingent, context-dependent, and unpredictable (Deleuze, 1994). These representations invite viewers to move beyond passive observation and engage actively with a shifting field of meaning.

Conclusion

In the modern era, architectural representation has evolved into a potent medium for conveying meanings that transcend the mere depiction of form and function. These representations not only reflect the realities of their time but also gesture towards broader, often abstract ideas and ideals. For instance, the Bauhaus school infused its representations with social determinism, aiming to redefine architecture's role in shaping society (Tanyeli & Köksal, 2002). Le Corbusier, on the other hand, employed his representations to articulate an architectural language grounded in order, clarity, and a utopian vision of progress (Le Corbusier, 2013b). Archigram further advanced this trajectory by deconstructing traditional representations, challenging established architectural narratives, and envisioning futuristic, often utopian cities that questioned societal norms and proposed alternative ways of living (Cook, 1999).

The evolution of architectural representation mirrors broader cultural and intellectual shifts. Le Corbusier, with tools like the Modulor system, saw representation as a means of reshaping society, reflecting his belief in architecture's potential to influence human behaviour and foster a rational, orderly world (Le Corbusier, 2013). Meanwhile, Archigram's speculative representations offered a radical departure, using visionary drawings to critique existing social structures and imagine alternative futures (Sadler, 2004). Their work exemplifies how representations can both critique the present and project potential futures. Similarly, Daniel Libeskind's architectural drawings challenge traditional frameworks by emphasising the potential of representation to convey abstract, transformative ideas. His End Space series, for instance, disrupts conventional expectations and invites viewers to engage with a dynamic and evolving dialogue, reflecting his belief in the power of representation to provoke deeper contemplation and reimagine spatial experience (Tanyeli, 2001). Collectively, these approaches demonstrate how architectural representations can transcend mere depiction to engage with broader intellectual and cultural dialogues.

Le Corbusier's modernist approach aligns with Foucault's notion of disciplinary power-his use of standardised forms, regulating lines, and the Modulor system constructs a normative vision of the "ideal" human subject, embedding control and order into the very fabric of architectural space (Foucault, 1983). Archigram, by contrast, reflects Rancière's critique of representational consensus: their speculative, pop-culture-infused projects resist fixed meanings and hierarchical authorship, proposing instead an open, participatory visual language that decentralises architectural authority and disrupts traditional social roles (Rancière, 2009). Libeskind's fragmented, non-linear drawings most vividly illustrate Deleuze and Guattari's concepts of the rhizome and the Body without Organs, where meaning emerges through rupture, multiplicity, and becoming. Unlike Le Corbusier's totalising vision or Archigram's techno-utopian optimism, Libeskind embraces ambiguity and indeterminacy, inviting viewers into a continuous process of interpretation. Together, these architects demonstrate the evolving politics of representation-shifting from modernist control to radical openness, to a post-structuralist embrace of complexity and territorialisation (Deleuze, 1994; Deleuze & Guattari, 1987).

This study has demonstrated how architectural representation has developed through history by examining the works of key architects and groups. By analysing figures such as Le Corbusier, Archigram, and Daniel Libeskind, it becomes evident that each era and ideology shaped distinct modes of representation-whether as a tool of control, a site of resistance, or a space of philosophical inquiry (Cook, 1999; Frampton, 2007; Tanyeli, 2001). Over time, however, representation has undergone a significant transformation. It is increasingly detached from fixed meanings and is no longer confined to the creator's original intentions. It is open to multiple interpretations shaped by the viewer's context and perspective (Barthes, 1977; Berger, 1972; Rancière, 2009). As representations circulate and evolve, the meanings they carry shift accordingly, fostering new dialogues and interactions between the viewer and the work. Although institutional forces may attempt to stabilise meaning, the inherently fluid nature of architectural representation ensures that meanings are continuously questioned, challenged, and redefined. In this dynamic process, viewers become active participants in meaning-making, engaging with representations as living, interpretive texts rather than static visuals (Deleuze & Guattari, 1987; Foucault, 1983). Thus, architectural representation stands as both a reflection of its time and a catalyst for future discourse-ever-changing, contested, and deeply embedded in cultural and intellectual movements.

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References

Barthes, R. (1977). *Image, music, and text*. (S. Heath, Trans.). Fontana Press.

Berger, J. (1972). *Ways of Seeing*. Penguin Books.

Cook, P. (1999). *Archigram: Architecture Without Architecture*. Princeton Architectural Press.

Deleuze, G. (1994). *Difference and Repetition*. Columbia University Press.

Deleuze, G., & Guattari, F. (1987). Introduction: rhizome. *A Thousand Plateaus: Capitalism and Schizophrenia*, *2*, 3–25.

Denzin, N. K., & Lincoln, Y. S. (Eds.). (2018). *Part V: The art and practices of interpretation, evaluation, and representation* (pp. 1307–1319). In The SAGE Handbook of Qualitative Research (5th ed.). SAGE Publications.

Evans, R. (1995). *The Projective Cast: Architecture and Its Three Geometries*. MIT Press.

Foucault, M. (1970). *The Order of Things: An Archaeology of the Human Sciences*. Pantheon Books.

Foucault, M. (1980). *Power/Knowledge: Selected Interviews and Other Writings, 1972–1977*, edited by C. Gordon. & Trans.). Vintage.

Foucault, M. (1983). *This Is Not a Pipe*. (J. Harkness, Trans.). University of California Press.

Frampton, K. (2007). *Modern Architecture: A Critical History* (4th ed.). Thames and Hudson.

Geertz, C. (1973). *Interpretation of Cultures: Selected Essays*. Basic Books.

Gropius, W. (2002). *The New Architecture and the Bauhaus*. MIT Press.

Kester, G., & Rattenbury, K. (Eds.). (2002). *This is Not Architecture: Media Constructions*. Routledge.

Le Corbusier. (2013a). *The Modulor*. (Originally published 1961). Dover Publications.

Le Corbusier. (2013b). *Towards a New Architecture*. (Originally published 1923). Dover Publications.

Libeskind, D. (1991). *End Space*. Architectural Association.

Libeskind, D., & Crichton, S. (2004). *Breaking Ground*. Riverhead Books.

Oxford English Dictionary. (2023). *Representation*. Oxford University Press.

Panofsky, E. (1991). *Perspective as a Symbolic Form* (C. S. Wood, Trans.). New York, NY: Zone Books. (Original work published 1927)

Pawley, M. (1998). *Archigram: The Book*. Architectural Press.

Pink, S. (2007). *Visual Ethnography* (2nd ed.). SAGE Publications. https://doi.org/10.4135/9780857025029

Pérez-Gómez, A. (1983). *Architecture and the Crisis of Modern Science*. Cambridge, MA: MIT Press; 2007.

Rancière, J. (2009). *The Emancipated Spectator*. Verso Books.

Robbins, E. (1994). *Why Architects Draw*. MIT Press; 2007.

Sadler, S. (2005). *Archigram: Architecture Without Architecture*. MIT Press.

Tanyeli, U. (1994). *Mimarlık düşüncesi üzerine denemeler [Essays on architectural thought]*. YEM Yayın. (In Turkish)

Tanyeli, U. (2001). *Mimarisiz temsiliyetten temsiliyetin mimosine [From representation without architecture to the architecture of representation]*. In M. Ekincioğlu (Ed.), Daniel Libeskind (pp. 7–16). İstanbul: Boyut Yayın.

Tanyeli, U. (2017). *Yıkarak yapmak: Anarşist bir mimarlık kuramı için altlık [Building by destroying: A basis for an anarchist architectural theory]*." Metis Yayınları.

Tanyeli, U., & Köksal, A. (Eds.). (2002). *Walter Gropius ve Bauhaus [Walter Gropius and the Bauhaus]*. Boyut Yayın Grubu.

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Research Article

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Examining the Impact and Perception of Thermal Comfort on Student Performance in Architectural Studios

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Abstract Well-designed and thermally comfortable educational environments significantly enhance academic performance, concentration, and general well-being. The thermal conditions within these spaces are closely linked to students' learning outcomes and health. In tropical Nigeria, rising temperatures, particularly during the dry season, have negatively affected the thermal comfort of educational facilities. Architecture students, who spend considerable time in design studios, often encounter uncomfortable thermal conditions intensified by climate change and insufficient design considerations. This research explored how thermal comfort influences students' productivity and well-being, aiming to enhance students' academic performance and physical, mental, and social health. A structured questionnaire was distributed to 185 architecture students, and 171 responses were collected for analysis. Descriptive and inferential statistical methods were employed to evaluate the data at different research levels. The results reveal that environmental factors such as temperature, ventilation, and humidity impact productivity, performance, and concentration levels. Lower temperatures, especially during the harmattan season, may improve the performance. Ventilation and air quality also affect performance, but the concentration is situation-dependent. The study concludes that insufficient thermal comfort adversely affects productivity, contributing to psychological challenges and decreased student performance. It is recommended that architects adopt design features that ensure proper ventilation and incorporate passive design strategies to enhance the thermal quality of learning spaces.

Keywords Architectural Studios · Performance · Productivity · Thermal Comfort · Wellbeing

Author Note

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Introduction

Globally, thermal comfort significantly impacts individuals' productivity and well-being across various environments, making it a vital aspect of everyday life (Siwczuk et al., 2024). As society evolves and climate conditions change, the importance of thermal comfort in building design and environmental human-environment studies is increasingly recognized. In architectural design studios, thermal comfort is key to enhancing students' performance and well-being, particularly in diverse climates such as those in the Mediterranean, India, and other places (Khambadkone et al., 2022). Thermal comfort encompasses individuals' satisfaction and well-being regarding their thermal surroundings, shaped by elements such as air temperature, humidity, clothing, and activity levels (Fan et al., 2023). The process involves a complex thermoregulation process in humans, which includes both autonomic and behavioral responses aimed at balancing heat produced by metabolism with heat exchanged with the environment (Zeyad et al., 2022).

Recent research has underscored the important role of indoor environmental quality (IEQ) in influencing students' comfort, performance, and productivity within architectural design studios. Thermal comfort has been recognized as a vital element impacting student performance across various ventilation systems and seasons (Ranjbar, 2019; Elnaklah et al., 2023). Studies have indicated that HVAC systems create the most favorable indoor conditions, improving student performance (Ranjbar, 2019). Nevertheless, there is a necessity for tailored thermal comfort guidelines for educational facilities, as comfort levels among students differ between design studios and lecture halls (Elnaklah et al., 2023).

Various indoor environmental quality (IEQ) factors, including noise, humidity, lighting, and air quality, are crucial in shaping students' comfort and academic success (Al-Jokhadar et al., 2023); (Munonye & Ifebi, 2018). Furthermore, physical and administrative elements greatly affect students' productivity in design studios, with thermal comfort emerging as the most significant factor throughout all design stages (Alhusban et al., 2024). These insights highlight the necessity of addressing multiple IEQ aspects to improve students' learning experiences and productivity in architectural education.

In warmer climates, common adaptation strategies include opening windows, wearing lighter clothing, and using fans (Chali et al., 2023); (Munonye et al., 2023). Moreover, Yous*ef* et al. (2016) stressed the importance of monitoring variables such as temperature, humidity, and noise levels to improve comfort in studio settings. Recognizing and applying adaptive strategies tailored to local climate conditions is vital for fostering effective global learning environments in architectural studios. It is essential to investigate the impact of thermal comfort on student performance and well-being in educational contexts, particularly within architectural studios.

Moktan and Uprety (2023) highlighted the significance of thoughtfully designed classrooms with optimal thermal conditions to boost academic performance, focus, and productivity. A study comparing various university hall types revealed that students in design studios and lecture halls experienced different levels of thermal comfort, which influenced their perceived learning effectiveness (Elnaklah et al., 2023). Furthermore, research conducted in primary schools indicated a disparity in thermal comfort perceptions between students and teachers, emphasizing the necessity for customized design strategies to cater to the unique comfort needs of various age groups in warm and humid environments (de la Cruz Chaidez et al., 2022). Understanding and applying suitable passive design techniques can enhance thermal comfort in educational facilities, thereby benefiting students' overall well-being and learning results.

Nonetheless, there is a call for additional research into the relationship between thermal comfort, indoor air quality, and energy consumption for ventilation in educational settings (Jia, 2021). Additionally, the significance of prioritizing students' well-being and performance in designing and operating educational buildings has been stressed (Shan, 2018). Currently, there is a lack of research exploring thermal comfort in architectural studio environments and the adaptation strategies used by occupants in various climates, as noted in studies from India and Turkey (Khambadkone et al., 2022).

This research gap emphasizes understanding the impact of environmental factors on thermal comfort in studio classrooms by researching temperature, humidity, air quality, and airflow in architectural studio classes. The objectives of the study are: (i) to identify the environmental factors that affect thermal comfort. (ii). Determine the environmental factors that affect student performance in the studio (iii). Establish a relationship between thermal comfort and student performance. The research examines the following two hypotheses:

H0: No significant relationship was observed between thermal comfort and performance.

H1: A significant relationship between thermal comfort and performance.

H0: There is no significant relationship between thermal comfort of air quality/airflow and performance.

H1: There is a significant relationship between the thermal comfort of air quality and airflow and performance.

Literature Review

An architectural studio plays a crucial role in architectural education, providing a setting where students can hone their design skills, enhance their critical thinking, and improve their problem-solving abilities (Alfredo, 2002; Shanthi-Priya et al., 2020). It serves as a center for interdisciplinary and intercultural collaboration, supported by advancements in information and communication technologies that facilitate virtual interactions and design activities, overcoming geographical and temporal limitations (Vecchia *et al.,* 2009). The studio environment encourages students to participate in collaborative design processes, enriching their educational experiences and equipping them with modern design practices (Niculae, 2011).

Architecture studios ensure students' thermal comfort and enhance learning outcomes (Ifebi et al., 2020). Research from various locations, including Izmir, Turkey, and Tumkur, India, underscores the importance of adaptive thermal comfort in educational environments (Elnaklah et al., 2023; Pekdogan & Avci, 2022). Multiple studies (Guevara et al., 2021; Khambadkone et al., 2022) have indicated that design studio students often experience different thermal sensations than traditional lecture halls, with temperature fluctuations affecting their perceived productivity and comfort. These findings highlight the necessity of understanding and optimizing thermal conditions in architecture studios to foster environments that promote students' well-being and academic success.

Thermal comfort has a vital role in the performance and productivity of students in educational environments. Research across different contexts underscores the necessity of maintaining ideal classroom thermal conditions to improve learning results. Surveys conducted in Malaysia reveal a positive relationship between thermal sensation and student performance, suggesting that students achieve better results when they feel cooler and when air velocity is appropriately managed (Chong et al., 2023; Mohamad et al., 2022). Furthermore, these studies stress the importance of various factors, including indoor temperature, air velocity, and relative humidity, in fostering an effective learning atmosphere (Mohamad et al., 2023).

Research in Nepal highlights the importance of passive design strategies in enhancing thermal comfort and boosting students' concentration and productivity (Moktan & Uprety, 2023). Additionally, studies in Jordan indicate variations in thermal comfort between design studios and lecture halls, with students noting increased productivity when they feel cooler (Elnaklah et al., 2023). Furthermore, investigations in Nigeria reveal differing perceptions of thermal comfort between children and adults, underscoring the necessity for customized design solutions in warm and humid climates to improve learning environments (Jastaneyah et al., 2023; Munonye et al., (2023). In summary, ensuring suitable classroom thermal conditions promotes students' focus, performance, and overall productivity.

In Nigerian architecture studios, thermal comfort, especially in warm, humid climates, is essential for creating a favorable learning environment for students. According to studies by Okafor et al. (2022), Nwalusi et al. (2022), Elshafei (2021), and Qays and associates (2023) in warm, humid places like Southeastern Nigeria, traditional buildings typically provide higher indoor thermal comfort than modern ones. To lower energy consumption and achieve the highest levels of thermal comfort in African nations, including Nigeria, Verma (2023) highlighted the integration of passive solar systems with bioclimatic architectural solutions. Additionally, building orientation is important for maximizing thermal comfort; for commercial buildings in warm-humid climates like Uyo Urban, Nigeria, the S-N orientation is thought to be ideal (Bello et al., 2022; Gottkehaskamp & Willmann, 2022).

Passive design strategies, such as double skin facades, have been proposed to increase buildings' natural ventilation, internal thermal comfort, and overall comfort levels (Pekdogan & Avci, 2022). Research has also emphasized the significance of incorporating climate-responsive design elements and principles to address the challenges presented by hot and humid climates. Specifically, architects and designers must prioritize functional building requirements for energy-efficient and climate-responsive structures (Adaji et al., 2022; Santos et al., 2022; Obi-George et al., 2024). Nigerian architects and designers must consider these findings when global warming worsens and apply design techniques that improve thermal comfort to produce sustainable and comfortable architectural studio spaces (George et al., 2022).

Active and passive design techniques can be used to create thermally comfortable buildings (Emechebe & Eze, 2019; Ming et al., 2023). However, because of Minna, Nigeria's intermittent power outages, it is challenging to maintain suitable thermal comfort conditions in schools, particularly when active measures like artificial ventilation, cooling, and heating are used. When combined with the current power shortfall, the demand for electricity rises during the hottest dry season, leading to an intolerable indoor temperature (Hachem-Vermette & Yadav, 2023). The optimum method for achieving thermal comfort in educational buildings at the study location under the circumstances is passive design.

To create a comfortable building environment while lowering the need for active design techniques, passive design effectively utilizes climate conditions and natural energy sources like wind gusts and thermal buoyancy (Bulbaai & Halman, 2021). A well-designed building uses air movement for optimal cooling and solar heat gain (Gassar et al., 2021). A building cannot be considered effective if it uses too much energy to provide thermal comfort. On the other hand, zero-net energy buildings are inadequate if they do not provide a comfortable environment for their occupants (Gokce & Touraj, 2024). In hotter climates, passive design techniques described in the literature are essential for improving thermal comfort in architecture studios.

Factors Affecting Thermal Comfort

The concept of thermal comfort describes how people feel about the temperature, humidity, airflow, and heat in indoor spaces. ASHRAE Standard 55 defines thermal comfort as "that state of mind which expresses satisfaction with the thermal environment." This occurs when the heat produced by the body is balanced with the heat it loses or gains to maintain a steady core body temperature. Several factors, such as air temperature, humidity, air movement, and radiant temperature, must be balanced to achieve thermal comfort in buildings. Variables such as time of day, tenant activity, building design, and temperature can all impact these factors. Arowoiya et al. (2024) posited that achieving thermal comfort requires careful consideration of the HVAC system, building materials, room layout, and other elements affecting the interior temperature and humidity.

Both personal and environmental factors influence thermal comfort. Environmental parameters included air temperature, mean radiant temperature, air velocity, and humidity. The degree of clothing and metabolic rate are examples of personal factors. Human thermoregulation is a complicated process involving behavioral and autonomic reactions (Fan et al., 2023). Personalized solutions and energy-efficient designs are the focus of adaptive thermal comfort, which encourages behavioral psychological and physiological acclimation (Luo, 2023). According to Jia et al., (2021), static standards and HVAC control strategies frequently impede indoor thermal comfort in building design, resulting in imprecise assessments of occupants' thermal demands and energy consumption. In contrast, dynamic control strategies can maximize comfort while minimizing energy consumption. Knowing the thermal demands of inhabitants is essential for designing comfortable spaces with less energy waste, particularly in non-uniform thermal conditions where both local and general comfort must be considered (Xiaowen et al., 2024).

Research Methodology

A research technique is essential to any research project involving a methodical strategy for analyzing research problems and gaining knowledge (Swarooprani, 2022). This entails understanding the different procedures researchers take to study their research problems, choosing acceptable methods and techniques, and properly analyzing data. Methodology changes depending on the study subject at hand; therefore, researchers must modify their approach accordingly (Swarooprani, 2022). Conventional methods for gathering primary data in quantitative and qualitative research include questionnaires, documents, and observations. Mixed-method research can provide a full understanding of the effects of thermal comfort by combining qualitative and quantitative research methodologies. Mixed-method research allows for the collection, analysis, and interpretation of both quantitative and qualitative findings from focus groups and interviews.

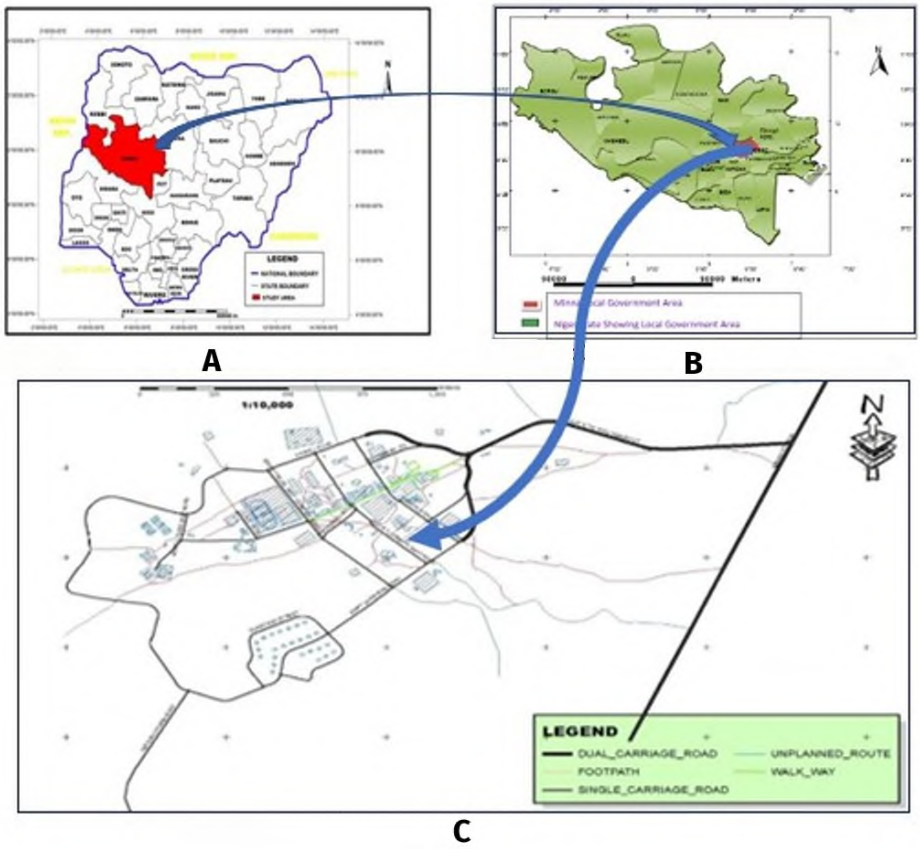
Study Area

The study area Federal University of Technology is located in a Gidan kwano, which lies southwest of Minna, located along the Minna-Kateregi-Bida Road, between latitude 9 0 26′15′′N; 9 0 37′30′′N and longitude 6 0 23′15′′E; 6 0 28′45′′E. Minna is Niger State capital city and is located in Nigeria's north-central geopolitical zone. It is a huge neighborhood that links the cities of Abuja, Kano, Ibadan, and Lagos. It has a land area of 76,363 square kilometers. It is located between latitude 9.58 and longitude 6.54 east of the Greenwich Meridian (Figures 1A, B and C). Minna was chosen as the study's data collection site because it accurately depicts the North-central Nigerian ecotype. The climatic conditions in Minna is characterized by high temperatures throughout the year, resulting in insufficient thermal conditions for school building occupants. The research area is rather warm and receives moderate amounts and durations of rainfall, creating a typical

tropical ecological context. Minna has two distinct seasons: rainy (May to October) and dry (December to March), with transition periods in April and November. While the dry season often peaks in February and March due to unusually hot temperatures, rains usually peak in August. From November to January, the northeast trade wind produces chilly and dry weather conditions (known as the harmattan).

Figure 1

A: Map of Nigeria Showing Niger State. B: Map of Niger State Showing Minna. C: Map of Gidan Kwano Showing Campus FUT Minna



Survey

The study used a quantitative survey approach that included primary and secondary data. The primary data were gathered using a field survey that used a questionnaire to determine the thermal effects in the indoor environment of the studios. Akande et al., (2018) stated that questionnaires can efficiently and effectively sample a wide population. The secondary data collection strategy comprised thoroughly examining and analyzing scientific literature from journals, conferences, Google Scholar, Science Direct, Scopus, and Web of Science. This study uses a survey of students with substantial experience of the thermal conditions of an architectural studio environment in a studio setting. Questionnaires were administered to students who use or stay in architectural design studios to enhance the data's accuracy and validity. The survey was conducted from November to December, and data were collected during school hours from 8:00 am to 4:00 pm. These periods are the peak periods when students use the studios.

Instruments

Questionnaires are simply forms that contain a collection of questions designed to collect data for a survey. In this research, questionnaires were considered the most effective instrument for contacting respondents quickly, economically, and efficiently to collect the necessary data. The surveys were distributed to 200, 300, and 500-level architecture students through architectural design studios. Before distributing the questionnaire, a pilot survey was conducted among the 20 respondents interviewed using a structured questionnaire to ensure that the questionnaire was understandable to the respondents. The study sample was drawn from an architectural design studio at the Department of Architecture. The research assistant administered some of the questionnaires while the researcher administered the rest. Constant surveillance was used to secure respondents' consent to participate in the questionnaires. Furthermore, questionnaires were carefully distributed to respondents in the morning and midday (during school hours) to determine their thermal perception during these periods.

Validity and Reliability of Instruments

Cronbach's alpha was used to verify the instrument. The questionnaire was distributed to students who only used the design studio environment to determine and improve the device's dependability and to collect exact and valid data on their thermal perception of the studio environment. Cronbach's alpha was calculated for each scale using SPSS 23. Table 1 displays reliability statistics. The scales had satisfactory values, and the internal reliability coefficients of the respondents' responses were 0.724. This is considered highly reliable.

Table 1
Reliability Statistics

Cronbach's Alpha	Number of Items
0.724	29

Reliability test

To verify the reliability of the measurement, the scales employed in this study's analysis, the data were analyzed, and reliability tests were carried out. Using Cronbach's standardized alpha (Table 2), the reliability of the instruments was determined to ensure one-dimensionality between the test scales. From the data set, 14 variables were observed because these are the variables with numeric values, and the reliability coefficient of all 14 parameters is 0.878. This implies high data reliability.

Table 2
Reliability Statistics

Variable	Items	Reliability	Interpretation
Thermal Comfort	12	0.822	Highly reliable
Influence of thermal factors on productivity	5	0.788	Highly reliable
Level of Productivity	6	0.534	Moderately reliable
Health Evaluation	6	0.746	Highly reliable
Overall	29	0.724	Highly reliable

Results and Discussion

Sociodemographic Characteristics of Respondents

A total of 185 questionnaires were distributed among architecture students who use the studio using a random sampling method, with 171 returned, with a frequency of 121 male respondents to 50 female respondents (Table 3). The response rate was 92.4% as a result, the sample size is deemed sufficient.

Table 3

Respondents' background characteristics

Variable	Frequency	(Percentage)
Male	121	(70.8)
Female	50	(29.2)
Age		
14-20	49	(28.7)
21-30	118	–69
31-40	4	(2.3)
Level		
100L	15	(8.8)
200L	83	(48.5)
300L	27	(15.8)
500L	46	(26.9)
Hours worked in studio		
1-2 hrs	9	(5.3)
2-4 hrs	51	–2981
4-6 hrs	56	(32.7)
6-8 hrs	34	(19.9)
Greater than 8 hours	21	(12.3)

Table 3 provides a detailed overview of a sample population's demographic and behavioral factors, highlighting their frequency and percentage distribution. The sample is primarily composed of males, with 121 (70.8%) identifying as such and females accounting for 50 (29.2%). This considerable gap points to a male-dominated sample, which may influence research outcomes. The bulk of participants, 118 (69%) were between the ages of 21 and 30. The younger age group of 14-20 years contains 49 members (28.7%), while only 4 people (2.3%) were between the ages of 31 and 40. This age distribution shows a young demographic, which may represent the study's context, which could be focused on a younger group involved in specific activities or environments.

Participants' educational levels were also documented, with second-year students (200L) accounting for 83 individuals (48.5%). First-year students (100L) comprised a smaller section, with 15 (8.8%), while third-year (300L) and fifth-year (500L) students comprised 27 (15.8%) and 46 (26.9%), respectively. This distribution indicates that responders are primarily in the early to mid-phase of their academic careers. Finally, the table shows the hours spent in the studio working, demonstrating that the majority of participants devote 4-6 hours to their job, with 56 (32.7%) falling into this category. 2-4 hours was the second most common response, with 51 individuals (29.8%). Fewer participants report spending 6-8 hours (34 persons, 19.9%) or

more than 8 hours (21 individuals, 12.3%) in the studio, with only a few (9 individuals, 5.3%) working for 1-2 hours. This distribution demonstrates a high level of studio work among the participants, which may be relevant to the study objectives. Overall, the data presented in the table provide useful insights into the sample population's demographic traits and behaviors, which are critical for understanding the context and implications of the research results.

Table 4

Evaluate the environmental factors that affect student performance in the studio

Variable	VL	BA	A	AA	VH	Mean score	Decision
Level of sensitivity to temperature	8(4.7)	17(9.9)	59(34.5)	51(29.8)	36(21.1)	3.5	AA
Performance and concentration levels at high studio temperature	61(35.7)	45(26.3)	45(26.3)	10(5.8)	10(5.8)	3.82.197	BA
Performance and concentration levels at low studio temperature	19(11.1)	40(23.4)	62(36.3)	43(25.1)	7(4.1)	2.88	A
Performance and concentration levels in relation to the current ventilation and air quality of the studio	8(4.7)	30(17.5)	84(49.1)	40(23.4)	9(5.3)	3.07	A
Concentration when airflow in the studio is low	48(28.1)	68(39.8)	39(22.8)	11(6.4)	5(2.9)	2.16	BA
Concentration at high humidity	15(8.8)	55(32.2)	66(38.6)	28(16.4)	7(4.1)	2.75	A

NOTE VL= Very Low, BA= Below Average, A= Average, AA= Above Average, VH= Very High, Sample size = 171, Percentage value in bracket.

Table 4 presents an analysis of various environmental factors affecting performance and concentration levels in a studio setting, based on a sample size of 171 participants. Each variable was categorized into five distinct levels of sensitivity or impact: Very Low (VL), Below Average (BA), Average (A), Above Average (AA), and Very High (VH). The mean scores for each variable provide a quantitative measure of the participant's responses, which are further interpreted to determine the overall decision regarding each factor's influence. The first variable assessed was the level of sensitivity to changes in temperature, where a significant majority of respondents (59, or 34.5%) rated their sensitivity as Average (A), leading to a mean score of 3.5, classified as Above Average (AA). This show that temperature fluctuations notably affect the participants' comfort and performance.

In terms of performance and concentration when the studio temperature is high, the results indicate that a substantial portion of respondents (61, or 35.7%) experienced a Very Low (VL) level of productivity, with a mean score of 3.82, categorized as Below Average (BA). This finding highlights the harmful effects of elevated temperatures on cognitive functioning and task performance. Conversely, when the studio temperature was low, the responses showed a more favorable outcome, with 62 participants (36.3%) rating their performance and concentration as Average (A), resulting in a mean score of 2.88. These results shows that cooler temperatures may enhance focus and efficiency in the studio environment.

The analysis of performance and concentration levels with the current ventilation and air quality revealed that 84 respondents (49.1%) rated their experience as Average (A), with a mean score of 3.07. This indicates that adequate ventilation and air quality are crucial for maintaining optimal productivity levels. When examining concentration under low airflow conditions, the results indicate a concerning trend, with

68 participants (39.8%) reporting a Below Average (BA) concentration level, reflected in a mean score of 2.16. This underscores the importance of sufficient airflow in promoting cognitive performance.

The impact of high humidity on concentration levels showed that 66 respondents (38.6%) rated their concentration as Average (A), with a mean score of 2.75. This shows that although high humidity does not severely hinder concentration, it still warrants consideration in the studio environment. The findings from this table illustrate the complex interplay between environmental factors such as temperature, ventilation, and humidity on productivity, performance and concentration levels. The varying mean scores and classifications indicate that while some conditions may enhance performance, others can significantly detract from it, emphasizing the need for careful management of the studio environment to optimize cognitive functioning. This finding agrees with the study conducted by Asaju et al. (2024), in which the result revealed a strong relationship between good studio indoor environmental quality (IEQ) and architectural students' academic performance concerning the season. The study also recommended that a good IEQ should be provided to enhance academic performance.

Table 5

Relationship between air quality/airflow performance and thermal comfort

			Performance and concentration at high studio temperature	Performance and concentration when the studio temperature is low
Kendal tau b:	Heat season indoor air temperature	Correlation Coeff	-.015	-.036
		Sig. (2-tailed)	.811	.572
	Harmattan season indoor air temperature	Correlation Coeff	.044	.154*
		Sig. (2-tailed)	.493	.017
	Use of the mechanical cooling system	Correlation Coeff	-.053	.109
		Sig. (2-tailed)	.405	.085
	Indoor temperature in the studio during a power outage	Correlation Coeff	.044	-.108
		Sig. (2-tailed)	.499	.097
		N	171	171

Table 5 presents a comparative analysis of performance and concentration levels in relation to indoor temperature variations within a studio environment, specifically during high- and low-temperature conditions. The data is analyzed using Kendall's tau-b correlation coefficient, which assesses the strength and direction of the association between two variables. In the context of high-temperature conditions, the correlation coefficients revealed a generally weak relationship between indoor air temperature and productivity and concentration. For the heating season indoor air temperature, the correlation coefficient is −0.015, indicating a negligible negative correlation, with a significance level (p-value) of 0.811, suggesting that this relationship is not statistically significant. Similarly, during the Harmattan season, the correlation coefficient is 0.044, also reflecting a weak positive correlation, with a significance level of 0.493, further indicating a lack of significant association.

When examining the use of mechanical cooling systems, the correlation coefficient is −0.053, which again points to a weak negative correlation, with a significance level of 0.405. These results shows that the use of cooling systems does not have a meaningful impact on the performance and concentration in high-temperature settings. Additionally, the correlation for indoor temperature during power outages was 0.044,

with a significance level of 0.499, reinforcing the notion of a weak and statistically insignificant relationship. In contrast, the analysis under low-temperature conditions presents a different picture. The correlation coefficient for the Harmattan season indoor air temperature was 0.154, indicating a moderate positive correlation with productivity and concentration, and this relationship is statistically significant with a p-value of 0.017. This shows that lower temperatures during the Harmattan season may enhance the performance and concentration levels of the flora. Conversely, the correlation for the heat season indoor air temperature is −0.036, which remained weak and statistically insignificant (p=.572).

The use of mechanical cooling systems under low-temperature conditions has a correlation coefficient of 0.109, approaching significance with a p-value of 0.085, hinting at a potential positive influence on performance and concentration, although it does not reach conventional levels of statistical significance. Lastly, the correlation for indoor temperature during power outages is −0.108, with a significance level of 0.097, indicating a weak negative correlation that approaches significance but does not confirm a strong relationship. The findings shows that although high temperatures do not significantly affect performance and concentration, lower temperatures, particularly during the Harmattan season, may positively influence these outcomes. The data underscore the importance of temperature management in studio environments to optimize student performance. The above study is in line with the study by Jia et al. (2021) which clearly stated that the advantage of temperature management lower energy consumption and improves thermal comfort to achieve good indoor performance in educational buildings.

Table 6

Relationship between student concentration and airflow

			Productivity and concentration when the current ventilation and air quality of the studio	Concentration when airflow in the studio is low
Kendall's tau_b	The ventilation and air quality of the studio	Correlation Coefficient	.178**	-.074
		Sig. (2-tailed)	.006	.252
	Air flow in the studio	Correlation Coefficient	.161*	-.062
		Sig. (2-tailed)	.013	.334
	Use of the mechanical cooling system	Correlation Coefficient	.185**	.064
		Sig. (2-tailed)	.004	.317
	Air quality when mechanical cooling systems are not in use	Correlation Coefficient	.099	.130*
		Sig. (2-tailed)	.132	.048
		N	171	171

Table 6 presents a statistical analysis of the relationship between various factors related to ventilation and air quality and their impact on productivity and concentration within a studio environment. The analysis employs Kendall's tau-b, a non-parametric measure of correlation, to assess the strength and direction of these relationships.

The first row indicates a significant positive correlation between the ventilation and air quality of the studio and productivity, with a correlation coefficient of 0.178 (p = .006). This shows that productivity tends to increase as the quality of ventilation and air improves. Conversely, when examining the correlation between low airflow in the studio and concentration, the coefficient is negative at −0.074, with a p-value of 0.252, indicating no significant relationship.

The second row highlights the correlation between airflow in the studio and productivity, yielding a coefficient of 0.161 (p = .013), which again signifies a positive relationship; better airflow is associated with higher productivity levels. However, the correlation with concentration under low airflow conditions was slightly negative at −0.062, with a p-value of .334, showing no meaningful correlation.

The third row assesses the use of mechanical cooling systems, revealing a positive correlation with productivity (correlation coefficient of 0.185, p = .004). This finding implies that the implementation of mechanical cooling systems can enhance the studio performance. In contrast, the correlation between air quality when mechanical cooling systems are not in use and concentration shows a positive coefficient of 0.130 (p = .048), indicating a statistically significant relationship; better air quality in the absence of mechanical cooling appears to support concentration levels.

The sample size for these studies was 171, which provides a substantial dataset for examining these connections. The findings indicate that ventilation and air quality are important factors affecting performance although the effects on concentration are more complex and situation-dependent. These findings highlight the necessity of maintaining adequate air quality and ventilation in studio environments to enhance student performance and focus.

Table 7

Relationship between thermal comfort and performance.

Model		Unstandardized Coefficients		Standardized Coefficients			
		B	Std. Error	Beta	t	Sig.	R square
1	(Constant)	2321	.214		10859	.000	
	ThermalComfort	.108	.077	.107	1397	.164	.107

The results in Table 7 show a regression analysis examining the relationship between the independent variable, Thermal Comfort, and a dependent variable, which is not explicitly stated but can be inferred to be related to overall comfort or satisfaction levels. The first row of the table provides the constant term, which is the intercept of the regression equation. The unstandardized coefficient of the constant is 2.321, with a standard error of 0.214. This indicates that when the independent variable is zero, the expected value of the dependent variable is 2.321. The t-value associated with this constant is 10.859, with a significance level (p-value) of 0.000, showing that the constant is statistically significant.

The second row details the coefficient for the variable Thermal Comfort. The unstandardized coefficient (B) is 0.108, with a standard error of 0.077. This coefficient indicates that for each one-unit increase in Thermal Comfort, the dependent variable is expected to increase by 0.108 units, assuming that all other variables remain constant. The standardized coefficient (Beta) for thermal comfort was 0.107, allowing for comparison across different variables by standardizing the units. The t-value for thermal comfort was 1.397, and the significance level was 0.164. This p-value indicates that the relationship between Thermal Comfort and the dependent variable is not statistically significant at conventional levels (e.g., $p < .05$), suggesting that although there may be a positive association, it is not strong enough to be considered conclusive.

The R-squared value of 0.107 indicates that approximately 10.7% of the variance in the dependent variable can be explained by the independent variable, Thermal Comfort. This relatively low R-squared value shows that other factors not included in the model significantly influence the dependent variable. Overall, although the analysis indicates a potential positive relationship between Thermal Comfort and the

dependent variable, the lack of statistical significance and the modest explanatory power highlight the need for further investigation into additional variables that may contribute to the observed outcomes.

Conclusion

This study investigated the effects of thermal comfort on students' productivity and well-being to improve their academic performance and physical and mental well-being. The study objectives were to identify the environmental factors that affect thermal comfort, determine the environmental factors that affect student performance in the studio, and establish the relationship between thermal comfort and student performance. A questionnaire survey approach was adopted and the finding shows 3 key points.: (1) Environmental factors such as temperature, ventilation, and humidity significantly influence productivity, performance, and concentration levels. (2) Although high temperatures do not greatly hinder performance and concentration, lower temperatures, especially during the Harmattan season, can positively affect these aspects. This highlights the need for effective temperature management in studio environments to enhance student performance. (3) Ventilation and air quality are crucial for performance, although their effects on concentration can vary depending on the situation. This research adds to the existing body of knowledge regarding the impact of thermal conditions on learning outcomes and student performance. The study recommends that thermal comfort be considered in building design and construction to create indoor environments that meet the needs of occupants. Ensuring thermal comfort is vital for users' health and well-being. Effective design, construction, and maintenance can reduce energy consumption while providing a comfortable indoor atmosphere. In addition, passive design strategies can enhance thermal comfort while minimizing energy use. These recommendations aim to guide future efforts and design considerations to improve the thermal comfort of learning environments, thereby promoting better productivity and performance among students.

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References

Adaji, M., Adekunle, T., & Watkins, R. (2022). *Overheating and passive cooling strategies in low-income residential buildings in Abuja, Nigeria*. In book: Routledge Handbook of Resilient Thermal Comfort Edition: 1 Publisher: Routledge doi: 10.4324/9781003244929-14

Akande, O. K., Olagunju, R.E., Aremu, S.C., & Ogundepo, E. (2018). Exploring Factors Influencing Project Management Success in Public Building Projects in Nigeria. *YBL Journal of Built Environment*, 6, 47-62. DOI: 10.2478/jbe-2018-0004

Alfredo, A. (2002). Architectural studios online: the "internet studio network". Siggraph '02: Acm Siggraph 2002 Conference Abstracts and Applications 301 https://doi.org/10.1145/1242073.1242309

Alhusban, S.A., Alhusban, A.A., Sqour, S., Al Shawabkeh, R., Eshruq Labin, A., & Alhusban, M.W.A. (2024). Examining the factors influencing students' productivity in architectural design studio of governmental Jordanian universities. *Facilities*, 42(9/10), 771-788. https://doi.org/10.1108/F-12-2023-0109

Al-Jokhadar, A., Alnusairat, S., Abuhashem, Y., & Soudi, Y. (2023). The Impact of Indoor Environmental Quality (IEQ) in Design Studios on the Comfort and Academic Performance of Architecture Students. *Buildings*, *13*(11), 2883. https://doi.org/10.3390/buildings13112883

Arowoiya, V. A., Onososen, A. O., Moehler, R. C., & Fang, Y. (2024). Influence of Thermal Comfort on Energy Consumption for Building Occupants: The Current State of the Art. *Buildings*, *14*(5), 1310. https://doi.org/10.3390/buildings14051310

Asaju, O., Onamade, A., Chukwuka, O., Odefadehan, C., & Alagbe, O. (2024). The Effect of the IEQ of the Studio Environment on the Academic Performance of Architectural Students at Caleb University, Lagos, Nigeria. *Middle Eastern Journal of Research in Education and Social Sciences*, 5, 1-7. DOI: 10.47631/mejress.v5i1.672

Bello, H., Hamza, B., & Abdulhamid, F. (2022). Exploring double skin façades as a strategy for achieving thermal comfort in a proposed mixed-use office complex Kano, Nigeria. *Dutse Journal of Pure and Applied Sciences*, DOI:10.4314/dujopas.v7i4b.15

Bulbaai, R., & Halman, J. I. M. (2021). Energy-Efficient Building Design for a Tropical Climate: A Field Study on the Caribbean Island Curaçao. *Sustainability*, *13*(23), 13274. https://doi.org/10.3390/su132313274

Chali Y., Madhavi I., Gudina T. T., & Esayas A. (2023). Study on adaptive thermal comfort model and behavioral adaptation in naturally ventilated residential buildings, Jimma Town, Ethiopia. *Energy and Buildings,* 298, 113483, https://doi.org/10.1016/j.enbuild.2023.113483.

Chong Z. Y., Mohamad N. A. N. A., Azian H., Amir A. M. D., & Mohd S. S. M. (2023). Preliminary Study on Student's Performance and Thermal Comfort in Classroom. *Journal of Advanced Research in Fluid Mechanics and Thermal Sciences*, *101*(1), 59–72. https://doi.org/10.37934/arfmts.101.1.5972

de la Cruz Chaidez, M. T., Armendáriz López, J. F., Martín del Campo Saray, F. J., Sahagún Valenzuela, M. I., Castañón Bautista, M. C., & García Gómez, C. (2022). Thermal and aluminic comfort assessment in university classrooms in Tijuana, Baja California. Case study of FCITEC, Valle de las Palmas. *Revista De Ciencias Tecnológicas*, *5*(4), e233. https://doi.org/10.37636/recit.v5n4e233

Elnaklah, R., Ayyad, Y., Alnusairat, S., AlWaer, H., & AlShboul, A. (2023). A Comparison of Students' Thermal Comfort and Perceived Learning Performance between Two Types of University Halls: Architecture Design Studios and Ordinary Lecture Rooms during the Heating Season. *Sustainability*, *15*(2), 1142. https://doi.org/10.3390/su15021142

Elshafei, G. (2021). Bioclimatic Design Strategies Recommendations for Thermal Comfort Using Mahoney Tables in Hot Desert Bioclimatic Region. *Journal of Urban Research*, 39(1), 59-74. DOI: 10.21608/jur.2021.39201.1019

Emechebe, L.C. & Eze, C. J. (2019). Integration of sustainable urban green space in reducing thermal heat in residential area in Abuja. *Environmental Technology & Science Journal, 10*(2), 24-32.

Fan, G., Chen, Y., & Deng, Q. (2023). Thermal Comfort. In: Wang, F., Yang, B., Deng, Q., Luo, M. (eds) *Personal Comfort Systems for Improving Indoor Thermal Comfort and Air Quality*. Indoor Environment and Sustainable Building. Springer, Singapore. https://doi.org/10.1007/978-981-99-0718-2_1

Gassar, A. A. A., Koo, C., Kim, T. W., & Cha, S. H. (2021). Performance Optimization Studies on Heating, Cooling and Lighting Energy Systems of Buildings during the Design Stage: A Review. *Sustainability*, *13*(17), 9815. https://doi.org/10.3390/su13179815

George, S. B., Ekanemesang, A. S., Aniefiok, I. S., & Idara, E. P. (2022). Indoor Thermal Comfort for Commercial Buildings in Nigeria Urban Environment. *Journal of Environmental Impact and Management Policy,* 2(05), 1–11. https://doi.org/10.55529/jeimp.25.1.11

Gokce, T., & Touraj, A. (2024). Climate-resilient building energy efficiency retrofit: Evaluating climate change impacts on residential buildings, *Energy and Buildings,* 316, 114315, https://doi.org/10.1016/j.enbuild.2024.114315.

Gottkehaskamp, B., & Willmann, A. (2022). Investigating passive strategies in a cold climate: Teaching EDDA in architectural education *IOP Conference Series: Earth and Environmental Science*, DOI 10.1088/1755-1315/1078/1/012059

Guevara, G., Soriano, G., & Mino-Rodriguez, I. (2021). Thermal comfort in university classrooms: An experimental study in the tropics. *Building and Environment*, 187, 107430, https://doi.org/10.1016/j.buildenv.2020.107430

Hachem-Vermette, C., & Yadav, S. (2023). Impact of Power Interruption on Buildings and Neighborhoods and Potential Technical and Design Adaptation Methods. *Sustainability*, *15*(21), 15299. https://doi.org/10.3390/su152115299

Ifebi, O., Olotuah, A., & Ezeji, K. (2020). Influence Of Indoor Air Temperature on Occupants' Thermal Sensation in Architecture Design Studios of Universities in Southeast Nigeria. *COOU African Journal of Environmental Research*, 2(1), 221-229.

Jastaneyah, Z., Kamar, H., & Al Garalleh, H. (2023). A review paper on thermal comfort and ventilation systems in educational buildings: Nano-mechanical and mathematical aspects. *Journal of Nanofluids*, 12(1), 1-17. DOI: https://doi.org/10.1166/jon.2023.1902

Jia, L. R., Han, J., Chen, X., Li, Q. -Y., Lee, C. -C., & Fung, Y. -H. (2021). Interaction between Thermal Comfort, Indoor Air Quality, and Ventilation Energy Consumption of Educational Buildings: A Comprehensive Review. *Buildings*, *11*(12), 591. https://doi.org/10.3390/buildings11120591

Khambadkone N. K., Madhumati P, & Ranganath M. N. (2022). Thermal comfort evaluation in architectural studio classrooms – A summer study in a warm to moderate Indian climate. *Indoor and Built Environment*, 31(9), 2331-2365. doi:10.1177/1420326X221098552

Luo, M. (2023). Adaptive Thermal Comfort. In: Wang, F., Yang, B., Deng, Q., Luo, M. (eds) *Personal Comfort Systems for Improving Indoor Thermal Comfort and Air Quality*. Indoor Environment and Sustainable Building. Springer, Singapore. https://doi.org/10.1007/978-981-99-0718-2_2

Madhavi, I. (2010). Adaptive use of natural ventilation for thermal comfort in Indian apartments. *Building and Environment*, 45(6), 1490-1507, https://doi.org/10.1016/j.buildenv.2009.12.013.

Ming, H., Kai, Z., Quynh, N., & Tolga, T. (2023). The effects of passive design on indoor thermal comfort and energy savings for residential buildings in hot climates: A systematic review. *Urban Climate*, 49, 101466, doi:10.1016/j.uclim.2023.101466

Mohamad, N. A. N. A., Muhammad, A. K., Azian, H., Chong, Z. Y., Amir, A. M. D., & Mohd, S. S. M. (2022). A Pilot Study on Investigation of Thermal Sensation Votes (TSV) and Students' Performance in Naturally Ventilated Classroom. *Environment and Ecology Research*, 10(4), 508-517. DOI: 10.13189/eer.2022.100409.

Mohamad, N. A. N. A., Azian, H., Chong, Z. Y., Muhammad, A. K., Amir, A. M. D., Mohd, S. S. M., & Hashim, K. (2023). Influence of Air Velocity on Thermal Comfort and Performance of Students in Naturally Ventilated Classrooms in Tropical Climate E3S Web of Conf., 396(2023) 01116 DOI: https://doi.org/10.1051/e3sconf/202339601116

Moktan, B., & Uprety, S. (2023). Improving classroom thermal comfort of educational buildings: Case of Kantipur City College. *Journal of Engineering Issues and Solutions*, *2*(1), 93–110. https://doi.org/10.3126/joeis.v2i1.49486

Munonye, C., Ifebi, O., Maduka, N., & Ngobili, M. (2023). An Overview of Implications and Suggestions for Reducing Temperature Rise in Buildings Located in the Tropics. *Research & Development*, 4(1), 20-26.

Munonye, C., Ngobili, M., Umeora, C., Oluchi, I., Maduka, N., & Onwuzuligbo, C. (2023). Comparative Analysis of Comfort Temperature of School Children and Their Teachers. *Research & Development*, 4(1), 27-39.

Munonye, C., & Ifebi, O. (2018). Assessing Thermal Comfort in Relation to Building Designs: A Case Study of Naturally Ventilated Studio Classrooms in A Warm and Humid Uli, Nigeria. *Academic Journal of Science*, 8(01), 121-132

Niculae, R. L. (2011). The Virtual Architectural Studio – An Experiment of Online Cooperation. *Review of Applied Socio-Economic Research, Pro Global Science Association*, 1(1)38-46, https://ideas.repec.org/a/rse/wpaper/v1y2011i1p38-46.html

Nwalusi, D. M., Obi, N. I., Chendo, I. G., & Okeke, F. O. (2022). Climate-Responsive Design Strategies for Contemporary Low-rise Residential Buildings in the Tropical Environment of Enugu, Nigeria. *IOP Conference Series: Earth and Environmental Science,* DOI: 10.1088/1755-1315/1054/1/012052

Obi-George, L. C., Ifebi, O. C., Nwokorie, A. J., Maduka, N. M., Ibe, P. C., Okoro, O. N., & Iweha, C. M. (2024). Thermal Comfort in Residential Buildings: A Case for Building Material Efficiency on Occupants Wellbeing. *International Journal of Innovative Environmental Studies Research,* 12(3), 174-197.

Okafor, M. U., Awuzie, B. O., Otasowie, K., Marcel-Okafor, U., & Aigbavboa, C. (2022). Evaluation of Indoor Thermal Comfort Conditions of Residential Traditional and Modern Buildings in a Warm-Humid Climate. *Sustainability*, *14*(19), 12138. https://doi.org/10.3390/su141912138

Pekdogan, T., & Avci, A. B. (2022). *A Field Study on Adaptive Thermal Comfort in A Naturally Ventilated Design Studio Class during the Post-Pandemic Period*. Universiti Putra Malaysia Press 2. 80-86. DOI: 10.47836/AC.15.2.PAPER09

Qays, M., Mat-Sulaiman, M. K. A., & Mohamed, M. F. (2023). Passive Cooling Strategies in the Hot-Humid Climate: A Review Study. *ARID International Journal for Science and Technology*, 76-106. DOI: 10.36772/arid.aijst.2023.6115

Ranjbar, Ali. (2019). The effects of thermal comfort and indoor air quality in design studios and classrooms on student performance were analyzed. *IOP Conference Series: Materials Science and Engineering*, 609, 042086. doi: 10.1088/1757-899X/609/4/042086

Santos, M. M., Ferreira, A. V., & Lanzinha, J. C. G. (2022). Passive Solar Systems for the Promotion of Thermal Comfort in African Countries: A Review. *Energies*, 15(23), 9167. https://doi.org/10.3390/en15239167

Shan, X., Melina, A. N., & Yang, E. (2018). Impact of indoor environmental quality on students' well-being and performance in educational buildings from a life cycle costing perspective. *Journal of Cleaner Production,* 204, 298-309, https://doi.org/10.1016/j.jclepro.2018.09.002.

Shanthi-Priya, R., Shabitha, P., & Radhakrishnan, S. (2020). Collaborative and participatory design approach in architectural design studios, *Social Sciences & Humanities Open,* 2(1), 100033, https://doi.org/10.1016/j.ssaho.2020.100033.

Siwczuk, N., Piotrowski, J., & Honus, S. (2024). Investigation of Thermal Comfort, Productivity, and Lighting Conditions in Higher Education Buildings. *Rocznik Ochrona Środowiska*, 26, 30-40. 10.54740/ros.2024.003. https://ros.edu.pl/images/roczniki/2024/003_ROS_V26_R2024.pdf

Swarooprani, K. (2022). An Study of Research Methodology. *International Journal of Scientific Research in Science, Engineering and Technology (IJSRSET),* 9(3) 537-543. https://doi.org/10.32628/IJSRSET2293175

Vecchia, L. D., da Silva, A., & Pereira, A. (2009). Teaching/Learning Architectural Design based on a Virtual Learning Environment. *International Journal of Architectural Computing*, 7(2), 255-266. doi:10.1260/147807709788921976

Verma, E., & Srivastava, S. (2023). The Role of Passive Design Techniques in a Comfortable Indoor Environment: Comparison between Tradition & Modern Architecture in Hot Climate. *Ijraset Journal for Research in Applied Science and Engineering Technology,* https://doi.org/10.22214/ijraset.2023.54444

Xiaowen, S., Yanping, Y., Zhaojun, W., Wei, L., Liu, L., & Zhiwei, L. (2024). Human thermal comfort in non-uniform thermal environments: A review. *Energy and Built Environment,* 5(6), 853-862. https://doi.org/10.1016/j.enbenv.2023.06.012.

Yousef, A., Mohammed, A., Katafygiotou, M., Ahmed, M., Amit, K., & Elsarrag, E. (2016). Impact of indoor environmental quality on occupant well-being and comfort: A review of the literature. *International Journal of Sustainable Built Environment,* 5(1), 1-11. https://doi.org/10.1016/j.ijsbe.2016.03.006.

Zeyad A. A., Mohd-Isa M. H, Noor, F. A., & Faizal, B. (2022). A Comparison in Perception of Local and Foreign Residents to Thermal Comfort in Naturally Conditioned Residential Buildings. *Journal of Advanced Research in Fluid Mechanics and Thermal Sciences*, *100*(3), 78–91. https://doi.org/10.37934/arfmts.100.3.7891

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A Methodological Approach to Historic Building Conservation: A DSS for Restoration Project Process Optimisation

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Abstract This study investigates ongoing project submission and evaluation processes in institutions responsible for restoration projects in Turkey to accelerate processes by digitising and transferring restoration project submission and evaluation processes to a digital environment for sustainable conservation and to ensure resilient archives. The proposed method is based on domain knowledge acquisition and content analysis of multiple interviews. The study hypothesised that a decision support system (DSS) would be suitable for digitalising the process because both systems perform on flowcharts. The interviews were conducted based on content analyses of multiple structured stakeholder interviews. The process flowchart was evaluated based on stakeholder interviews. Their responses revealed strengths and weaknesses that can be used in future studies. By mapping out the existing legislation-based workflow, this study aims to lay the groundwork for a more efficient, digitised system to manage restoration projects in Turkey. One of the most important findings was that the restoration project submission and evaluation process evolved over the years, and the councils compensated for the insufficient definitions of the related legislation. Under these terms, a common medium is necessary to support our analyses of the need for DSSs. This study is an example of a process surveying explicit processes defined in legislation and tacit, experience-based processes.

Keywords Decision Support Systems · Restoration Project Processes · Sustainable Conservation · Domain Knowledge Acquisition

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Introduction

Conservation and restoration of cultural heritage are important, not only because they safeguard the traces of former sociocultural, socioeconomic, and sociopolitic trends and movements of civil history, but also because restoration provides a solution for sustainable development in terms of carbon emission, energy efficiency, and usage of new resources; like Cunningham (2002) suggests as revitalising the already occupied domain rather than expanding it. Similarly, in current ecological architecture approaches, large-scale transformations are replaced by small-scale approaches focused on transforming the system to a more ecological point while preserving the intrinsic value of the city (Boyacioglu et al., 2020). Power (2008) discussed the case, and questions whether demolishing or refurbishing existing building stock is more efficient in terms of energy use. A complementary study about life cycle analysis (LCA) is made by Caruso et al. (2020) to suggest a framework for identifying building renovation strategies that lead to an optimal balance, considering both economic and environmental impacts. On the other hand, Liao et al. (2023) found that although refurbishment is a must, economic and policy barriers as well as design obstacles exist. At this point, an effective approach for solving this multi-layered problem could be useful. By nature, a DSS can provide this option as it concentrates more on improving effectiveness and can employ evolutionary and "middle-out" design strategies (Klein and Hirschheim, 1985).

This study proposes a multilateral framework for Turkey's conservation and restoration procedures by mapping resolution no. 660 "*Grouping, Maintenance and Repairs of Immovable Cultural Properties*" (1999). Resolution no. 660, by its nature, gives the general outlines of the restoration project submission and evaluation process and is used as guidance support at the Regional Councils for the Conservation of Cultural Property. The Regional Councils are under the High Council for the Conservation of Cultural Property, which is under the Ministry of Culture and Tourism in an organisational hierarchy. This study examines the ongoing bureaucratic approval processes for restoration projects in relevant Turkish public institutions. This research aims to address the restoration project submission and evaluation processes and propose an adaptable and sustainable restoration framework based on (a) domain knowledge acquisition in architecture by local authorities in Turkey and (b) the United Nations Sustainable Development Goals (UN-SDGs) through digitisation. The outcome of this study; the adaptable multilateral framework for restoration project processes in Turkey (local impact), could facilitate the restoration project submission and evaluation processes in developing countries (global impact).

Although UN-SDGs are for global purposes, the contribution and participation of local authorities are also crucial. Khalaf (2015) underlined the importance of a participatory approach for defining heritage values. This aligns with the ICOMOS' *Declaration of Amsterdam* (1975); "*Local authorities, which whom most of the important planning decisions rest, have a special responsibility for the protection of the architectural heritage and should assist one another by the exchange of ideas and information.*" The main contribution of our research is to suggest a multilateral framework to bring different institutions at different scales from Turkey and stakeholders involved in architectural heritage preservation together with the help of a DSS and to create a sustainable method for working, communicating, and transferring documents among these different actors for agile governance.

However, conservation and restoration procedures in Turkey are often bureaucratic. The conservation and restoration processes involve diverse stakeholders from different departments and organisations resulting in lengthy and complicated executions. The lengthy and complicated way of executing conservation and restoration procedures decelerates the work and creates a comparably unpopular opinion about restoration.

To popularise conservation and restoration for sustainable urban development, procedures should also be adapted to daily life practices in this digital age, by answering user needs while being efficient, cost-reducing, and economical.

Numerous studies have illustrated the impact of DSSs. One of these benefits is that DSS provides a wide range of solutions for people, whether they work together in a specific office or individually away from each other (Dempster, 1980). DSS also provides many benefits as it allows a better understanding of the business, fast response to unexpected situations, control, and more effective teamwork. (Keen, 1981). On the one hand, it is also claimed that these benefits are not humanistic and do not consider human needs; on the other hand, it was also explained that using DSS can lead to decision making, which stimulates initiative, creativity, and flexibility throughout the organisation (Klein and Hirschheim, 1985). With the help of DSSs, the conservation and restoration of architecture processes can be streamlined, allowing for more efficient collaboration and open knowledge sharing among diverse stakeholders.

The main research question is;

- *How can a multilateral framework be proposed to optimise restoration project submission and evaluation processes in Turkey?*

Building on these investigations, this study aims to lay the foundation for more efficient restoration project management in architectural heritage conservation by mapping out existing workflows in Turkey, detecting problems that are not seen unless you are included in the procedures, suggesting solutions for the root causes of those problems, and digitising the restoration project submission and evaluation process. This research offers a methodology that can also be adapted and used for any kind of tacit knowledge-based process digitisation involving both written and un-written processes, which can also be useful for digitising intangible heritage examples with similar processes. By translating resolution no. 660 into a flowchart, as in this study, the nodes formed by repetitive actions during the restoration project process until an appropriate outcome is obtained. These nodes are also useful for understanding the nature of the process and making it possible to question whether the cause depends on the resolution, technology, or related stakeholder.

As an answer to the main research question: *How can a multilateral framework be proposed to optimise the restoration project submission and evaluation processes in Turkey?*, a more optimised and technology-enabled process could benefit all stakeholders and for the transfer of knowledge, the best-fitting medium for this case is a DSS because it increases the number of the examined alternatives, can provide a better understanding of the business, enables fast response to unexpected situations, control, cost and time savings, more efficient teamwork, and makes better use of the data resource (Keen, 1981).

This paper is structured into four sections following this introduction. In Section 2, The Literature Review provides the background for the proposed multilateral architectural conversation and restoration framework and explains current conversation technologies in the world and the situation in Turkey. Section 3, Methods explains the steps of the study and the techniques used to acquire domain knowledge acquisition. Section 4, Results lists the research findings and provides the necessary information for developing a new framework. Section 5, Discussion shows the potential of the new framework and finally Section 6, Conclussion defines ways for further studies.

Literature Review

The works on digitalisation in the conservation field are grouped around a few different trends in visualisation, documentation, construction technologies, fabrication, and administration. These trends are

mostly grouped as; reconstruction or three-dimensional modelling, Heritage Building Information Modelling (HBIM), risk analysis and imaging, documentation of tangible and intangible cultural heritage, technological studies on materials used during conservation, visualisation of the cultural heritage using virtual reality (VR), augmented reality (AR), or mixed reality (MR) techniques, 3D scanning, and digital museums (Yuan et al. 2023). These trends are primarily used for the education, teaching, and application purposes of cultural heritage. On the other hand, there are studies on the digitalisation of administrative processes (Kourakou et al. 2014, Nikolina et al. 2020, Pelse et al. 2021), but these studies are in different fields than restoration. However, the aforementioned studies are being conducted worldwide. Kourakou et al. (2014) took this topic from an e-government perspective and used case studies from three Swiss cantons. Nikolina et al. (2020) made their study about the digitalisation of public management at the territorial community level in Ukraine. Pelse et al. (2021) focused on the diversity of institutions. They conducted their research on four different public administration institutions in Latvia and compared their digitalisation levels.

In Turkey, studies are mainly carried out in fields such as public administration, information systems, and documentation management. Kudde et al. (2019) completed a project that the Directorate of Cultural Heritage Preservation of Istanbul Metropolitan Municipality initiated as an inventory project in 2015. This study aims to create a digital database accessible to multiple stakeholders. Tuna et al. (2015) also carried out a similar project in Edirne, Turkey and they resulted in their study with a web-based platform that is publicly accessible. Merdan (2022) questions the digitalisation of governmental services and compared traditional and e-government services by referring to early e-governance studies at the beginning of the 2000s. Göksan (2023) took this comparison and discussed the benefits and the problems of the digitalisation of public administration. When the PhD theses on conservation in the field of architecture in Turkey since 1983 were examined, 15 out of the 284 theses are on information and communication systems (https://tez.yok.gov.tr/_UlusalTezMerkezi/tezSorguSonucYeni.jsp). Only 4 of these 15 studies were on decision support or information systems.

On a global scale, some studies have reported on the use of DSSs in the conservation field. An AI-based DSS has been proposed for the preventive conservation of museum collections in historic buildings. Another study was conducted by Di Matteo et al. (2021) to develop a DSS framework for cultural heritage management with similar concerns parallel to this study, but their case study applied the framework to a museum and its management. Acampa et al. (2023) conducted their study on a bigger scale and suggested an evaluation system for the management of interventions in the Historic Centre of Florence by using a DSS. As DSSs provide resilience for the archiving and management of processes, Ripp et al. (2024) conducted a study about the integrity of resilience in practical cases and used the European research projects SHELTER and ARCH to determine whether a practicable integration of resilience with planning and development practices surrounding urban heritage was possible.

Methods

The requirements for restoration projects in Turkey were categorised and visually presented as a list. This list was transformed into a mind map, relating items to Information and Communications Technology (ICT) terms (Figure 1). The mind map indicates that a DSS is suitable for digitising the process. The relevant legislation was converted into a flowchart to digitalise the process in a DSS (Figure 2). This identified the main steps and actors. The interviews were conducted based on content analyses of multiple structured stakeholder interviews prepared from the flowchart points. These interviews were conducted after stakeholders

clearly declared their consent to be a part of this study, and they were recorded on camera immediately before the interviews began. This was explained to the Ethics board and their approval for this study.

The flowchart was evaluated based on stakeholder interviews. Their responses revealed strengths and weaknesses that will inform future studies on the use of DSSs in architectural conservation and restoration field.

Figure 1

Mind map of the project requirements list and ICT tools.

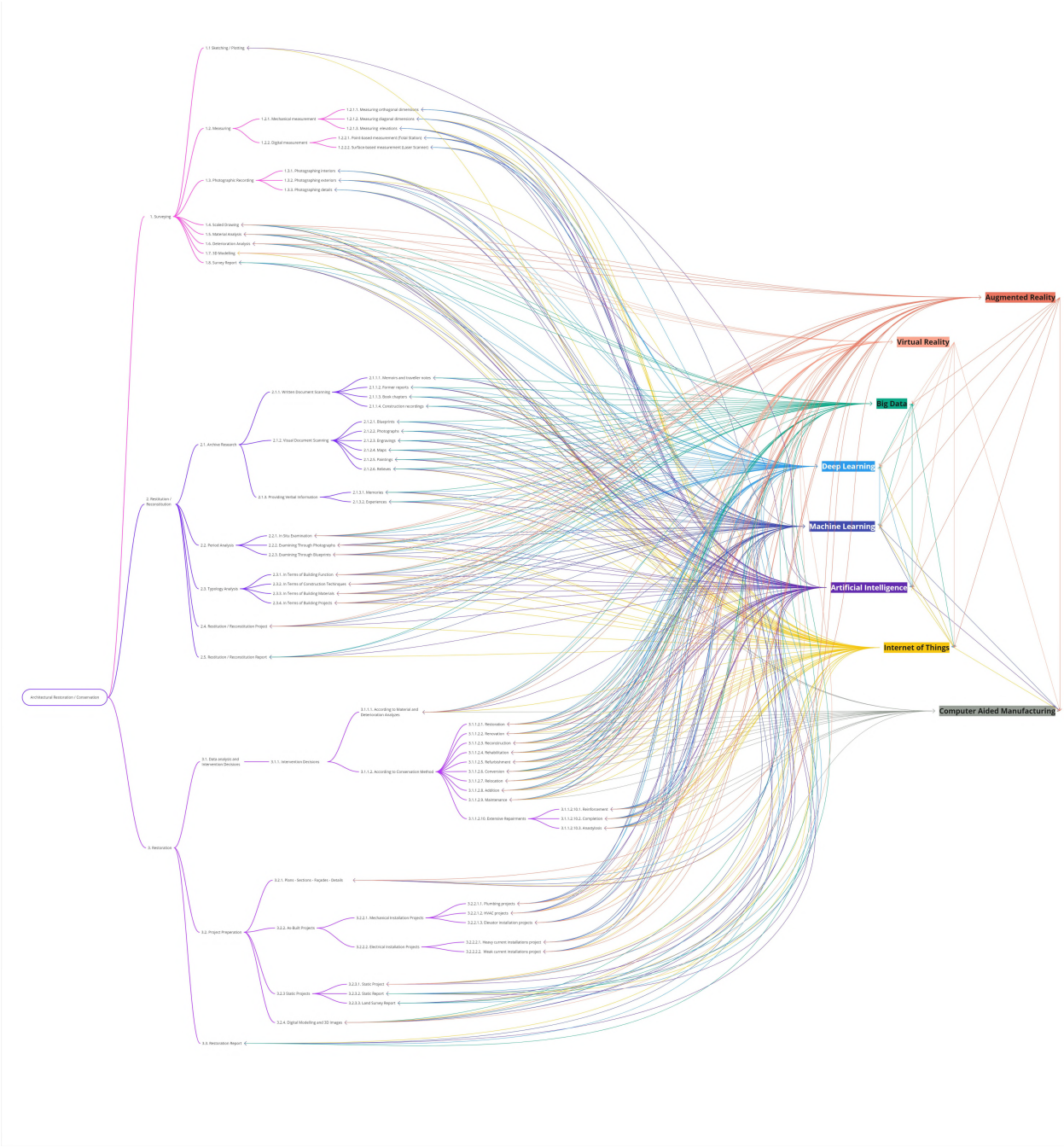
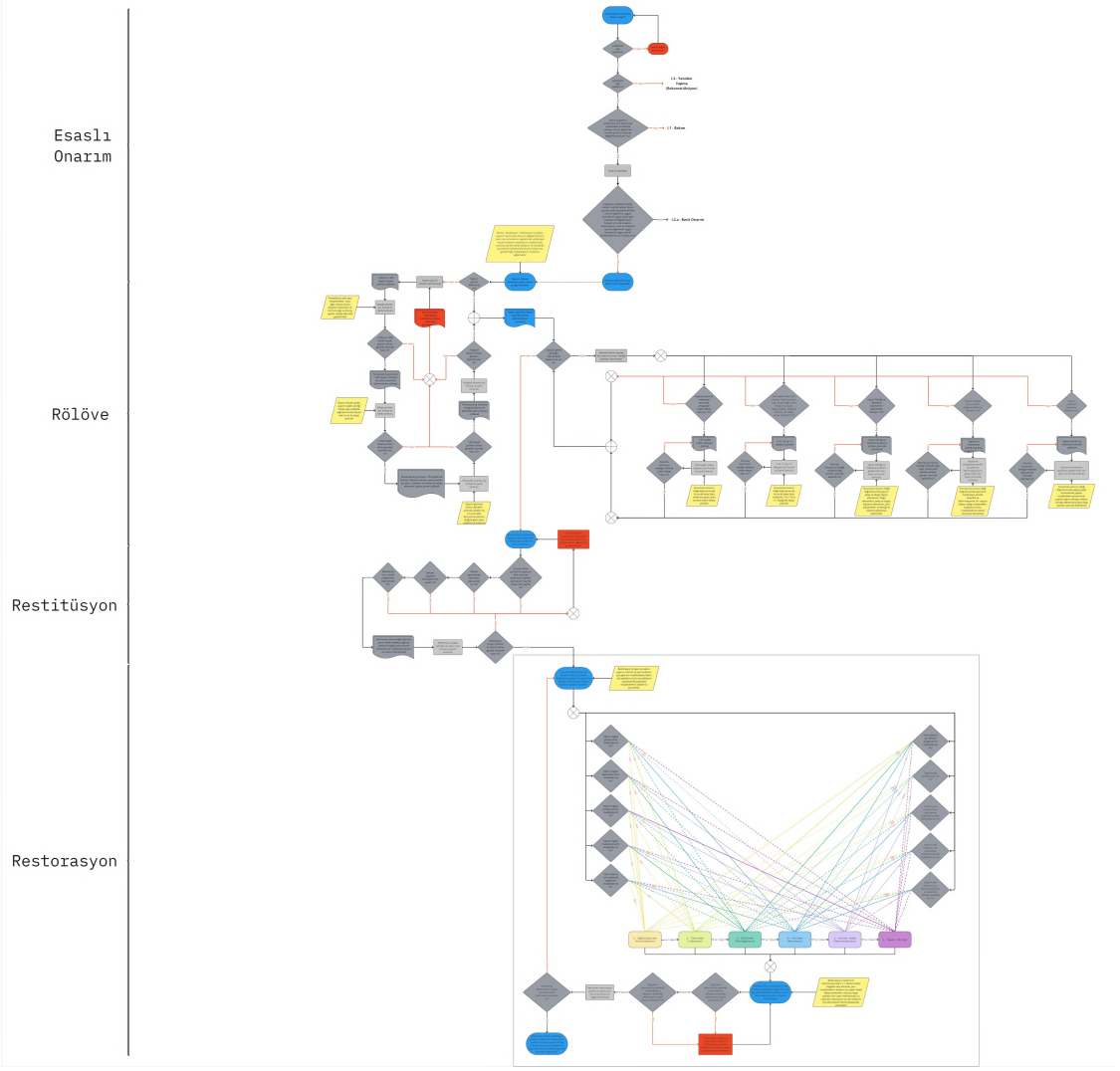


Figure 2

Flowchart of project process according to Resolution No. 660



In these concerns and respects, this study's main question is whether the restoration project process can be transformable into a digital medium so that the data gathered through the process can be stored, analysed, and monitored by the related stakeholders and institutions within a multilateral framework. Several sub-research questions were formed while searching for the answer to the main question. The first sub-research question was whether resolution no. 660 is up-to-date and meets the restoration project process's needs. The second sub-research question was whether the needs have changed or new needs have appeared over time, and how do the councils adapt to this change. Finally, the third sub-research question is as follows: was whether a multilateral framework was needed to optimise the restoration project submission and evaluation processes in Turkey.

The methodology used in this study is based on domain knowledge acquisition in architectural conservation and restoration. As Alexander and Judy (1988) define; domain knowledge is a realm of knowledge that individuals have about a particular field of study, so domain knowledge encompasses declarative (knowing that), procedural (knowing how), and conditional (knowing when and where) knowledge, which can operate

at a tacit or explicit level (Alexander, 1992). Domain knowledge acquisition provides a way to understand the bureaucratic processes that are executed tacitly due to the nature of the expertise. To obtain domain knowledge the process followed these steps;

1) Write down the whole architectural conservation and restoration project submission and evaluation process explained in resolution no. 660 as a flowchart and visualise the process.
2) Preparing a questionnaire according to the process steps and nodes formed by repetitive actions in the flowchart.
3) Differentiating participants from different positions in the process depending on their contribution to the process.
4) Questioning the participants through structured interviews and analysing their answers to detect obvious and hidden problems with the first flowchart.
5) Suggesting a multilateral and adaptive architectural restoration and conservation framework for councils.

Results

To answer the main research question and understand the existing situation in Turkey's restoration project submission and evaluation process, first the resolution is transformed into a flowchart and visualised the process. After visualising the existing steps, a clear distinction appeared. The resolution defines the possible interventions under three main fields; the first one is basic repair, which covers the basic interventions like painting, fixing, or changing the woodwork and similar actions, that need no specific expertise; the second one is major repair, which covers the conservation-related interventions that need certain specific expertise; and the third one is reconstruction, which covers the whole project process of reconstruction that needs both; certain specific expertise and sufficient documents for reconstruction to verify the cause. As the purpose of this study is to scan and identify the problematic points of the restoration project process and the resolution related to it, the context of the study is limited to the restoration project processes of commercial and residential buildings under major repair. As they have a lesser amount of additional procedures than other conservation interventions such as reconstruction. Although their restoration project processes are also classified under extensive maintenance, monuments and monumental buildings were also excluded because of their need for different fields of expertise during the whole project process.

The next step after this segregation was to understand the situation. The first sub-research question was whether the existing resolution was still applicable, as it was dated back to 1999. We asked whether the project submission was still made, as defined in the resolution. This question was useful to form the first part of the questionnaire. In the first part, the submission content and format was questioned. The process was very clearly separated into three major drawing sets; surveying, restitution, and restoration (This term may have different meanings in other countries but in Turkey, it is related to the overall action, rather than narrowing the intervention options under a single alternative). In the following parts of the questionnaire; the process's surveying, restitution, and restoration sets were questioned. For each of the three drawing sets, the same set of questions were asked;

1) How should a submission be made? Can the three different drawing sets be submitted together or separately? What are the pros and cons of submitting the drawing sets together and separately? Does it affect the pace of the project evaluation process at the councils?

2) Is the bare minimum for the restoration project submission as described above? Is there any request for another set of drawings that is not mentioned in resolution no.660 but demanded by the councils? (This question was useful in searching for the answer to the second sub-research question; if the needs have changed or new needs have appeared over time, how do the councils adapt to this change?)
3) How should a submission be named "an ideal submission"? What should it contain? Can you anonymously provide examples from real cases without violating the confidentiality of the cases?
4) How should a submission be made that can be defined as "the perfect storm"? What must it not contain? Can you provide examples from your professional experience or anonymously from real cases without violating the confidentiality of the cases?
5) Is the format and medium for submission and presentation of the projects are sufficient? Are there any limitations related to the format and/or medium of the submissions?

A qualitative and exploratory research approach was used that included structured interviews with eleven experts from three different positions of the restoration project process; the professional architect as the project author, the council corresponder as the project controller for the Regional Councils for the Conservation of Cultural Heritage, and the expert board member, as the decision maker for the Regional Councils for the Conservation of Cultural Heritage. These three expert groups were chosen according to the process structure. The project author's expertise was needed to prepare and submit the drawings so that the process could begin. The project controller's expertise was needed to control submissions to determine their proficiency and lead the process until submissions were ready to be presented to the board. Finally, decision-makers' expertise was needed to evaluate the submission and conclude the process. According to this setup, the selection criteria for these eleven experts were their working and project preparing, controlling and evaluating locations in Turkey. The selection was attempted to be made as the expertise covers as many as different locations possible.

Since the answers were obtained through domain knowledge acquisition, the expert conducting the interview had to interpret the answers given within the framework of his/her expertise. In light of all the information obtained from the interviewed experts, a very clear answer emerged for the first sub-research question; "*whether the resolution no. 660 is up-to-date and meets the restoration project process's needs*". There is a marked difference between the definition of the process as written in the resolution and practice. The infrastructure and facilities required to prepare a substantial restoration project have changed significantly in the last 20 years. The new available mediums have created new alternatives in terms of the content and presentation techniques of the projects. Another change is that the techniques applied in the field of analysis and conservation can be customised to finer details by the use of advanced technology. This allows for case-specific and problem-specific solutions to be developed, rather than generalisations of intervention decisions and techniques, which is more compatible with the definition in ICOMOS' *Washington Charter* (1975); "*4. Conservation in a historical town or urban area requires prudence, a systematic approach, and discipline. Rigidity should be avoided since individual cases may present specific problems.*".

The answer to the second sub-research question; "*whether the needs have changed or new needs have appeared over time, how do the councils adapt to this change*." was also given during the interviews. The bare minimum requirements for the project submission are not enough anymore. Extra requirements mentioned in the resolution became a part of the standard submission. In addition to this change, some regional councils have begun to demand a "credibility sheet" from the project authors to add to their submissions. Resolution no. 660 set the format and described the requirements for project submissions to councils in

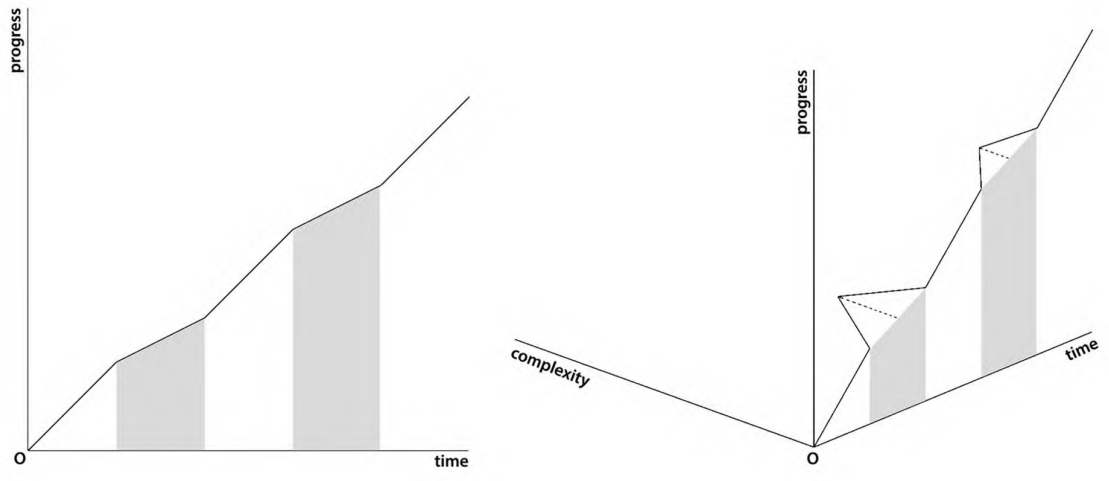
1999. Today, as the cases become more detailed and multilayered, the regional councils try to fill the void palliatively, as resolution no. 660 lacks the answers to newly emerged needs. To standardise all the process formats among regional councils, a multilateral medium is needed to bring all stakeholders together within a DSS.

The need answers the third sub-research question; "*whether a multilateral framework is needed to optimise the restoration project submission and evaluation processes in Turkey*". There are several reasons for this need. First of all, as mentioned earlier, there is an optimisation problem among the council standards. Second, during the COVID-19 pandemic, it was experienced that existing workflows were mostly for offline practices, and the voids in the workflows were completed by the experts' experience. Work definitions or workflows do not have clear steps to follow. This causes problems when usual processes should be completed online or remotely, and this situation affects the pace of progress.

Furthermore, some other results were obtained although they were not expected. The pace of the project's progress also changed under urgent conditions. Abandoning the idea of protecting cultural heritage for rent and profit or the risk for the loss of cultural heritage due to disasters, such as earthquakes and fires, is the reason for urgent actions. Another obtained point was that in cases such as the cultural heritage has vital importance, such as hospitals, that also requires restoration; fast progress is only possible if board members, as the decision-makers, are experienced. This situation affects the pace of progress. The regional councils with such experienced board members can evaluate cases rapidly, whereas councils lacking this expertise need more time to evaluate such cases. The graph on the right shows the reason for the change in the pace of progress of undefined areas in the process by adding the complexity axis for undefined and/or emergent cases. This also shows that the process timeline is not linear but rather planar. Therefore, a flowchart with multiple dimensions would be more useful than a linear flowchart (Figure 3).

Figure 3

Workflow graph and undefined areas in the process on the left (marked with grey areas).



In some cases, this difference in expertise can affect the evaluation criteria and the requirements demanded by the councils during the project submission phase. Documentation was also mentioned during the interviews. The drawings that are submitted to the councils may have changed during the execution of the decided interventions. If the project author has missed updating the project, the document in the

archives and the completed intervention will be at two different points. Finally, the risk of data loss over the years due to the way documents are stored was also mentioned. This risk validates the need for digitalisation of the councils but neither the councils have sufficient tools for that transformation nor the infrastructure is adequate. On the other hand, to protect the confidentiality of the cases sampled for this study, the problems were not exposed with all the details in order not to implicate the institutions or the authors. This is also a problem that makes it difficult to control cases.

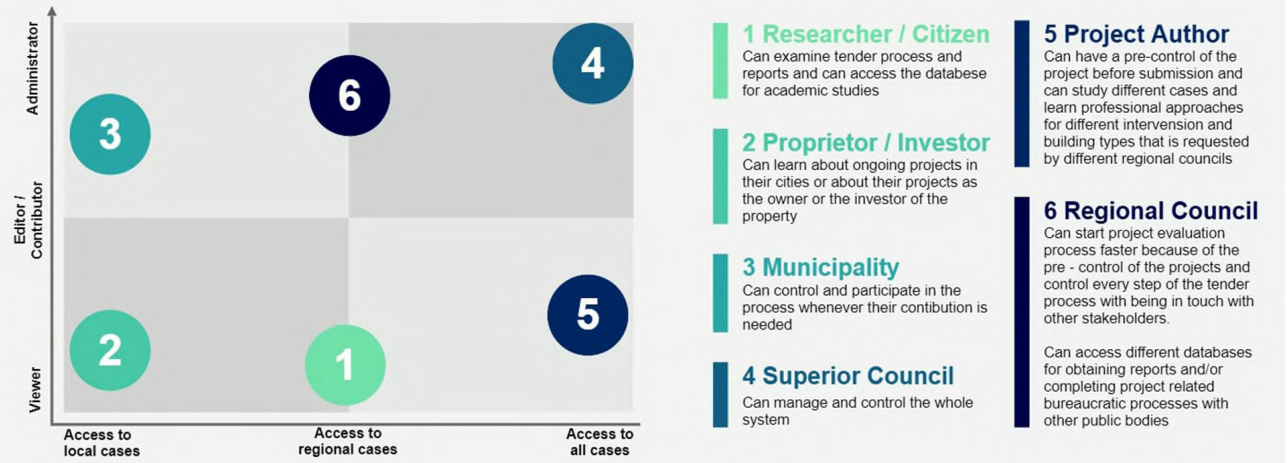
Discussion

The world is heading to a digital future, and there are some efforts to digitise the existing daily practices. Particular fields such as; communication, management, and archiving are getting digitised rapidly due to their adaptable nature. On the other hand, private and public institutions that function within these fields are not equally adaptive although their organisations and workflows are alike. Private companies and institutions are more adaptive to paradigm changes, depending on their agile nature. In contrast, public institutions are not very adaptive to paradigm changes because their bureaucratic procedures can be lengthy and complicated if more than one department, let alone an institution, is involved in the process.

According to the findings of this study, the need is to create a system so the process can be adaptable among different councils. Creating a digital archive that can be accessible by different stakeholders at different levels can be very useful (Figure 4). This database can be stored on the servers of the Ministry of Culture and Tourism and executive authorisation of the Regional Councils for the Conservation of Cultural Heritage would be provided by the High Council for the Conservation of Cultural Heritage within the organisational hierarchy. This flowchart for the DSS also allows the digitisation of the process at various scales and contents, with the possibility of describing the work of the stakeholders involved in the process in the flowchart. The digitisation of the system allows the process to be less bureaucratic and accessible to different stakeholders at a faster and wider scale. Another advantage of this system is that in cases where councils need to assign employees for certain files due to the insufficient number of staff they have, employees access through the system that allows the process to be examined through an inter council system.

Figure 4

The DSS and the database relation over the project authors, coulcils, researchers, citizens, and municipalities' roles.



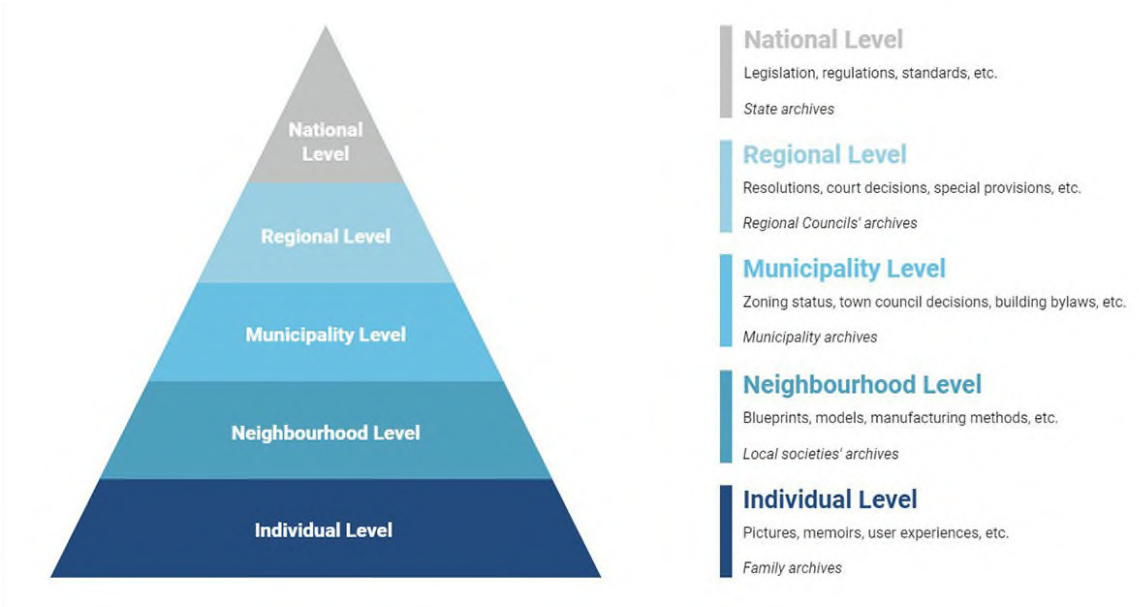
Although all this system formation, standardisation, and digitisation has the potential to enable the process to work with more agility, it does not mean that the entire system should completely be digitised. Especially when the technological development process of the last twenty years is considered, the problems of accessing the data within the media such as floppy disks, or lately with CD/DVDs where all the data in a large period was stored is also a problem. The probability of not having an access or having troubles accessing the data today should not be ignored. Cloud services can be useful in preventing this problem, but copyright and privacy can become an issue between institutions and service providers. This problem can be avoided if public institutions develop servers to store and share their data with authorised stakeholders. In addition, some neutral stakeholders like universities and NGOs should keep independent archives for backup and control of digitally stored data in case it is needed so that the whole process can be transparent and trackable at any point.

Another point is that in case of emergencies, the experience of covering the voids of the flowcharts or undefined areas in the process is vital for the continuity of the process. Digitisation can cause a bureaucratic burden in cases that should be acted swiftly first and then the bureaucracy to follow these actions. If this DSS or similar systems had been established before the catastrophes, such as the Notre Dame fire in 2019 and two devastating earthquakes in Turkey on February 6th, 2023. The recovery process might have been faster and more organised. This point also shows that the digitalisation of this process provides resilience to the protection of data and can be useful globally. It may be useful to underline that the purpose of all this DSS and standardisation is to improve the process, and that is a step towards enhancing the councils' current problems by bureaucratically solving the problematic points in the functioning of the councils. In other words, what should be done is not replacing employees with machines but enhancing them through ICT. As council archives have not yet been completed as digitised, the councils are limiting the database of the councils themselves. Spreading this experience can also be beneficial for on-the-job training among architects, council employees, and researchers. This also matches with the 16th Article of the Venice Charter (1964), which is about the publication of the study and the records; "*...(The reports) should be placed in the archives of a public Institution and made available to research workers. It is recommended that the report should be published*."

This transformation can lead to further changes in council structures. The first change can be related to project formats, and councils may start asking for BIM-based projects rather than only two-dimensional drawings (Arayici et al., 2017). As a result of this basic change, projects and intervention decisions can be saved in council archives both digitally and in printed-out formats. Once the projects are delivered in BIM format, digitisation of the existing archives and the entities in them will not increase in number but can rather be transformed in time. Another advantage might be that if these digital building copies are also stored in a cloud system, the new interventions can be updated on the models simultaneously, and it would be possible to see former interventions on the same element in the model. Further, this cloud service is integrated with blockchain technology, so councils can determine who can access which kind of document according to the kind of authorisation they have. This can also create unity among the councils and archives, but the existing infrastructure and the technological know-how are not adequate for this kind of transformation to be completed (Figure 5).

Figure 5

Graph showing different levels of data; the type of the data and the related archive type.

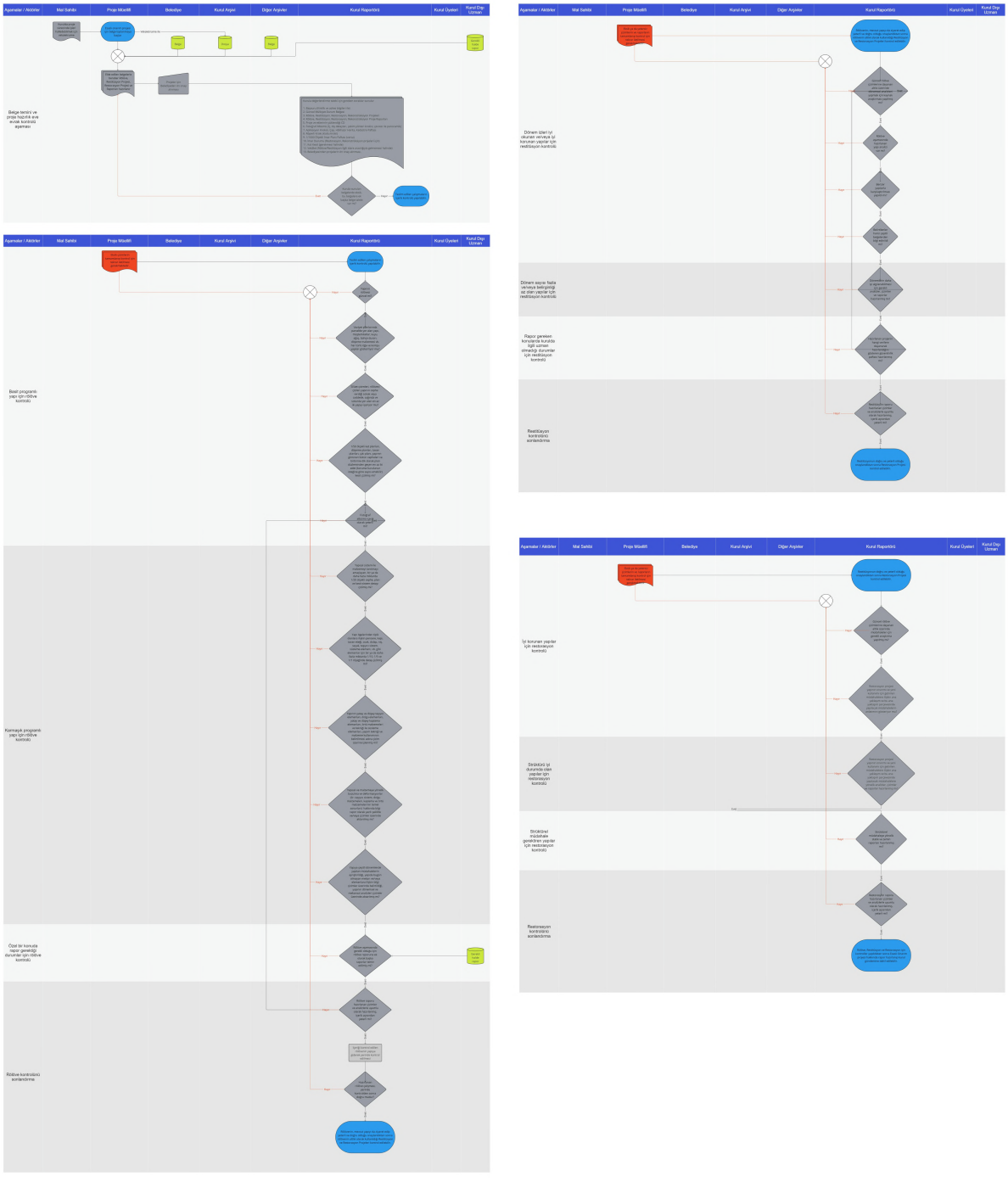


Conclusion

Considering all these factors, a more adaptable, elaborated flowchart is suggested, which is based on the analysis of the first flowchart. Rather than transforming the existing resolution into a flowchart, the ongoing project process is transformed into a flowchart and modified according to resolution no. 660. The second flowchart was prepared as a cross-functional flowchart and various stakeholders were involved in the process who were not mentioned in the resolution. By changing the format, the flowchart became legislation-independent (Figure 6). As the new flowchart is based on the process rather than the resolution itself, even if the law or resolution is updated or changed, the system is expected to be adaptable to these changes. This also allows the system to be used by different countries and councils around the world with similar problems, as discussed above in Turkey's case.

Figure 6

Enhanced flowchart for DSS that can adapt to different needs of different regional councils as well as provide a common basic flowchart for all the councils.



Knowing that as it was recognised in the *Delhi Declaration on Heritage and Democracy* (2017), "*... the role that digital technologies and modern communications now play in heritage management*" it is becoming more crucial to adopt and innovate similar technologies in the conservation field as much as technological advancements allow.

This study can be further elaborated in future studies in several different areas, such as computer science, software engineering, information and document management, information and communication technologies, architectural conservation, and digital heritage. The objective of this study was to create a methodological framework with an exploratory approach by using domain knowledge acquisition. Incorporating existing knowledge into a visual workflow by the validation of the domain knowledge and digitising an existing process is also aimed at transforming empirical experience into DSSs that can be adapted into similar organisations in need of any digitisation process. It can also be elaborated and used for intangible heritage-related topics and can help to form a framework for them in terms of transferring domain knowledge into a digital medium and being more accessible for interdisciplinary research. This digital medium provides another important point: When archiving becomes digital, it will be easier to store domain knowledge from various experts. The DSS creates the software and the network among these experts, making it possible to gather the big data from different interventions within this network using the DSS. After collecting an appropriate amount of data, it will be possible to train artificial intelligence (AI) agents and use them as assistants during similar evaluation processes. This possibility has the potential to be very useful by tracking down all the gathered data and suggesting AI-developed intervention alternatives from the patterns of existing data, even for cases without any useful data to evaluate for intervention.

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References

Acampa, G., Battisti, F., & Grasso, M. (2023). An Evaluation System to Optimise the Management of Interventions in the Historic Centre of Florence's World Heritage Site: From Building Preservation to Block Refurbishment. *Land*, *12*(4), 726. https://doi.org/10.3390/land12040726

Alexander, P. A. (1992). Domain knowledge: Evolving themes and emerging concerns. *Educational Psychologist*, *27*(1), 33–51. https://doi.org/10.1207/s15326985ep2701_4

Alexander, P. A., & Judy, J. E. (1988). The interaction between domain-specific and strategic knowledge in academic performance. *Review of Educational Research*, *58*(4), 375–404. https://doi.org/10.2307/1170279

Arayici, Y., Counsell, J., Mahdjoubi, L., Nagy, G., Ḥawwās, S. Z., & Dweidar, K. (Eds.). (2017). *Heritage building information modelling*. Abingdon: Routledge.

Boyacıoğlu, C., Ayıran, N., & Gökmen, G. P. (2020). Antroposen Çağı'nda Çevreci Mimarlığı Tartışmak: Post-Sürdürülebilirlik. *Mimarlık Dergisi*, *57*(412), 31-35.

Caruso, M., Pinho, R., Bianchi, F., Cavalieri, F., & Lemmo, M. T. (2020). A lifecycle framework for the identification of optimal building renovation strategies considering economic and environmental impacts. *Sustainability*, *12*(23), 10221.

Cunningham, S. (2002). *The restoration economy: the greatest new growth frontier*. Berrett-Koehler Publishers).

Dempster, M. (1980). Issues for the future of DSSs: Integrating Session Summary, Proceedings of an International Task Force Meeting June 23-25, 175-179.

Di Matteo, E., Roma, P., Zafonte, S., Panniello, U., & Abbate, L. (2021). Development of a Decision Support System Framework for Cultural Heritage Management. *Sustainability*, *13*(13), 7070. https://doi.org/10.3390/su13137070

Göksan, G. (2023). *Digitalisation in Public Administration*. In Two Faces of Digital Transformation (pp. 47-57). Emerald Publishing Limited.

High Council for the Conservation of Cultural and Natural Property (1999). *Resolution no. 660. - Classification, maintenance, and restoration of immovable cultural properties The Ministry of Culture and Tourism Website*. Retrieved December 10, 2024 https://kvmgm.ktb.gov.tr/TR-44311/ilke-karari--karar-no-660--karar-tarihi-05111999.html

ICOMOS. (1964). The Venice Charter: International Charter for the Conservation and Restoration of Monuments and Sites. ICOMOS Website. Retrieved December 10, 2024 from https://www.icomos.org/images/DOCUMENTS/Charters/venice_e.pdf

ICOMOS. (1975). *Washington Charter: Charter for the Conservation of Historic Towns and Urban Areas*. ICOMOS Website. Retrieved December 10, 2024

https://www.icomos.org/images/DOCUMENTS/Charters/towns_e.pdf

ICOMOS. (1975). *The Declaration of Amsterdam - Congress on the European Architectural Heritage*. Available at ICOMOS Website. Retrieved 10 December 2024 from https://www.icomos.org/en/charters-and-other doctrinal-texts/179-articles-en-francais/ressources/charters-and-standards/169-the-declaration-of-amsterdam

ICOMOS. (2017). *Delhi Declaration on Heritage and Democracy - The 19th General Assembly of the International Council on Monuments and Sites*. ICOMOS Website. Retrieved 10 December 2024 from https://www.icomos.org/images/DOCUMENTS/Charters/GA2017_Delhi-Declaration_20180117_EN.pdf

Keen, P.G.W. (1981). Value Analysis: Justifying Decision Support Systems, *MISQ*, 1-14

Khalaf, R. W. (2015). The reconciliation of heritage conservation and development: the success of criteria in guiding the design and assessment of contemporary interventions in historic places. Archnet-IJAR: *International Journal of Architectural Research*, *9*(1), 77.

Klein, H.K., & Hirschheim, R. (1985). Fundamental Issues of Decision Support Systems: A Consequentialist Perspective. *Decision Support Systems*, *1*(1), 6-7.

Kourakou, G., Glassey, O., & Evequoz, F. (2014). *The impact of digitisation on the management of administrative procedures: The case of building permits*. In Electronic Government and Electronic Participation (pp. 197-205). IOS Press.

Kudde, E., Erdogan, I., & Ilze, I. (2019). An inventory project on the cultural assets of Istanbul: A model for digitisation of cultural heritage. The International Archives of Photogrammetry. *Remote Sensing and Spatial Information Sciences*, *42*, 693-697.

La Russa, F. M., & Santagati, C. (2021). An AI-based DSS for the preventive conservation of museum collections in historic buildings. *Journal of Archaeological Science: Reports, 35*, 102735. https://doi.org/10.1016/j.jasrep.2020.102735

Li, Y., Du, Y., Yang, M., Liang, J., Bai, H., Li, R., & Law, A. (2023). A review of the tools and techniques used in the digital preservation of architectural heritage within disaster cycles. *Heritage Science*, *11*(1), 199.

Liao, H., Ren, R., & Li, L. (2023). Existing building renovation: a review of barriers to economic and environmental benefits. *International Journal of Environmental Research and Public Health*, *20*(5), 4058.

Merdan, K. (2022). *Digitalisation in public administration: The development process of e-government in Turkey*. The handbook of public administration, 33.

Nikolina, I. I., Hulivata, I. O., Husak, L. P., & Radzihovska, L. M. (2020). Assessment of digitalisation of public management and administration at the territorial community level. Natsional'nyi Hirnychyi Universytet, 2011. *Naukovyi Visnyk*, (5), 150-156.

Pelse, M., Strazdina, L., & Ancans, S. (2021, May). *Digitalisation in Public Administration Institutions*. In Economic Science for Rural Development Conference Proceedings (No. 55).

Power, A. (2008). Does the demolition or refurbishment of old and inefficient homes increase environmental, social, and economic viability? *Energy Policy*, *36*(12), 4487-4501.

Ripp, M., Egusquiza, A., & Lückerath, D. (2024). Urban Heritage Resilience: An Integrated and Operationable Definition Based on the SHELTER and ARCH Projects. *Land*, *13*(12), 2052. https://doi.org/10.3390/land13122052

Tuna, G., Zogo, R., Ciftci, E. E., Demirelli, B., & Tuna, A. (2015). Identification, preservation and management of cultural heritage of Edirne, Turkey by means of a web-based application. *Journal of Balkan Libraries Union*, *3*(2), 36-41.