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Integrating Historic Areas with the Urban Fabric for Sustainable Development: The Case of Diriyah, Saudi Arabia

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Abstract: This research investigates the integration of heritage centers into the urban fabric to achieve sustainable development, with Diriyah in Saudi Arabia as a case study. The study emphasizes the dual objective of conserving cultural identity while promoting socio-economic vitality. The novelty of the research lies in combining Space Syntax analysis with a comprehensive literature review, offering a framework that links spatial configuration with heritage conservation. The methodology compares pre- and post-development scenarios of Diriyah, where global integration values increased by 27% and local connectivity improved by 19%, reflecting enhanced accessibility and potential social interaction. These findings provide evidence-based insights into how heritage preservation can be aligned with contemporary urban planning strategies, contributing to a broader model for sustainable revitalization in historic cities.

Keywords: cultural heritage; heritage and historical centers; sustainable development; integration; diriyah

1. Introduction

Cultural heritage, in both its tangible and intangible forms, constitutes the collective memory and identity of societies. It encompasses historic buildings, archaeological sites, open spaces, and traditions that embody cultural expression. Far from being static remnants of the past, heritage centers play an active role in shaping urban identity, social cohesion, and sustainable development. Cultural heritage, in both its tangible and intangible forms, constitutes the collective memory and identity of societies. It encompasses historic buildings, archaeological sites, traditions, and practices that embody cultural expression. Far from being static remnants of the past, heritage centers actively shape urban identity, social cohesion, and sustainable development. As illustrated in Figure 1, cultural heritage is classified into tangible and intangible categories according to UNESCO, providing a comprehensive framework that will guide the analysis in this research.
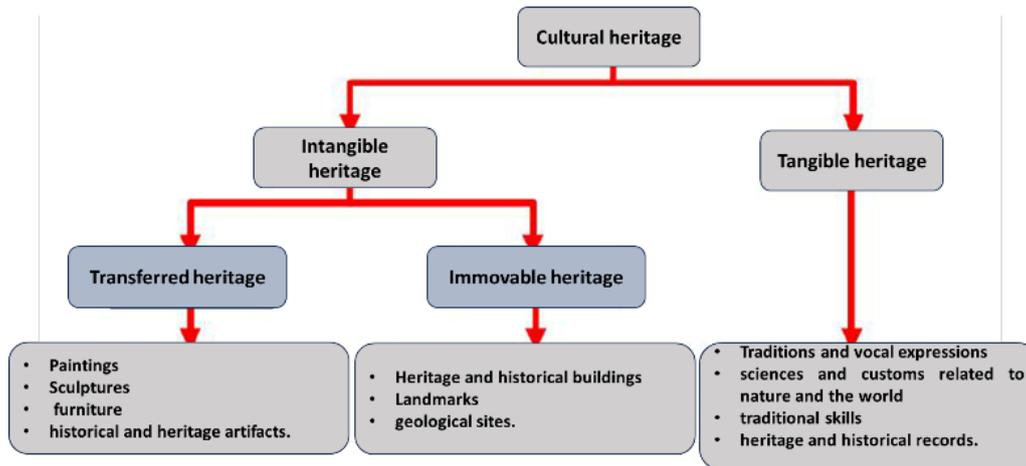
Figure 1. Sections of cultural heritage (tangible and traditional intangible heritage)- Source/Agricultural, relying on the UNESCO classification of cultural heritage.

In the case of Diriyah, cultural heritage is manifested in diverse forms that reflect both human and natural dimensions. The built environment showcases heritage buildings and historic sites, while the natural environment highlights landscapes shaped by nature, such as palm groves and valleys. In addition, archaeological findings and heritage artifacts further enrich the city's cultural identity. As illustrated in Figure 2, these categories demonstrate the multiple layers of heritage that contribute to Diriyah's significance as a living heritage center.

Figure 2. Cultural heritage in the city of Diriyah (tangible heritage and intangible heritage)- Source / Photography by the researchers (January 16, 2024) based on the UNESCO designation for cultural heritage.

However, rapid urbanization and socio-economic pressures in many Arab cities have marginalized these centers, exposing them to physical deterioration, isolation, and the risk of fragmentation from their surrounding urban fabric. This situation undermines their role as living spaces of interaction and continuity (Karim, 2020).

Preserving and integrating heritage (historical) centers within the contemporary city is therefore a strategic necessity. Integration provides multiple benefits: it reinforces cultural identity, enhances social interaction, stimulates economic activity through tourism and creative industries, and contributes to environmental sustainability. International frameworks such as the 1972 UNESCO Convention highlight the urgency of safeguarding cultural and natural heritage as a global responsibility (Karim, 2020).

Which stipulates that both cultural and natural heritage are increasingly threatened by destruction— not only due to losses from traditional factors, but also as a result of changing socio-economic conditions that exacerbate the situation, sometimes resulting in substantial and measurable levels of damage or

destruction (Kenig-Witkowska, 2019).

Cultural heritage is regarded as a broadly applicable analytical and developmental tool—often described as "quasi-universal"—in the sense that its principles of memory preservation, identity reinforcement, and intercultural dialogue can be flexibly adapted across diverse urban and cultural contexts. It is widely recognized as a driver for development, peace, and the establishment of constructive dialogue among different cultures. Therefore, most local heritage centers must receive greater attention and revitalization to qualify for inclusion in the World Heritage list, thereby achieving integration at the local level (by reinforcing community identity and spatial cohesion) and at the global level (by contributing to humanity's shared cultural heritage and universal legacy) (Meskell, 2013)(Al-Hinkawi &, Al-Saadawi, 2019).

While cultural heritage was traditionally represented within a conventional cultural discourse, recent scholarship—drawing on phenomenological and embodiment theories has emphasized that heritage is not merely symbolic but actively experienced through the surrounding environment. In this sense, cultural heritage has come to embody spatial, sensory, and social dimensions, extending beyond preservation to political, cultural, commercial, and educational purposes (Merleau-Ponty, 2012). The preservation, development, and management of cultural heritage is therefore crucial, as it represents the interconnection between history, humanity, geography, archaeology, social anthropology, and the conservation of local heritage (Nilson & Thorell, 2014).

Although the integration of heritage centers with the urban fabric has been addressed in international scholarship, there remains a noticeable gap in contextualizing such frameworks within Arab cities, particularly those undergoing large-scale revitalization projects. This study advances originality in two respects: first, by combining qualitative discourse analysis of cultural heritage with quantitative evaluation through Space Syntax, thus providing a mixed-method framework rarely applied in the Arab context. Second, by examining Diriyah as a unique UNESCO World Heritage site through a comparative lens before and after its recent development the paper demonstrates how integration values can be empirically measured and linked to morphological, social, and symbolic dimensions. Accordingly, the contribution of this research lies in bridging theoretical debates on cultural heritage with applied evidence, offering insights that are both context-specific and transferable to other Arab cities.

This raises several questions: How is heritage perceived in local and regional contexts? How should heritage be preserved? How can the dynamism of heritage be harnessed in integrating sites and addressing the complexities of its preservation? And how can dynamic sustainable development be achieved through the activation of heritage centers? These questions are further examined through the lens of contemporary heritage discourse, particularly scholarship on community heritage, participatory preservation, and decolonizing heritage practices, which provide critical frameworks for understanding how heritage can be perceived, preserved, and integrated within rapidly changing urban contexts.

The close relationship between heritage centers and their surrounding urban spaces determines these centers' ability to continue coexisting and fostering dialogue with their environment, enabling them to adapt despite changes. Literature has also emphasized the importance of heritage centers in forming an identity-based society, where cultural heritage interweaves with identity, since a strong identity is derived from both tangible and intangible elements (Petersen, 2010). Heritage is not only a record of the past but also a resource for future development (McDowell, 2016). This perspective emphasizes the dual role of heritage in both conservation and contemporary use. The cultural landscape approach highlights the relationship between people and their environment (Al-Hinkawi & Mohammed, 2015). It provides a framework for understanding heritage within its broader social and ecological context.

Hillier explained that the enhancement of social relationships plays a crucial role in spatial configuration. The sequence of rituals typical of a community constitutes a short-term social event that can give rise to a spatial system within which a long-term social event unfolds. In this way, designated spaces for specific activities are adapted to support their functions through certain behavioral rules followed by the community, leading the space to evolve into a structured entity (reflecting the compositional depth of cities both holistically and locally) in order to achieve the integration of the urban fabric (Hillier, 1996).

Ting-Lun, Huang, and others explain that what is considered heritage—from architecture to old historical buildings—is classified and protected as part of cultural heritage due to its strong connection to collective memory. They also indicate that various types of places and civic cultural activities can be identified through which communities are built. Collective memories are discovered, playing an important role in the continuity of architecture and society and in achieving integrated community development in terms of cultural heritage (Huang, Juan, James & Lee, 2015; Lafta & Jasim, 2016).

Dacia Viejo, writing on memory and heritage, noted that architecture has become a site for heritage memory because it reflects the identity of community members through collective memory—a memory that has become part of both individual histories and the city's history. Heritage buildings thus possess a

historical and social dimension that remains immortalized in people's memories, reflecting the culture of their city at both local and global levels (Viejo-Rose, 2015).

Heritage and historical buildings form an essential part of the urban body, offering us a contemporary glimpse of the past. Consequently, caring for these centers, preserving them, and re-establishing their interaction with their surroundings are key to integrating them with other parts of the city (UNESCO, 2006).

There are many factors that lead to the devaluation of heritage and historical centers, such as urban renewal policies, social developments, the abandonment of cultural practices, and economic imperatives that slowly erode the historical values of heritage properties. These factors contribute to a decline in the decisions made for their preservation, resulting in a breakdown in the spatial relationship and communication between the historical center and its modern components. Consequently, these centers fail to adapt to rapid developments, leading to their physical, social, and economic decline, and a reduced morphological significance (Ismail Said & Salim Bashir Umar, 2018).

Therefore, revitalizing these centers and reinvigorating their activities in conjunction with the surrounding space—to create a reciprocal relationship between the spatial organization of heritage (historical) centers and their urban fabric—plays a significant role in distinguishing a society's culture from others. This approach stimulates activities and behaviors that reflect the country's culture, achieves the integration of these distinctive sites within the urban fabric, and prevents their future isolation, thereby contributing to the construction of a sustainable city (Hillier, 2009)&(Yamu, van Nes & Garau, 2021).

Accordingly, this research addresses the problem of declining heritage centers in Arab cities, with a focus on the historic city of Diriyah in Saudi Arabia. It examines how the integration of heritage centers within the urban fabric can activate morphological, social, economic, and environmental dimensions, thus fostering cohesion and preventing the creation of isolated or deteriorated urban zones. The ultimate aim is to demonstrate the role of integration in achieving dynamic, sustainable development and ensuring resilient and vibrant urban communities.

To ensure conceptual clarity, this study defines its key terms. Heritage centers are understood as active nodes where tangible and intangible cultural assets intersect with community practices, functioning as hubs for cultural and social interaction. Historical centers are defined as traditional urban cores that preserve inherited architectural forms, urban morphology, and socio-spatial patterns. By contrast, cultural heritage is employed as the overarching umbrella concept that encompasses both heritage and historical centers, including monuments, archaeological remains, and intangible practices of cultural expression. Within this framework, the research adopts Space Syntax as a quasi-universal analytical tool—widely recognized for its ability to evaluate spatial integration and social functionality in diverse contexts.

The paper will begin by reviewing previous studies that specifically examine cultural heritage, heritage and historical centers, and their integration with the urban fabric. It will also discuss the role that such integration plays in achieving sustainable urban development. Following this review, the paper will outline the research methodology, which combines qualitative analysis of heritage discourse with quantitative spatial analysis using the Space Syntax method. This methodological approach enables the measurement of spatial integration, social interaction, and morphological continuity. The paper will then present the discussion and results of the practical application, before concluding with final reflections and recommendations.

2. Previous Studies

2.1. Cultural Heritage and Heritage & Historical Centers

Material and intangible cultural heritage significantly shape the urban image and constitute a vital dimension of urban planning. Tangible heritage, in particular, defines the morphology of cities by generating attractive images, establishing destinations, and providing hubs for social connectivity (Szubert et al., 2021). Recent studies further demonstrate how heritage centers contribute to sustainable urban development, reconfigure spatial relationships, and revive historic areas by integrating them socially and spatially (Naheed& Shooshtarian, 2022). At the same time, heritage centers function as cultural assets with strong symbolic and sensory influence, enhancing spatial awareness, guiding movement, and reinforcing socio-spatial identity at both local and global levels (Szubert et al., 2021, Throsby, 2010).

2.2. Integration of Historical Heritage Centers with the Urban Fabric

Historical heritage centers are vital components of the urban fabric, as their preservation and

revitalization protect cultural legacy while enhancing cohesion, livability, and urban identity (Abdurahiman, Kasthurba & Nuzhat, 2024). Scholars highlight the need to balance preservation with modernization to prevent neglect and isolation (Puren & Jordaan, 2014), while others stress the integration of heritage centers into holistic urban planning strategies that promote cultural, social, and economic sustainability (Muminović, 2020). Case studies in Bogotá and Bologna show how activating heritage centers can drive urban renewal, reshape spatial structures, and reinforce collective identity (Boeri et al., 2019). Similarly, (Al-Saffar, 2017) underscored their long-standing socio-economic functions in Arab cities, calling for renewed strategies to sustain their dual role as cultural and economic hubs. More recent approaches emphasize adaptive reuse as a pathway to sustainable preservation, reinforcing identity while reducing environmental impact (Wen Liang et al., 2023).

Conversely, challenges remain in contexts such as Jordan, where ineffective integration with urban expansion has led to the fragmentation and decline of heritage centers (Sharaf Al-Kheder et al., 2009). Complementary evidence from space syntax analyses reveals that reconfiguring spatial integration enhances pedestrian flow, social interaction, and cultural vitality (Ibrahim, 2025). International charters, such as the Xi'an Declaration (ICOMOS, 2005) and the Burra Charter (Australia ICOMOS, 2013), reinforce this perspective by framing heritage preservation not only as conservation of monuments but as the sustainable integration of historic areas into the dynamic urban fabric.

Collectively, **these contributions affirm that integrating heritage centers into contemporary urban environments is fundamental for achieving cohesive**, **sustainable urban growth**.

2.3. The Role of Integration in Achieving Sustainable Development for Heritage Centers

(Hillier, 1996) showed that movement patterns in traditional structures reveal spatial coherence and aid comprehension of urban form. Similarly, (Alexander, 1973) argued that heritage centers, as products of cumulative growth, form integrated structures in contrast to fragmented modern cities, while (Krier ,1984) linked the absence of cumulative growth to urban disorder. (Lynch, 1960) warned that disconnection between spatial layout and use undermines vitality. (Rapoport, 1977) further stressed the cultural dimension, where block configurations shape social behavior. The Italian School of urban morphology reinforced this view: (Muratori, 1959) and (Caniggia, 1986) emphasized continuous typological transformation, (Rossi, 1982) introduced the "city as collective memory", and (Aymonino, 1975) highlighted typology as a mediating tool between design and urban for Together, these contributions build a theoretical framework for integrating heritage centers into sustainable planning.

In the Arab context confirmed the need for global-local integration (Ibrahim Jwad & Mahdi, 2008), (Al-Hankawi, 2021) showed how road networks alter physical and functional attributes, and (Al-Hakim, 1986) emphasized reciprocal relations between spatial structure and context.

Economic sustainability is also linked to integration: Hillier (1993) noted that connected heritage sites attract commerce and shape land-use planning (Van Nes & Yamu, 2018), while (Kalfas et al. ,2023) found that strategic integration improves urban quality. (Zhen Wang et al. ,2022) highlighted spatio-temporal analysis for mobility, and (Rebwar Ibrahim et al. , 2022) stressed integrated street patterns for vitality. (Roosta, 2021) added that morphology affects resilience by linking infrastructure, form, and networks. (He et al. ,2019) confirmed that permeability fosters sustainability, while (Smith et al. ,1997) tied integration to livability. (Hammoodi & Al-Hinkawi ,2023) and (Li & Lv, 2017) similarly reinforced the role of dense, interconnected networks.

From a sustainability lens, (Guzmán et al. ,2017) connected heritage with environmental justice, UNESCO reaffirmed heritage as a cultural legacy, and (Kurniawan et al., 2011) (Spiliotopoulou & Roseland ,2020) argued for balancing economic, social, and environmental dimensions.

Practical cases in the Arab world further illustrate these principles: Al-Hafsia in Tunis combined revitalization, job creation, and community participation (Cherif & Jrad, 2019); Fez Al-Djadid pursued modernization without undermining its historic core through dedensification and local elite involvement (Alami & El Khazzan, 2017). Ghardaia in Algeria preserved vernacular morphologies and social identity (Diafat, 2019). Bastakia in Dubai applied adaptive reuse to transform traditional houses into cultural hubs (Aga Khan Trust for Culture, 2011), and Jeddah's Al-Balad leveraged conservation and adaptive reuse for tourism and socio-economic renewal (Sampieri & Bagader, 2024). Collectively, these cases show that Arab heritage centers are not only cultural symbols but active drivers of identity and urban vitality.
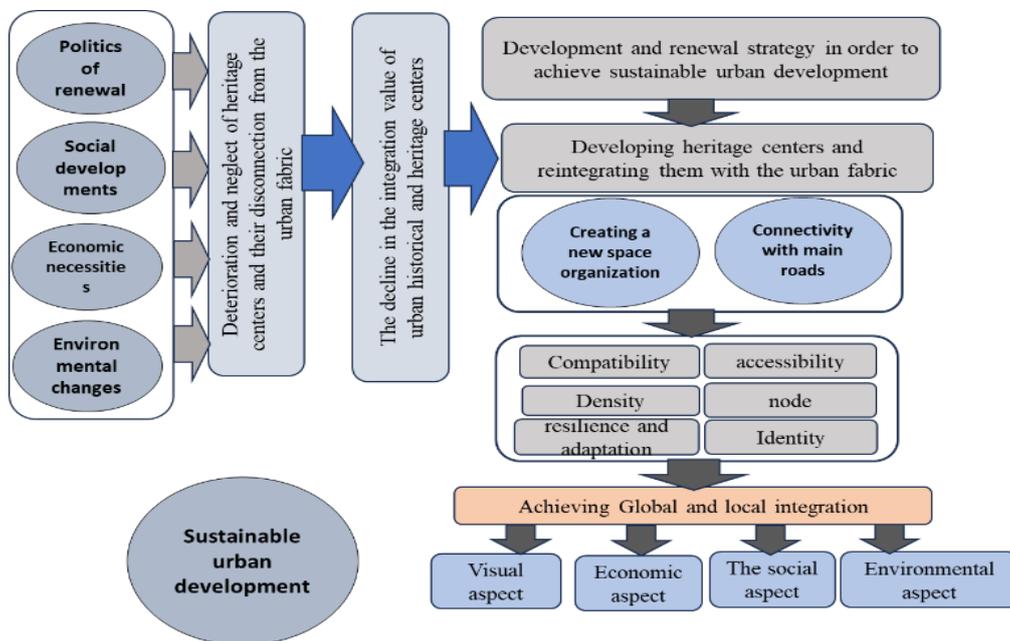
Summary of previous studies:

The collective body of research demonstrates that heritage and historical centers are not only cultural legacies but also dynamic catalysts for sustainable urbanism. Their integration with the urban fabric hinges on several morphological and functional indicators, including:

- **Accessibility**: Ease of movement within and around heritage sites.

- **Connectivity**: Clear, coherent spatial networks linking these centers to the broader urban fabric.
- **Coherence and Diversity**: A harmonious yet varied urban form that supports both uniformity and diversity.
- **Centrality and Density**: The strategic positioning and compactness that enhance urban activity.
- **Identity**, **Flexibility**, **and Adaptability**: Elements that reinforce a strong cultural identity while allowing for evolutionary change.

In summary, the reviewed literature reveals significant connections in which classical theories of spatial integration (Hillier, Alexander, Rapoport) converge with urban morphological schools (Muratori, Caniggia, Rossi) in emphasizing the coherence of urban form and its cultural meaning. At the same time, tensions exist between traditional cumulative growth models and modern fragmented planning approaches, as well as between global frameworks and their limited application in Arab contexts. These tensions underline the risk of urban disconnection and loss of identity. Finally, clear gaps remain in addressing how heritage centers in Arab cities can be integrated into sustainable development strategies using both quantitative and qualitative tools. This study addresses these gaps by applying a mixed-method framework that combines Space Syntax with discourse analysis to the case of Diriyah, thereby bridging theory with practice.

Based on the reviewed literature, a theoretical framework has been developed to connect morphological, functional, and symbolic dimensions of integration. As shown in "Figure 3" and "Table 1" indicators such as **accessibility**, **connectivity**, **centrality**, **density**, **diversity**, **and identity are interrelated**, forming the conceptual basis for the practical analysis of Diriyah. While the reviewed studies provide valuable insights, their contributions often remain fragmented across disciplinary boundaries. The spatial theories of Hillier, Alexander, and Lynch emphasize different but interrelated aspects of integration, spatial configuration, cumulative growth, and urban legibility .Yet, they collectively reinforce the role of heritage centers as dynamic urban nodes. Similarly, Arab world case studies illustrate successful practices but rarely integrate morphological, social, and symbolic dimensions into a unified framework. This gap highlights the need for a more holistic approach that synthesizes theoretical perspectives with empirical evidence. The present research addresses this gap by combining literature insights with spatial analysis, thus moving beyond descriptive accounts to construct a critical and comprehensive synthesis.

Figure 3. The impact of changes on the deterioration and neglect of heritage and historical centers and how to achieve comprehensive integration of the centers in achieving urban development.

Table 1. Summary of Previous Studies on Integration in Heritage and Historical Urban Centers.

Author(s), Year	Study Area/Focus	Main Indicators or Dimensions	Key Findings/Contribution
Hillier (1984)	Spatial configuration and urban movement	Accessibility, connectivity, depth, symmetry	Developed Space Syntax; demonstrated correlation between integration values and pedestrian flows
Christopher Alexander (1973)	Provides accessibility	Clarity of the global spatial structure of the city	- Activation of the social dimensions - Activation of the economic dimensions
Leon Krier (1984)	Mixed-use and urban morphology	the Global view of the urban system	Promoted social and economic integration
Kevin Lynch (1960)	Compatibility between local and global characteristics	Integration of spatial structure, conceptual framework, and actual usage	Activated social, economic, and environmental dimensions
Amos Rapoport (1977)	Realization of identity	Integration of spatial structure and human behavior	Strengthened social and environmental aspects
Ibrahim Jwad & Mahdi, 2008	Mixed-use in heritage cities	Global and Local integration	Enhanced functional dimensions
Wahda Al-Hinkawi (2021)	Morphological and functional diversity.	Integration of global and local structures.	Strengthened aesthetic and formal dimensions
Al-Hakeem (1987)	Social interaction and communication	Integration of spatial structures	Promoted social dimension
Hillier (1993)	Mixed-use and economic activation	Cohesion of urban fabric components.	Promoted economic dimension
Dimitrios Kalfas (2023)	Connectivity and accessibility in mixed-use	Connectivity to main roads, accessibility, density, mixed-use	Promoted economic, social, and cultural dimensions
Zhen Wang (2022)	Movement and permeability	Permeability, accessibility, variety of movement paths	Established local and global centers; promoted social dimension
Rebwar Ibrahim (2022)	Street and block development	Accessibility, road hierarchy, connectivity to main roads	Developed spatial, block, and street patterns; activated social and functional dimensions.
Maryam Roosta (2021)	Flexibility and adaptability in urban centers	Flexibility in mobility, adaptability, change	Improved urban centers' connections with surrounding streets; promoted social and economic dimensions
Sanwei He (2019)	Vitality and flexibility of the urban network	Vitality, permeability, flexibility	Enhanced integration of the urban network;

			promoted social and economic flexibility
Tara Smith, Maurice Nelischer & Nathan Perkins (1997)	Urban form and livability	Connectivity, mobility, personal freedom, diversity, livability, dynamic and visual connectivity	Strengthened relationship between blocks, streets, pedestrian pathways, and open spaces; activated social and environmental dimensions
S.A. Hammoodi & W.S. Al-Hinkawi (2023)	Urban density and vitality	Density, attractiveness, vitality, diversity	Promoted spatial integration of the road network; activated social, economic, aesthetic, and environmental dimensions
Guzmán (2017)	Vitality and diversity in urban systems	Integration between spatial distribution and road network	Advanced environmental, economic, and social justice
Maria Spiliotopoulou & Mark Roselan (2020)	Harmonization of local and global characteristics	Interaction, vitality, diversity	Supported social, economic, and environmental dimensions

3. Methodology and Tools

To clarify the alignment among research questions, objectives, and tools, Table 2 summarizes the relationships among these elements, ensuring methodological coherence and transparency throughout the study. Building on this alignment, to achieve the research objective of examining the role of integrating heritage and historical centers in realizing dynamic sustainable development within the urban fabric, the practical application proceeds with measuring the comprehensive integration of Diriyah's historic center. As illustrated in Figure 4, the methodological steps include: (1) Literature review and theoretical framework; (2) Data collection and mapping; (3) Space Syntax analysis; (4) Comparative assessment before and after development; and (5) Interpretation and recommendations.

Table 2. Alignment of Research Questions, Objectives, and Tools.

Research Question (RQ)	Research Objective (RO)	Research Tool
RQ1: How can the integration of heritage centers within the urban fabric enhance cultural identity and social interaction?	RO1: To evaluate the role of heritage integration in reinforcing identity and improving community interaction.	Literature Review + Space Syntax + Case Study (Diriyah)
RQ2: What are the spatial and functional indicators of integration in heritage centers?	RO2: To identify and measure spatial/functional integration indicators.	Space Syntax Analysis
RQ3: How does Diriyah's development illustrate the balance between heritage conservation and sustainable urban growth?	RO3: To analyze Diriyah as a case study demonstrating heritage integration within contemporary urban development.	Case Study Analysis (Before/After)
RQ4: What lessons from Diriyah can be generalized to other Arab and international heritage centers?	RO4: To propose transferable guidelines for integrating heritage centers in diverse contexts.	Comparative Analysis + Synthesis

Building upon the alignment between research questions, objectives, and tools shown in Table 2,

Figure 4 illustrates the methodological steps adopted to address the research problem and achieve accurate results.
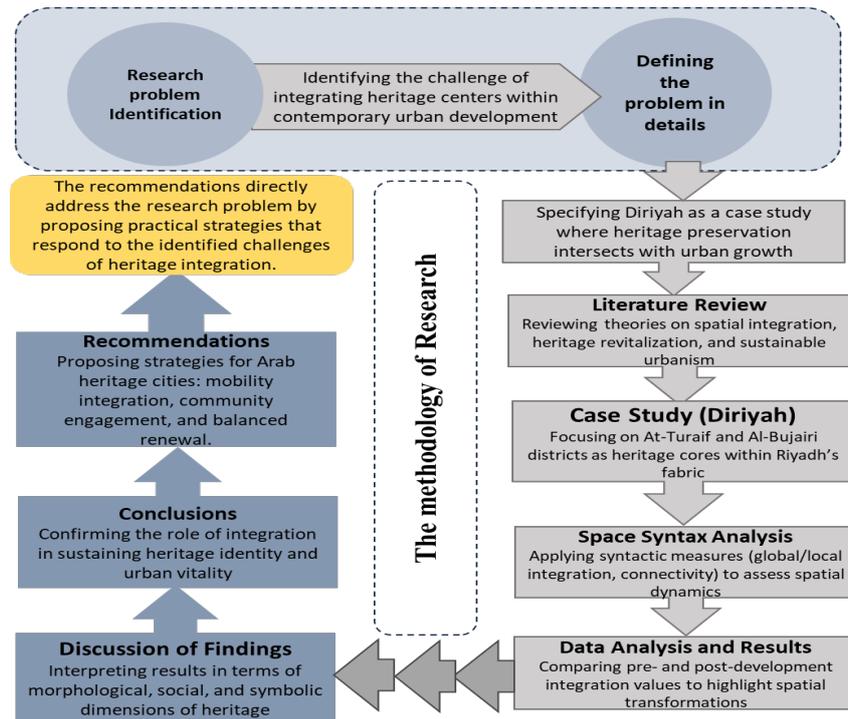

Figure 4. The methodology used to solve the research problem (Source: Authors, 2025).

Beyond outlining the procedural steps, the methodological framework was designed to serve a clear purpose: to connect theoretical knowledge with applied analysis. The literature review established the conceptual indicators of integration, while the case study of Diriyah provided the empirical ground to test these indicators. Space Syntax was adopted not merely as a technical tool, but as a means to quantify spatial and social integration values and to interpret their implications for sustainable development. By combining these elements into a single framework, the methodology ensures that results are not assessed in isolation but analyzed holistically, linking morphological, social, and symbolic dimensions in a comprehensive manner.

In this research, Space Syntax was adopted as the main analytical tool because it offers a structured and quantitative way to examine spatial integration and accessibility across the urban fabric. Its strength lies in its ability to reveal how the spatial layout of heritage areas shapes social interaction, movement flows, and the prominence of historic cores within the city. This makes it especially relevant for studying heritage centers. While other approaches could also be applied, Space Syntax provides a unique capacity to link morphological and social aspects within a single analytical framework. At the same time, its limitations need to be acknowledged: the method focuses primarily on spatial form and cannot, on its own, capture cultural values or qualitative dimensions of heritage integration. To address this, the study complements the syntactic analysis with insights from the literature, case study evidence, and interpretive discussion, ensuring a more balanced and comprehensive evaluation.

3.1. Measurement Methodology

The research employs the Space Syntax methodology, developed by Bill Hillier and Julienne Hanson, which is an analytical approach based on experimental theories and computational techniques. This method is used to analyze the urban structure emerging from the primary street network and its role in shaping functional, social, and economic relationships. Measuring the integration of the road network offers a comprehensive view of the structural characteristics of urban space. It allows for comparing the urban spatial structure with the city's functionality by assessing the clarity of mobility, perception, and interaction resulting from multi-use, which in turn increases user density. Consequently, the Space Syntax approach is utilized to predict the potential impacts of urban space on its users (Hillier, Leaman, Stansall, & Bedford, 1976) (Hillier& Hanson, 1984) (Jiang, Claramunt, & Klarqvist, 2000).

The study analyzed the complete structural layout of Diriyah city at two different points in time:

1. Phase One (Pre-Development, 2010): Based on the UNESCO map from 2010, which included the historic city as part of cultural and historical heritage conservation.
2. Phase Two (Post-Development, 2024): Using aerial imagery and field surveys conducted during a visit in January 2024.

The analysis was carried out on February 4, 2024, using Arch View 3.3 (integrated with the Ax Women program) after conducting field visits on January 15–16, 2024, as shown in Figure 5, which contains two subfigures: the first represents Figure 5(a) the global integration of the study area, while the second illustrates Figure 5(b) the local integration patterns. Presenting both within a single figure allows for a direct visual comparison between the two scales, highlighting the differences in accessibility and connectivity across the broader city network and the neighborhood level.

A comparative study was then performed between the global and local integration values from both phases to identify changes, particularly those resulting from the opening of new roads, pathways, and bridges, and their effects on the comprehensive and local integration values of the city's streets and spaces.
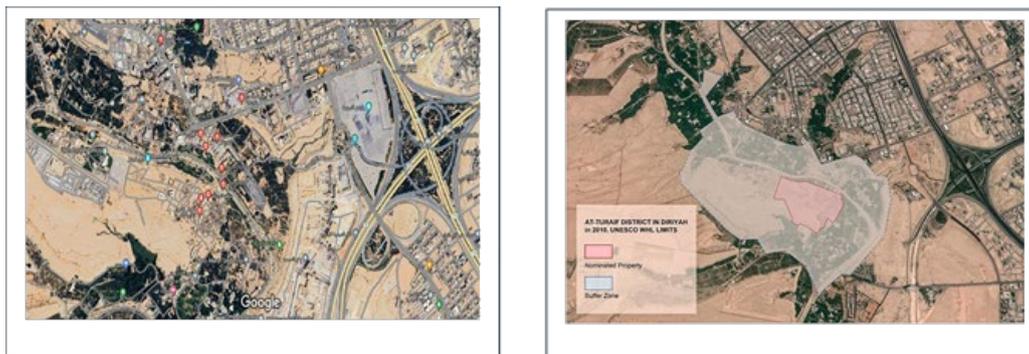
Figure 5. Global and local integration patterns of Diriyah: (**a**) global integration on the right, (**b**) local integration on the left: Source: Researchers via - Google Earth.

3.2. Measuring the Integration Index

Based on previous studies, the integration index quantifies the number of transitions required from one street to another so that a segment of a street can access all other parts of the network, using the shortest paths (Hillier, 1984). In Space Syntax analysis, the integration property refers to the degree of relative symmetry—termed relative depth—which is one of the most critical comprehensive morphological measures. The degree of spatial integration is calculated by determining the average depth of the space, with values ranging from 0 to 1. A value of 0 indicates a low depth (i.e., low integration), while higher integration values indicate greater accessibility and connectivity, whereas lower values reflect spatial segregation and isolation. The integration index in this research was measured using the Space Syntax analysis software through ArcView GIS 3.3, which evaluates both global and local integration indices with the support of the Ax Women plugin extension. (Van Nes. & Yamu, 2021).

In this study, the global integration (Rn) was calculated considering the entire street network, while the local integration was measured within radii of three and five steps (R3 and R5), representing short- and medium-range interactions at the neighborhood scale. These parameter settings allow capturing both the macro-level connectivity of Diriyah's urban fabric and the micro-level pedestrian accessibility. The analysis was conducted on a street-centerline-based axial map, ensuring consistency with previous Space Syntax applications.

To ensure methodological transparency, the calculation of integration values followed four main steps: First, preparing the axial map of Diriyah's road network; Second, generating justified graphs to identify step–depth relations; Third, calculating integration values through depth–to–mean depth ratios; and fourth, normalizing the results to enable comparison between the pre- and post-development phases. The detailed workflow of these steps is provided in Appendix X.

4. Case study: Diriyah City in the Kingdom of Saudi Arabia

Diriyah is considered the birthplace of the Saudi state and represents one of the most significant historic urban centers in the Kingdom.

To avoid redundancy, the case study section does not restate details already covered in the literature review. Instead, it focuses on applying the previously identified conceptual indicators to the spatial and

social context of Diriyah. In this way, the case study serves as a practical demonstration of how theoretical constructs are operationalized, rather than a repetition of descriptive content.

4.1. Historical Overview of Historic Center

Historic Diriyah is one of the most essential destinations in the Kingdom of Saudi Arabia and a key pillar in narrating the nation's rich historical legacy. Located to the northwest of Riyadh, Diriyah sits at the heart of the Arabian Peninsula, making it a pivotal landmark in Saudi history. The city's origins trace back to Man'a bin Rabia Al-Maridi, who laid the foundational cornerstone of one of Diriyah's most significant neighborhoods in the 15th century AD. The name "Diriyah" is derived from the Al-Duroua tribe, known to have inhabited the Hanifa Valley since ancient times. Established in 850 Hijri (1446 AD), Diriyah served as the Emirate of Prince Mohammed bin Saud and was the primary center from which the First Saudi State's capital emerged in the early 18th century (1727 AD) (UNESCO World Heritage Centre ,2010).

Diriyah is composed of several districts, including At-Turaif and Al-Bujairi, Ghaseeba, As-Sreha, Al-Zohayra, Al-Awda, and Al-Bulayda, as illustrated in Figure 6. Among these, At-Turaif stands out as the heart and symbol of Saudi cultural heritage due to its invaluable history that dates back to earlier Saudi states. Although the political center later shifted to Riyadh, Diriyah has preserved its cultural image through its remaining buildings and historical relics. Historically, the Diriyah market was one of the greatest commercial hubs in the Kingdom, and the city also functioned as a center of learning that attracted many Arab scholars. This intellectual prominence even prompted the Ottoman Empire, under Ibrahim Pasha, to attempt its occupation. Diriyah fell in 1233 Hijri after seven years of conflict, but Imam Turki bin Abdullah successfully liberated it and expelled the Ottoman garrisons ("Dir'iyah", 2024) (UNESCO World Heritage Centre ,2010).

Figure 6. The historical plan of Diriyah and its most important neighborhoods: Al-Turaif (historic) neighborhood and Al-Bujairi neighborhood. Al-Turaif is considered the heart and symbol of cultural heritage–Source/researchers.

Renowned for its distinctive architecture—characterized by brick construction and the traditional Najdi style—Diriyah's unique heritage contributed to its inscription on the UNESCO World Heritage List on July 29, 2010. Since then, the Kingdom has launched several initiatives to transform Diriyah into a sustainable destination. These initiatives focus on preserving its architectural landmarks, conserving water resources, enhancing energy efficiency, promoting health, and positioning Diriyah as a global tourist destination rooted in its historical, cultural, and heritage significance. The city's design also prioritizes walkability, featuring a three-kilometer-long pedestrian path overlooking the historic Hanifa Valley (UNESCO World Heritage Centre ,2010).

This modern design fosters enhanced human and social interaction within a healthy environment, effectively turning Diriyah into an oasis for a model community despite its harsh desert surroundings. Such transformation contributes to peace, prosperity, and a vision based on noble principles that have granted Diriyah a prominent political, economic, and religious status in the region-eventually establishing it as a beacon of knowledge and enlightenment. The Kingdom continues to honor Diriyah's legacy as the "Jewel of the Kingdom" and a prime investment hub for future conservation and development projects. Plans are underway to expand the development area to include parts of the Al-Khuzami, Al-Nakheel, and Urqa neighborhoods, with the goal of attracting 27 million local and international visitors by 2030. This initiative supports the national tourism strategy, fosters new economic

systems, and drives urban diversification toward sustainable development (Royal Commission for Riyadh City, 2024).

The development timeline for Diriyah began in 2017 with the issuance of a royal decree to establish the Diriyah Gate Development Authority. In 2019, King Salman laid the cornerstone of the project, followed by the inauguration of the first phase in 2022—which included At-Turaif and the Al-Bujairi district—and the current phase in 2024, marked by the opening of Diriyah Square and additional subsidiary projects ("Diriyah Gate: Land of Kings and Heroes," 2024).

4.2. Historical Overview of Historic Diriyah

The development of Diriyah has encompassed the revitalization of both the At-Turaif and Al-Bujairi districts, along with the construction of new roads that link these two historical areas. This integration, as shown in Figure 7.

Figure 7. The historical plan of Diriyah and its most important neighborhoods: Al-Turaif (historic) neighborhood and Al-Bujairi neighborhood. Al-Turaif is considered the heart and symbol of cultural heritage – (Source/researchers).

4.2.1. A Brief Overview of the Development of the Historic At-Turaif District in Diriyah

The development of the At-Turaif district is considered the jewel of Diriyah and a source of global pride for the Kingdom, as it was the first destination for the official inauguration. The project includes historical museums—such as the Diriyah Museum at Salwa Palace, the Social Life Museum, the Arabian Horses Museum, the Military Museum, the Trade Museum and the House of Finance, and the Arabian Architecture Museum. It also encompasses historical centers, including the Visitor Reception Center and the Diriyah History Documentation Center, as well as numerous local and international restaurants and markets, notably the heritage market, which is expected to offer an inspiring experience for tourists. Additionally, the area features the Imam Mohammed bin Saud Mosque, and the development has introduced the Sheikh Mohammed Abdulwahab Bridge, connecting two of Diriyah's most important districts: At-Turaif and Al-Bujairi (Diriyah Gate Development Authority – DGDA, 2024).

4.2.2. A Brief Overview of the Development of the Al-Bujairi District in Diriyah

The Al-Bujairi project spans an area of 60,000 square meters and involves the rehabilitation and transformation of the area into a tourist destination that caters equally to residents and visitors. The project's facade covers 15,000 square meters. Among the key landmarks being developed are the Sheikh Mohammed Abdulwahab Mosque, Al-Zohayra Mosque, Diriyah Park, and Al-Bujairi Square. The Development Authority aims to transform the city into a global tourist destination by blending heritage authenticity with modern added functions. In addition, the city is being equipped with a wide range of services including resorts, international hotels, cultural academies, a public university, global restaurants, walking parks, golf courses, promenades, open squares, historic plazas, and archaeological museums (Filippi and Mazzetto (2024).

4.2.3. New Road Development for Enhancing At-Turaif and Al-Bujairi

Historical landmarks were preserved and integrated into a master plan that adheres to UNESCO guidelines regarding building heights and latitudes during asset design. The western area was developed with a focus on cultural assets lining a primary pedestrian axis, considered the backbone of the project—this includes tangible elements such as activities, exhibitions, sculptures, and movement corridors. In

contrast, the eastern section was enhanced by adding a central hub featuring the opera house, a conference center, a contemporary art museum, and the grand mosque. These facilities are distributed along a major street that connects to King Saud University to the east of the site. The backbone of the pedestrian axis integrates with the central urban landscape to form the heart of the project, while the Hanifa Valley, surrounding the site from the south and west, has been incorporated as a historical natural heritage element. Additionally, a pedestrian bridge was constructed to establish a strong physical and functional connection between Al-Bujairi district and At-Turaif, accompanied by the creation of multiple pedestrian pathways that enhance accessibility and reinforce the integration of the historic core with the surrounding urban fabric (Arab News, 2019).

In sum, Diriyah represents a concrete model that illustrates both the challenges and opportunities of integrating heritage centers within contemporary urban fabrics. By combining qualitative heritage discourse analysis with quantitative spatial analysis (Space Syntax), the case study enables a deeper understanding of spatial connectivity, social interaction, and economic activation, thereby ensuring a comprehensive and rigorous basis for the subsequent practical application.

Rather than being merely descriptive, the case study analysis of Diriyah was intended to validate and operationalize the theoretical indicators identified in the literature review. The observed changes in integration values, as measured through Space Syntax, directly reflect the morphological, social, and symbolic dimensions emphasized by previous studies. In this way, the case study functions as a critical test bed that synthesizes theoretical insights with empirical evidence, demonstrating how descriptive observations are translated into analytical findings that reinforce the study's overall contribution to sustainable urban development.

While the analysis primarily relies on spatial configuration, the incorporation of participatory or community-based data could further enrich the findings. Surveys and interviews with residents and visitors, for example, would allow comparison between quantitative integration values and lived social experiences. Moreover, linking the results to social and economic indicators highlights how spatial integration fosters community interaction, cultural continuity, and tourism-driven economic development. In the case of Diriyah, such integration emphasizes not only morphological coherence but also the broader social and economic values that sustain its role as a dynamic heritage center.

5. Practical Application and Result

5.1. Global and Local Integration Values – Analysis of Phase One (Pre-Development of At-Turaif and Al-Bujairi, 2011)

1. The analysis data as illustrated in Table 3 revealed that the At-Turaif and Al-Bujairi districts were not directly connected to the main axes of global integration. These axes—namely the Northern Ring Road, King Khalid Road, Imam Abdulaziz Mohammed bin Saud Street, Prince Sattam bin Abdulaziz Street, and King Fahd Road-showed global integration values ranging between 0.929 and 0.875 and local integration values between 2.218 and 1.995. As a result, both At-Turaif and Al-Bujairi fell within isolation cores, with the directly connected axes exhibiting global integration values of 0.504–0.451 and local integration values of 0.434–0.211. This indicates a reduced cohesion of the urban fabric in these districts due to neglect, as illustrated in Figure 8.

2. The results also showed that there was no connection between the Al-Bujairi and At-Turaif districts, rendering them isolated from Diriyah's urban fabric

5.2. Global and Local Integration Values–Analysis of Phase Two (Post-Development of At-Turaif and Al-Bujairi, 2024)

1. The analysis data for the second phase similarly indicated that the At-Turaif and Al-Bujairi districts were not directly connected to the main global integration axes (the Northern Ring Road, King Khalid Road, Imam Abdulaziz Mohammed bin Saud Street, Prince Sattam bin Abdulaziz Street, and King Fahd Road), which maintained global integration values between 0.929 and 0.875 and local integration values between 2.218 and 1.995. Consequently, the At-Turaif and Al-Bujairi districts continued to fall within isolation cores, with directly connected axes recording global integration values of 0.504–0.451 and local integration values of 0.434–0.211. This indicates that the cohesion of the urban fabric in these areas remained diminished due to the neglect of the region, as shown in Figure 9.
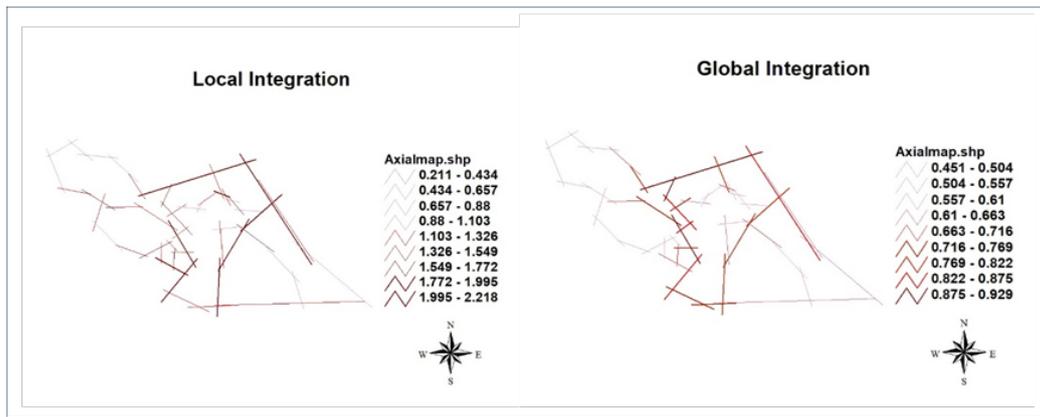
Figure 8. Results of the Global and Local Integration Index for the Analysis of Al-Diriyah City (Al-Turaif and Al-Bujairi Districts) Before the Development Process in 2011 – (Source/researchers).
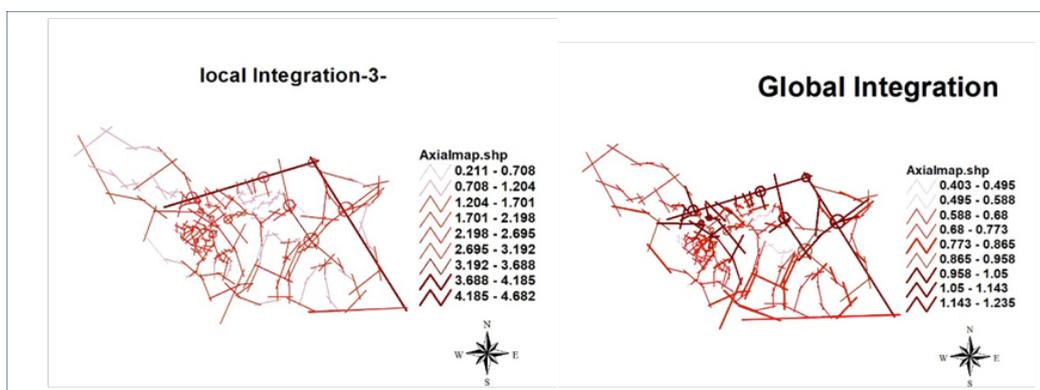
Figure 9. Results of the Global Integration Index (Right) and Local Integration Index (Left) for the Analysis of Al-Diriyah City (Al-Turaif and Al-Bujairi Districts) After the Development Process in 2024 – (Source/researchers).

Table 3. Global and Local Integration Values (Rn, R3) in Al-Turaif and Al-Bujairi Districts Before and After the Development Process.

Local Integration (R3) After Development	Global Integration (Rn) After Development	Local Integration (R3) Before Development	Global Integration (Rn) Before Development	Step Depth (Radius)
0.211	0.403	0.211	0.451	1
0.708	0.495	0.434	0.504	2
1.204	0.588	0.657	0.557	3
1.701	0.68	0.88	0.61	4
2.198	0.773	1.103	0.663	5
2.695	0.865	1.326	0.716	6
3.192	0.958	1.549	0.769	7
3.688	1.05	1.772	0.822	8
4.185	1.143	1.995	0.875	9
4.682	1.235	2.218	0.929	10

The integration values presented in Table 2 highlight the specific spatial transformation of Diriyah's heritage districts. The increase in both global (Rn) and local (R3) integration after the development process reflects stronger spatial connectivity between At-Turaif and Al-Bujairi and the wider Riyadh urban fabric. This indicates that the revitalization efforts not only enhanced accessibility but also reinforced the functional and symbolic role of these heritage centers as living nodes of cultural and social interaction. The rising integration values at different step-depth levels demonstrate how the development improved pedestrian flows, strengthened the linkage between heritage and contemporary functions, and ensured that the historical core remains central to the identity and sustainability of the city. Moreover, these outcomes reveal that shifts in global and local integration values are not merely technical indicators of spatial correlation but also critical drivers of social activities, economic functions, and cultural components within the urban fabric. Higher integration supports the vitality of public life, fosters inclusive economic participation, and reinforces cultural continuity, thereby ensuring that revitalization contributes simultaneously to functional efficiency and long-term urban sustainability.

To clarify, the comparison between the pre- and post-development phases of Diriyah is not limited to descriptive observations. Quantitative indicators were systematically measured using the Integration Index, which combines global and local integration, connectivity, and spatial accessibility. This index provides a comprehensive metric for evaluating how the spatial configuration of the heritage core has changed over development. The results show measurable improvements in both global and local integration, reflecting enhanced connectivity and accessibility within the urban fabric, thereby reinforcing the study's conclusions regarding the strengthened role of Diriyah as a dynamic heritage center.

## 6. Statistical Computation of Integration Values & Discussion

The statistical computation of integration values was conducted using the Space Syntax analysis software (ArcView GIS 3.3), and the resulting values were processed and tabulated in Microsoft Excel. Based on the outcomes of the global and local integration indices in both phases—before and after the development of Diriyah City, as illustrated in Figure 10—the following observations can be made:

The global integration values (represented in gray) increased to 1.235 after the development of Diriyah City, compared to 0.929 before development (blue). Similarly, the local integration values (yellow-orange) rose to 4.082 after development, whereas most pre-development values were around 0.218 (orange). This highlights the effective role of integrating heritage and historical buildings into the urban fabric, as the rise in the integration index indicates stronger connectivity and enhanced cohesion.

Following the development of the heritage and historical center—specifically, the At-Turaif and Al-Bujairi districts—there was a clear increase in their partial integration with the broader urban fabric of Riyadh. While both districts were previously located within isolation cores due to limited spatial connections, the development has improved their degree of cohesion with the surrounding fabric.

In addition, the global and local integration values of the main roads associated with the development areas (such as King Khalid Road, Imam Abdulaziz Mohammed bin Saud Street, Prince Sattam bin Abdulaziz Street, and King Fahd Road) have significantly improved. This outcome reflects the enhanced interaction between these roads and the At-Turaif and Al-Bujairi districts. Prior to the development, these roads remained relatively isolated and disconnected, which contributed to the lower integration values previously recorded in the two districts.

Moreover, the findings of Diriyah's case study explicitly reflect the theoretical framework established in the literature. Morphologically, the increase in global and local integration values confirms the role of spatial configuration in enhancing connectivity. Socially, the improved accessibility of the heritage core supports greater opportunities for interaction and cultural continuity. Economically, the revitalization of Diriyah demonstrates the potential of integrated heritage centers to foster tourism and generate sustainable economic activities. Thus, the practical results are directly linked to the morphological, social, and economic dimensions outlined in the theoretical framework, thereby reinforcing the study's holistic contribution.

Comparison of integration values before and after development.
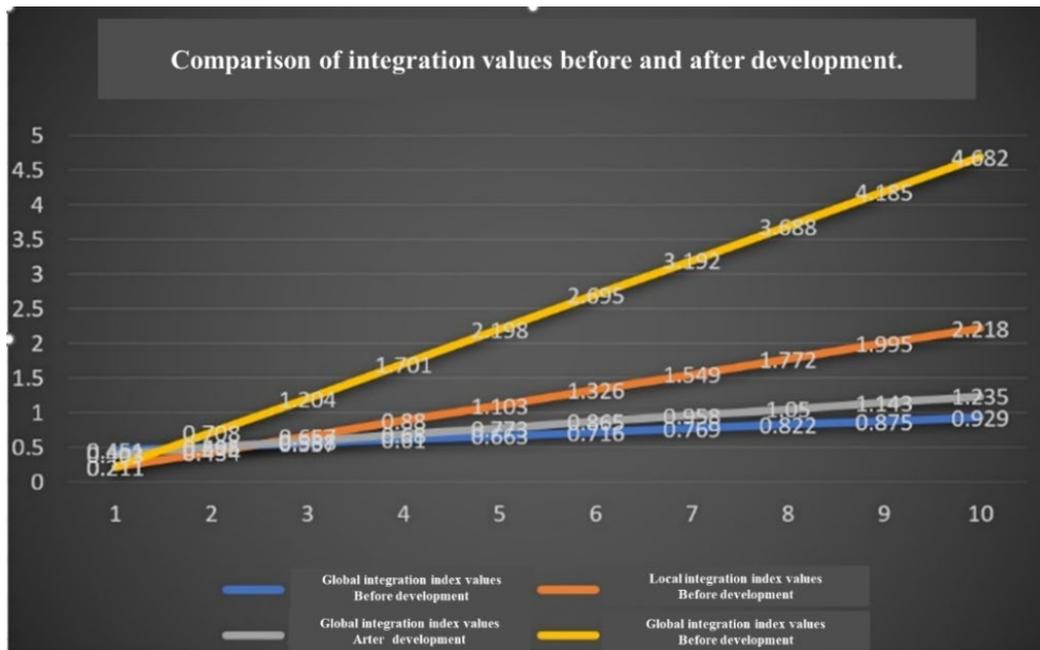
Figure 10. Integration values (Rn, R3, R5) for the axial map of Diriyah. The x-axis represents the different axial lines, while the y-axis shows the corresponding integration values. (Source/researchers).

The findings from Diriyah reinforce the theoretical perspectives discussed in the literature review, particularly the notion that heritage centers act as living nodes of cultural identity rather than static monuments. Consistent with Hillier's theory of spatial configuration, the reduced functional integration of Diriyah demonstrates how urban renewal policies can unintentionally marginalize heritage cores. At the same time, the observed emphasis on tourism over community use confirms the concerns raised by Silverman (2007) and Fairchild Ruggles (2007) regarding the risk of commodification. This suggests that sustainable revitalization requires a dual approach: preserving morphological and symbolic values while ensuring that intangible cultural practices remain embedded in daily urban life.

Beyond spatial integration, sustainable heritage revitalization requires active community participation. The voices of local residents, their perceptions, and their cultural practices ensure that integration is not merely a quantitative measure but also a socially embedded process. In the case of Diriyah, the alignment of physical connectivity with community engagement strengthens cultural identity, fosters inclusive economic activity, and supports long-term urban vitality. This holistic approach demonstrates that heritage integration is sustainable only when spatial accessibility is matched with the lived experiences and cultural continuity of the local community.

7. Conclusions

1. Integration is considered a fundamental indicator in achieving the sustainable development of heritage centers because it provides key morphological characteristics, such as (**accessibility**, **connectivity**, **coherence**, **diversity**, **centrality**, **density**, **identity**, **flexibility**, **and adaptability**) that foster a strong bond between heritage/historical centers and the urban fabric. In the case of Diriyah, the increase in both global and local integration values after the development process confirmed how enhanced spatial connectivity directly contributes to **social interaction**, **economic vitality**, and **environmental** balance. This demonstrates that integration is not only a theoretical construct but also an applied tool that ensures both functional integration (by strengthening social relationships, stimulating economic attraction, and achieving ecological harmony) and physical integration (visual and perceptual cohesion). Such outcomes position integration as one of the most critical contemporary elements for achieving sustainable urban development locally and globally.

2. The theoretical study confirmed that heritage and historical centers are vital components in improving quality of life by strengthening social integration and promoting both economic vitality and environmental sustainability. These centers shape the urban form by responding to social and spatial needs, redistributing activities, and introducing new functions that reinforce urban resilience at both local and global scales. Their revitalization thus emerges not only as a cultural and historical necessity but also as a strategic driver for sustainable urban renewal.

3. Prioritizing the social, economic, environmental, and even political dimensions is fundamental to achieving sustainable urban development, as these aspects directly influence the quality of social interaction. Sustainable revitalization can be fostered by attracting tourism to culturally rich and environmentally healthy areas that emphasize the use of traditional building materials, by enhancing pedestrian mobility through active pathways and bridges, and by reinforcing urban hubs with diverse activities integrated into green spaces. Ensuring easy and equitable access to heritage and historical centers is therefore essential to maintain their vitality, cultural resonance, and role as living nodes within the contemporary urban fabric.

4. Building on the theoretical findings, the practical analysis of Diriyah conducted during the first phase (prior to the development of the Al-Bujairi and At-Turaif districts) showed that the area suffered from relatively low global and local integration values within its road network. This weakness stemmed from the absence of direct links to the main arterial roads (including the Northern Ring Road, King Khalid Road, Imam Abdulaziz bin Mohammed Street, Prince Sattam bin Abdulaziz Street, and King Fahd Road) and from the lack of clear connecting routes. Consequently, the area was confined to isolated cores, contributing to spatial fragmentation and the deterioration of zones that remained disconnected from the broader urban fabric, reflecting the failure to integrate its local and global morphological characteristics.

5. In the post-development phase of Diriyah, the spatial reorganization of Al-Bujairi and At-Turaif, through their direct linkage with the main road network, the establishment of multiple urban nodes enriched by new activities and events, and the introduction of a sports pedestrian route along with pedestrian bridges connecting both districts ,resulted in noticeably higher global and local integration values compared to the pre-development phase. This transformation demonstrates that Diriyah's historic center has shifted from isolated cores to integrated cores, reflecting greater coherence with the surrounding urban fabric and affirming the effectiveness of the revitalization strategies adopted.

6. The practical analysis further revealed that the integration of Diriyah's heritage center was not confined to improving the values of internal streets and bridges; rather, it also enhanced the global and local integration of the surrounding main road network compared to the pre-development phase. This outcome reflects a strengthened long-term cohesion of the city's urban fabric, laying the foundation to reinforce cultural, social, economic, and environmental dimensions and thereby supporting the goals of sustainable urban development.

7. The study also underscored the pivotal role of pedestrian paths and bridges in reintegrating the previously deteriorated area and reestablishing its connectivity with the broader urban fabric. By providing both physical accessibility (mobility permeability) and visual permeability, these pedestrian networks encouraged higher user frequency, facilitated the introduction of diverse activities and events, and enhanced the site's vitality. Thus, integration was achieved not only through connections to the vehicular road system but also through a human-centered pedestrian framework.

8. Finally, the study demonstrates that space syntax–based integration analysis is not merely a technical tool but a strategic instrument for guiding heritage revitalization policies. The findings, while drawn from Diriyah, offer broader lessons for other Arab heritage centers, emphasizing that enhancing spatial integration directly contributes to social vitality, economic resilience, and cultural continuity. This reinforces the view supported by international charters such as the Xi'an Declaration and the Italian School of urban morphology that heritage conservation and sustainable urban development are inherently interdependent.

9. Moreover, linking the conclusions with community participation further strengthens the research outcomes. Involving residents, stakeholders, and visitors in the evaluation process would validate the spatial findings with lived experiences, ensuring that integration strategies are not only technically sound but also socially grounded and sustainable.

8. Recommendations

Based on the findings of the study and the comparison of global and local integration values before and after development, it is essential to prioritize the redevelopment and revitalization of heritage and historical centers by enhancing their integration with the city's overall mobility and traffic systems. Strengthening these connections fosters a cohesive urban fabric, as the integration index provides structural, functional, and physical (material) characteristics that are fundamental for sustainable urban development. Furthermore, the study recommends adopting a comprehensive strategy that combines urban renewal with social integration, grounded in evidence and knowledge and the active utilization of cultural heritage. Importantly, these recommendations are not limited to Diriyah but can be applied to heritage centers across the Arab region, aligning with international perspectives such as the Xi'an Declaration and the Italian School of urban morphology. This makes the findings not only academically relevant but also practically useful for decision-makers and urban planners in shaping sustainable,

culturally rooted urban futures.

For instance, studies on Historic Jeddah and Cairo's Fatimid core reveal similar benefits of enhancing spatial integration, including the revitalization of socio-economic functions and the reinforcement of cultural identity. Likewise, international cases such as Toledo in Spain illustrate how connecting heritage cores with modern infrastructure fosters sustainable tourism and community engagement. Situating Diriyah's findings within this comparative perspective strengthens the interpretive value of the results and demonstrates their transferability to other heritage centers globally.

9. Guidelines and Generalization

To translate these findings into broader guidelines, the study suggests three levels of application. At the theoretical level, integration indicators such as accessibility, connectivity, and centrality can serve as benchmarks for evaluating heritage centers in diverse urban contexts. At the methodological level, combining quantitative tools like Space Syntax with qualitative assessments provides a replicable framework for analysis. At the policy and planning level, the results demonstrate that linking heritage cores with the wider mobility network fosters socio-economic vitality and cultural sustainability. While tested in Diriyah, these guidelines can be generalized to other Arab and international heritage centers, offering transferable lessons for sustainable urban regeneration.

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