

Entry

Unpacking Transdisciplinary Research Scenarios in Architecture and Urbanism

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Definition: Research in architecture and urbanism is a complex undertaking. It involves a multitude of challenges, approaches, variables, diverse scales, and types of environments to examine. This entry dives into the complexities of architectural and urban research and explores the integration of diverse approaches into various research topics or domains. Recognizing the dynamic interplay of human, cultural, technological, and environmental factors in architecture and urbanism, it proposes a transdisciplinary approach to bridge existing disciplinary and methodological boundaries. This entry adopts and operationalizes a comprehensive approach that encompasses hybrid scenario development, integrated socio-spatial analysis, a revised experiential approach, and the integration of environmental psychology into architectural and urban studies. These components are envisioned to harmonize various methodologies and to depict a picture of what research in architecture and urbanism could be within an identified set of domains. This approach is grounded in a rigorous literature review, empirical evidence, and relevant validation through case studies. The application of this approach instigates a series of research scenarios which act as frameworks that provide new insights into design and practice-based research, building anatomy research, city dynamics research, housing dynamics research, and user perception studies. Each scenario demonstrates the applicability of combining theoretical insights with empirical investigations. The implications of these scenarios for architectural and urban research emphasize the significance of transdisciplinarity and highlights the importance of integrating diverse theoretical tenets and methodological insights to address the complex challenges of research in architecture and urbanism.



Citation: Salama, A.M.; Patil, M.P. Unpacking Transdisciplinary Research Scenarios in Architecture and Urbanism. *Encyclopedia* **2024**, *4*, 352–378. <https://doi.org/10.3390/encyclopedia4010025>

Academic Editors: Andrea De Montis and Raffaele Barretta

Received: 15 December 2023

Revised: 6 February 2024

Accepted: 9 February 2024

Published: 11 February 2024



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Keywords: architectural research; urban studies; transdisciplinarity; transdisciplinary action; building anatomy; city dynamics; housing; environment-behavior studies; empirical methods

1. Introduction

In the dynamic and multifaceted world of architecture and urbanism, there is a continuous journey toward a deeper understanding of how we design, build, and interact with our built environments. This journey encompasses the exploration of how these environments are influenced by and in turn influence various human, cultural, technological, and environmental factors. Within this broad spectrum of inquiry, this entry explores the complexities of research in architecture and urbanism which continues to face ongoing challenges. Despite the remarkable evolution of architectural theory and practice, achieving a comprehensive understanding of their interplay remains an elusive endeavor [1–4].

Historical research in architecture has traditionally emphasized styles, cultural influences, and the evolutionary narrative of design practices to provide invaluable context and to link architectural developments to broader historical and cultural movements or phenomena. Recently, however, there has been a paradigm shift that demonstrates a growing emphasis on empirical methods and interdisciplinary approaches [5,6].

The human dimension of architecture has increasingly become central to contemporary discussions, with research delving into how individuals interact with and perceive their

built environments. This user-centric perspective has expanded the scope of research and enabled the integration of insights from social sciences to enrich the understanding of the experiential aspects of the built environment. Simultaneously, technological advancements like geographic information systems (GIS), building information modeling (BIM), and artificial intelligence (AI) have revolutionized architectural conceptualization and execution, leading to unprecedented precision and efficiency in design processes. Likewise, social and environmental sustainability have surged to the forefront of architectural and urban concerns, with research addressing the pressing need for sustainable design practices and evaluating the social and environmental impacts of buildings. Such a focus has prompted a re-evaluation of priorities in both the theoretical and practical realms of architecture and urbanism.

Despite the preceding advancements and emerging issues, the integration of diverse approaches into a comprehensive framework, which draws from different disciplines, remains a significant challenge. Therefore, this entry proposes a transdisciplinary approach to bridge these divides while considering a holistic understanding of architectural and urban studies. To achieve this objective, this entry introduces transdisciplinary perspectives such as hybrid scenario development, integrated socio-spatial analysis, a revised experiential approach, and the integration of environmental psychology into the study of the physical environment and its relationship with users and different types of stakeholders. These perspectives are developed to harmonize various methodologies and to establish the beginning steps towards transdisciplinary research in architecture and urbanism.

Drawing on the seminal works of researchers like Franz [5] and Groat and Wang [6] and the conceptual contributions of the lead author [7], this entry sets ambitious and multifaceted objectives that seek to delineate the intrinsic characteristics and philosophical stances underpinning research methodologies in architecture and urbanism. Additionally, this entry aims to introduce and elucidate five distinct research scenarios, each of which highlights a unique aspect of architectural and urban inquiry.

Shaping solid research frameworks, the approach adopted in developing the five research scenarios is grounded in a rigorous literature review, empirical evidence, and case study analysis. The scenarios serve as pathways, guiding researchers through the intricate landscape of knowledge production in architecture and urbanism. The implications of this entry extend beyond academic discourse by offering insights and practical applications for scholars, practitioners, and policymakers alike. By enhancing our understanding and advocating for the use of transdisciplinary approaches, this effort aims to shape the future of architectural and urban research, ensuring that it remains relevant, responsive, and robust in the face of ever-changing global challenges.

Rationale: Transdisciplinarity and the Need for Robust Research Scenarios

Transdisciplinarity is a philosophy and approach to transcendence, problem solving, and transgression [1]. It emphasizes a multidimensional exploration of complex topics while also recognizing the dynamic and evolving nature of research subjects or focus areas. It is not, however, directly attributed to a specific philosopher or scholar, but is influenced by several thinkers who have contributed to its development as a concept and as a paradigm of thinking. Notable scholars have made significant contributions to its evolution, including Jean Piaget, Edgar Morin, and Basarab Nicolescu [2–4]. Jean Piaget, a pioneering developmental psychologist, contributed to transdisciplinarity discourse by emphasizing the importance of understanding cognitive development as a holistic and integrated process, recognizing the interconnectedness of various domains of knowledge [2]. Edgar Morin, a key figure in complexity theory, promoted the idea that complex systems should be studied as wholes while urging scholars to transcend disciplinary boundaries for a better understanding of phenomena [3]. Basarab Nicolescu introduced the concept of the “transdisciplinary object” and emphasized the necessity of a new, integrative language that goes beyond the limitations of individual disciplines to invigorate a more holistic approach to knowledge production [4]. These contributions highlight the significance of transcending

disciplinary boundaries and the value of embracing complexity while fostering a holistic understanding of social or environmental phenomena [8].

Transdisciplinarity can be elucidated as a form of knowledge developed through action involving cooperation among different parts of society, professionals, and academia to meet complex challenges of society. Transdisciplinary research starts from tangible real-world problems [9]. Answers to challenges are devised in collaboration with multiple stakeholders including academics and professionals from different disciplinary backgrounds [10]. Therefore, various arguments assert that transdisciplinarity is about transcending the boundaries of various disciplines. As a mode of knowledge production, it can concomitantly confront complexity while challenging the fragmentation of knowledge. Its hybrid and non-linear nature can easily enable disciplines to transcend and truly incorporate various academic or research structures [11–14]. Hence, it becomes crucial to envision a seamless integration between theory and practice which can be realized through the creation of scenarios that serve as pragmatic frameworks and encapsulate the dynamic and comprehensive principles of transdisciplinary thinking as it relates to research in architecture and urbanism. Emphasizing the need for scenarios, perspectives, and interdependencies within research in architecture and urbanism, transdisciplinarity allows researchers to gain a more profound understanding of the complexities involved in research undertakings by dissecting complex topics into theoretical tenets and relevant methodological approaches. The application of the transdisciplinary approach in this entry is captured through the development of five research scenarios, each of which incorporates components which stem from diverse disciplines and considers approaches like hybridity, the integration of socio-spatial analysis, a revisited experiential approach, and the assimilation of environmental psychology into urban studies.

2. An Approach to Transdisciplinary Research in Architecture and Urbanism

In the realm of transdisciplinary research in architecture and urbanism, encompassing a comprehensive approach, with diverse yet interconnected components, is essential. These components ensure a systematic exploration while integrating theoretical concepts with empirical data and relevant research tools. Four components for the development of an approach to transdisciplinary research in architecture and urbanism can be envisioned as follows:

- *Hybrid scenario development* forms a cornerstone of this approach. It leverages the integration of phenomenological analysis with advanced spatial data analytical tools, such as GIS and visual attention software (VAS), to develop intricate research scenarios. It combines qualitative insights from user experiences with quantitative spatial data. This component is applied across various research areas, including practice-based research, city dynamics, and housing dynamics. Primary techniques, like attitude surveys and user perspectives, gather experiential feedback and enrich the analysis and examination of phenomena. Scenario planning and content analysis aid in interpreting qualitative data. Walking tour assessments are applied to evaluate the practical implications and real-world pertinence.
- *Integrated socio-spatial analysis* is another pivotal component which fuses sociological theories with spatial data. Employing GIS tools, it examines areas like urban governance and public space use and utilization to offer a nuanced perspective of the relationship between social dynamics and physical manifestations. Sociocultural surveys and ethnographic studies gather in-depth insights into community behaviors and social interactions. User participation and community design are fundamental in understanding and integrating the social and behavioral dynamics into decision making.
- *A revised experiential approach* represents a modern reinterpretation of phenomenological methods in architecture. This component integrates technological advancements, particularly VAS and GIS, to deepen our understanding of the human experience. It espouses philosophical and aesthetic considerations with functional elements. This component is crucial in building anatomy research and post-occupancy evaluations

as it enables a more profound and data-informed understanding of user experiences and behaviors.

- *The integration of environmental psychology into urban studies* is gaining momentum in recent years as an approach that embeds psychological considerations directly into urban studies. Utilizing GIS for spatial representation of psychological and behavioral factors, it paves new pathways for examining spaces that focus on psychological well-being of individuals and communities. This is essential in housing dynamics research and user perception studies as it offers insights into how urban environments affect human behavior and well-being.

Collectively, these components form a cohesive approach that guides the creation of effective and innovative research scenarios. They enable a comprehensive exploration of architectural and urban issues while ensuring that the research endeavor is not only academically robust but also practically relevant and responsive to the complexities of real-world concerns.

Imperative Constituents of Selected Research Scenarios

The identification of imperative constituents for the five research scenarios places emphasis on foundational principles that shape their framing and development. These include interdisciplinary integration, empirical validation, triadic structuring, multidimensional exploration, adaptation, and refinement [14]. Applied across all research scenarios, this form of systematization ensures a rigorous approach that effectively integrates theory and practice across various domains of architectural and urban research. By focusing on the imperatives underpinning the scenarios, one can gain deeper insights into how scenarios are conceived, developed, and applied across various domains, thereby contributing to both knowledge advancement and practical solutions to real-world challenges. The illustrated representation of these scenarios in Figure 1 provides a succinct overview of their interconnected nature.



Figure 1. Approach to construct five transdisciplinary research scenarios in architecture and urbanism (source: the authors).

- *Interdisciplinary Integration:* This imperative recognizes that complex research topics frequently necessitate a pluri-epistemological approach to gain a thorough understanding of the phenomena or the challenges being studied. Hybrid scenario development and integrated socio-spatial analysis exemplify interdisciplinary integration by merg-

ing experiential analysis with advanced spatial tools such as GIS and AI and by applying sociological theories within the context of spatial analysis. This imperative enables a comprehensive understanding of complex architectural and urban phenomena and allows for richer insights into both the qualitative and quantitative aspects of the phenomena being examined.

- *Empirical Validation*: The emphasis of this imperative is on ensuring that research scenarios go beyond theoretical constructs and become practical tools for real-world applications. The revised phenomenological approach in architecture and the integration of environmental psychology into urban studies ensure that research scenarios are grounded in the practicalities of the real world. This involves the collection and analysis of empirical data to assess the applicability of the scenarios, ensuring they effectively bridge the gap between theoretical conceptualizations and practical realities. The objective, in this sense, is to evaluate how successfully these scenarios convert theoretical knowledge into implementable strategies and insights that have a tangible impact.
- *Triadic Structuring*: Triads are made up of three interconnected elements and are an important imperative addressed in the five scenarios. This imperative organizes the scenarios in a systematic manner and engages in a process of identifying key interconnected elements within a research scenario and the way in which they contribute to a structured understanding of the components with a research domain or topic.
- *Multidimensional Exploration*: Multidimensional exploration is emphasized as an imperative that entails identifying and examining the various dimensions or facets of the research topic. It considers diverse viewpoints and the understanding of how they interact to provide a well-rounded perspective that speaks to various aspects of the research challenge being addressed.
- *Adaptation and Refinement*: Given the dynamic nature of research in architecture and urbanism, this imperative is crucial for upholding scenarios to remain flexible and adaptable as new challenges emerge, as new knowledge develops, and as the overall research landscape evolves. Because of this adaptability, the scenarios can be updated and refined to remain relevant and effective in addressing emerging challenges in various contexts.

The preceding imperatives ensure that scenario development seamlessly integrates theory with practice. Elucidated through a lens of theoretical tenets, each scenario includes framework components derived from underpinning theories and involves operationalization. This process unveils the intellectual foundations that guide the development of each scenario while demonstrating its applicability. Yet, the subsequent analysis discerns how components are derived from these theories to formulate robust frameworks that generate a nuanced understanding of the complex dynamics of each area or domain.

3. Scenario 1: Practice-Based Research

The ability of architects and urbanists to respond to the ever-changing challenges posed by the contemporary built environment is inextricably linked to the survival and relevance of the dynamic realms of architecture and urbanism. Historically, the development of cities, towns, and buildings has been influenced by a complex interplay of cultural, social, environmental, and economic factors. However, today's demands necessitate a more proactive approach in which architects take on a greater responsibility for understanding and incorporating these multifaceted elements into their designs. Architects must also embrace social and ethical considerations to revitalize their role in shaping the built environment and demonstrate their value to society. As the architectural profession has evolved over the last three decades, three central concepts have emerged: programming or pre-designing, post-occupancy evaluation (POE) or building performance evaluation (BPE), and community design or user participation [7,15–17].

3.1. Theoretical Tenets of Practice-Based Research

This scenario is grounded in key theoretical tenets that shape its underpinnings as it articulates the landscape of practice-based research in architecture and urbanism. First and foremost, this scenario is inspired by phenomenology, specifically the work of Christian Norberg-Schulz, which emphasizes the subjective experience of architectural spaces [18]. Within the programming phase, this perspective guides the exploration of values such as socialization, privacy, and personalization, aligning with the phenomenological understanding of how people perceive and interact with the built environment. A second theoretical foundation is based on user-centered design principles, which prioritize human experience. Another critical theoretical foundation is democratic architecture and participatory or community design principles, where the scenario, informed by community development theories, initiates a shift toward inclusive decision-making processes [19]. This is based on the principles of participatory action research which emphasizes the value of collaboration with stakeholders and end users to ensure that architectural designs truthfully reflect the diverse values and preferences of the communities they serve. These theoretical foundations converge to inform a holistic scenario that prioritizes human experience, inclusive decision-making process, and adaptability to changing societal needs.

3.2. Components of Practice-Based Research

The practice-based research scenario is shaped by three fundamental components: architectural programming or pre-design, post-occupancy and building performance evaluation, and community design or user participation. These components, when combined, redefine architecture as a knowledge-based profession by offering a holistic and dynamic approach to practice-based research [19].

3.2.1. Programming: Articulating Architectural Values and Goals

Architectural programming is a comprehensive process essential to the initial stages of design. It involves a thorough understanding of user needs and client requirements and includes the gathering and analysis of data to inform design decisions that effectively address functional, contextual, social, and psychological aspects [7,15,20]. It is responsible for articulating the values and goals to which the architect should respond in design [7]. Three distinct value categories are discernible: enduring values, circumstantial values, and institutional values [20]. Enduring values, akin to architectural qualities such as convenience, durability, and aesthetics, directly impact individuals and communities. When embarking on the design process, it is crucial to explore socio-behavioral phenomena like socialization, privacy, and personalization while articulating both functional and social objectives in the architectural program. Furthermore, programming presents the challenge of articulating people's preferences and interpretations of the visual environment within socio-cultural contexts.

Beyond the enduring values, architects must also identify circumstantial values that encompass human, societal, technological, economic, and aesthetic factors specific to given environments. Programming thus serves to elucidate institutional values by focusing on the building's purpose and worth, along with their implications for defined goals, objectives, and needs of clients and users. These institutional values play a key role in guiding designers to address design challenges [19–21].

The focus of programming is strengthened by influential writings, such as Christopher Alexander's seminal work *A Pattern Language*, which underscore the importance of designing spaces that promote social connections [22]. Architects must be able to navigate the delicate balance between openness and seclusion, crafting environments that respect individual boundaries and offer moments of respite. Hence, architects explore the particulars of programming to ensure that evidence of design decisions is articulated and that designs resonate with the personal narratives of those who inhabit the environment.

3.2.2. Post-Occupancy Evaluation and Building Performance Evaluation: Learning from Experience and Precedents

Post-occupancy evaluation (POE) and building performance evaluation (BPE) have gained prominence as tools to assess the success of buildings and designed environments. POE is a systematic assessment conducted after a building or space has been occupied and in continuous use. It involves collecting feedback from users, analyzing how well the design meets functional and performance expectations, and identifying areas for improvement [16,17]. BPE is a comprehensive assessment of a building's performance, considering aspects such as energy efficiency, environmental impact, occupant satisfaction, and functionality. BPE aims to evaluate how well a building performs in various aspects, providing insights for future design improvements and informing sustainable practices. In this scenario, both POE and BPE focus on three fundamental elements: technical aspects related to health, safety, and security; functional aspects related to the efficient operation of spaces; and behavioral aspects related to user satisfaction, both social and psychological. Both POE and BPE offer a range of benefits. In the short term, they help to identify and solve issues and improve space utilization and use, while engaging building occupants in the evaluation process. In the medium term, they enhance adaptability, cost-efficiency, and considerations of building performance. Over the long term, they offer guidance towards building improvements and promote better tools for assessing building performance [16,17]. By scrutinizing technical, functional, and behavioral elements, evaluations provide architects with multifaceted insights that can be incorporated into design decision making.

Within the transdisciplinary framework, evaluations play a crucial role in merging theoretical insights with practical applications. By integrating academic theory with the exigencies of real-world building performance, POE and BPE exemplify the transdisciplinary approach, addressing multiple types of knowledge and ensuring socially relevant solutions. The benefits extend beyond immediate problem solving to include influencing user attitudes and contributing to the continual improvement of design practices within the dynamic and evolving built environment.

3.2.3. Community Design and User Participation: Fostering Democratic Architecture

The concept of community design, encompassing social architecture, community development, and community planning, champions the democratic movement in architecture and allied professions. Interest in the realm of user participation or community involvement is not a novel concept. It does not stem from romantic notions of human involvement or human rights, but rather emanates from the acknowledgment that users possess a distinct expertise, equally vital to that of architects. This expertise ought to be integrated into a process dedicated to developing an appropriate built environment [7].

Recognizing the profound impact of mismanaged built environments on individuals and communities this approach advocates for user participation as a fundamental aspect of the design process. By integrating user expertise, considering their values and preferences [23,24], and reducing feelings of anonymity, community design positively influences the built environment. Key aspects of community-centered design include enhancing trust through involvement in decision making and providing a voice in design processes, crucial for improving plans, decisions, and the overall service delivery within the architectural profession [19,25,26]. These principles not only empower users but also contribute to the socio-cultural and environmental contexts in which buildings are created.

3.3. Operationalization of Practice-Based Research Scenario

The preceding components of practice-based research represent social and ethical approaches to architecture. They are reshaping the role of the architect [7,27] and are offering a framework through which architects can address social and ethical questions within professional practice. They provide avenues to integrate different types of knowledge into design which result from transdisciplinary practice. Transdisciplinarity, in this sense, represents a new form of learning and problem solving that brings together professionals

from diverse backgrounds, stakeholders, and academia to tackle complex societal and environmental challenges.

The operationalization of the practice-based research scenario reflects a profound transformation within architectural research and knowledge production. Architects find themselves in an ever-evolving landscape marked by expanded scopes, complex activities, and a surge in complex developments. This metamorphosis necessitates a re-evaluation of the profession's traditional roles while embracing a more comprehensive and socially responsive approach towards both knowledge creation and design decision making (Figure 2). This is evident in several features that characterize current efforts within architectural research, pedagogy, and practice and can be articulated as follows:

- *The Changing Role of Architects:* The conventional role of architects is undergoing a paradigm shift, driven by technological advancements and rapid societal value changes. Integrated design and construction teams are replacing pure design practices, making architects key team players in a spectrum of responsibilities. From programming and feasibility analysis to construction management and building operation, architects are adapting to a more interactive agenda that redefines their societal and professional impact.
- *Challenges in Architectural Education:* Architectural education faces challenges in aligning with the evolving professional landscape. The traditional architectural studio often perpetuates an egoist role model, limiting students to a singular view of design. To address this, contemporary teaching practices must expose students to diverse architect role models which emanate from the three components of practice-based research, which adopt and employ critical thinking and evidence-based decision making as core skills.
- *Transdisciplinary Pedagogy:* A responsive pedagogy in architecture demands a departure from conventional models. Concepts such as programming, post-occupancy evaluation, and user participation are becoming integral to design teaching. The community/university-learning lab concept, embodied in 'design-build' or 'live projects', immerses students in real-world design problems through an action research approach that fosters a transdisciplinary knowledge production and evidence-based design decision making.
- *Integration of Ethical Considerations:* Ethical considerations play a pivotal role in the future of architectural education and practice. Integrating social and ethical approaches to design requires exposing students to alternative social roles and user needs. In this respect, programming and post-occupancy evaluation become important vehicles for making ethical design decisions while emphasizing their impact on the well-being of users and rigorous learning from precedents.
- *Knowledge Types and Transdisciplinarity:* Knowledge making within the architectural profession involves four distinct types: scientific expert knowledge, folk knowledge, practical knowledge, and tacit knowledge. Transdisciplinarity emerges as a guiding principle that places emphasis on the holistic integration of these knowledge types, ethical considerations, and responsive decision making. Notably, this underscores the unique knowledge-building mode in architectural design.

The preceding features necessitate navigating challenges in architectural education, embracing a transdisciplinary pedagogy and practice, and integrating ethical considerations into design processes. This transformative approach aligns architectural practices with societal needs, paving the way for a socially responsible future of architecture as an academic discipline and as a profession.

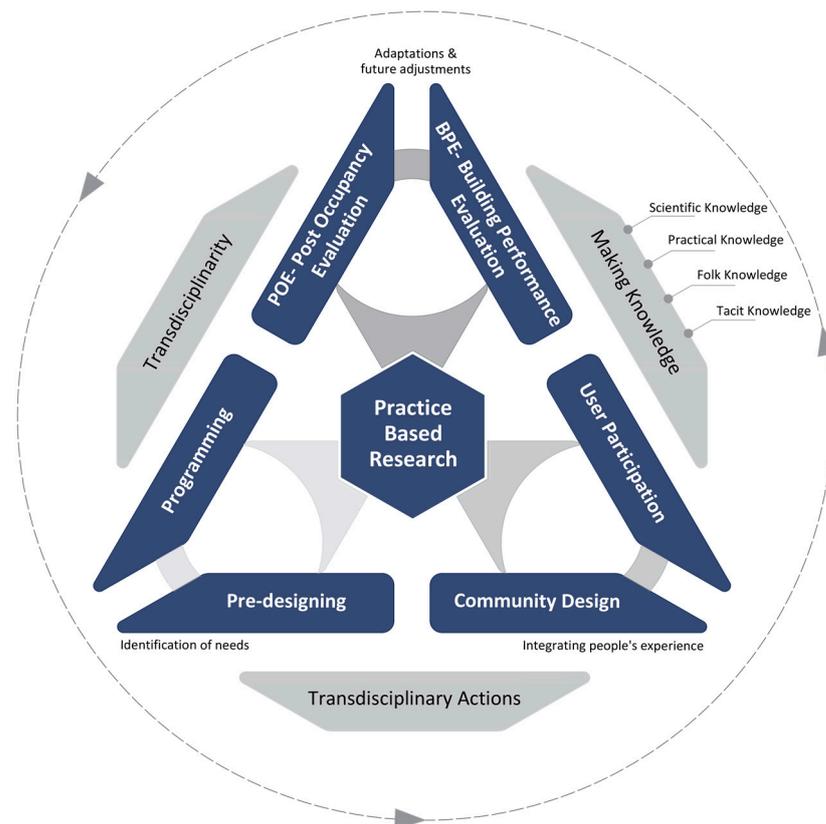


Figure 2. Transdisciplinary practice-based research scenario: programming, evaluation, and user participation (source: the authors).

4. Scenario 2: Building Anatomy Research

Building anatomy research consists of three distinctive facets: architectural criticism, building performance evaluation, and habitability [28–30]. This scenario establishes a theoretical paradigm for evaluation, a departure from traditional methods of assessment often reliant on architects’ press releases or arguments made by critics. This scenario calls for the coexistence of this new paradigm of ‘evaluation’ with traditional methods of ‘criticism’ to avoid perceived or potential knowledge gaps instigated by the exclusive reliance on ‘criticism’ in architectural circles. This integration ensures a robust and reliable understanding of buildings, transcending individual standpoints and contributing to a holistic perspective of design, performance, and livability.

4.1. Theoretical Tenets of Building Anatomy Research

The theoretical foundation in this scenario draws from key perspectives that contribute a comprehensive and interconnected framework. Firstly, phenomenology serves as a foundational element that places emphasis on the subjective nature of architectural criticism. Inspired by the works of philosophers such as Edmund Husserl and Maurice Merleau-Ponty [31–33], phenomenology recognizes the individual’s subjective perception and experience of the built environment.

Building performance evaluation (BPE) [17,34] forms a crucial aspect grounded in empirical inquiry, reflecting a commitment to systematic assessment and real-world data. By employing empirical research methods, BPE considers user-centered assessments and technical, material, and sustainable considerations. Furthermore, the theoretical underpinning of habitability incorporates sociocultural perspectives [35,36]. It recognizes that the quality of environments is contingent upon cultural contexts and societal values. Informed by anthropological and sociological theories, habitability considers the ways in which individuals or groups interact with and perceive their surroundings.

The overarching theoretical foundation of the building anatomy research scenario is rooted in holistic analysis that advocates for the integration of architectural criticism, BPE, and habitability into a unique scenario for inquiry. This is inspired by systems thinking and transdisciplinary approaches that acknowledge that the built environment is a complex system where various elements interact.

4.2. Components of Building Anatomy Research

Anchored in foundational theories, the building anatomy research scenario focuses on three critical components—architectural criticism, building performance evaluation (BPE), and habitability. Each component contributes unique insights and enriches our understanding of how the built environment is perceived, assessed, and experienced.

4.2.1. Architectural Criticism

Architectural criticism is a key component of this scenario, albeit not without its challenges. Criticism, inherently subjective, targets specific readerships, whether popular or specialist. However, the success of any critical work hinges on maintaining objectivity. Dennis Sharp [37] emphasized the importance of objectivity in architectural criticism, aligning it with good judgment, sagacity, and the ability to resist mediocre mass cultural values. Wayne Attoe [38] stressed the importance and prevalence of criticism in the architectural press, especially with respect to the potential of influencing decision-makers. In essence, architectural criticism is an appreciative examination of a building or a project within a vast array of historical, philosophical, technological, social, and environmental contexts [30]. More recently, several writings have explained the relationship between criticism, the profession, and the public. Thomas Fisher argued that criticism is most useful when it “engages the broadest public possible in what our field has to say about the world’s most pressing problems” [39]. Despite its historical relevance, recent years have witnessed a divergence of criticism from its public-oriented purpose, necessitating a realignment with its original intent.

4.2.2. Building Performance Evaluation (BPE)

Building performance evaluation (BPE) evolved from systematic post-occupancy assessments, which gained prominence in the 1960s. Initially focused on user-centric assessments, BPE has expanded its scope to include technical aspects, material characteristics, and sustainability dimensions (environmental, social, and economic). Early studies, such as those by Sim van der Ryn (1967) [40] and Victor Hsia (1967) [41] in the United States and Thomas Markus in the United Kingdom, were centered on users to enhance design based on real-world experiences. Along similar lines, the Building Performance Research Unit (BPRU) at the University of Strathclyde, in 1968, commenced a project focusing on evaluating newly built comprehensive schools for children ages 11–18 [42,43]. The results of these early studies remain valid, highlighting recurring issues such as a focus on reduced initial building cost, design errors, poor alignment of buildings and spaces to users’ needs, contextual parameters, and overemphasis on single design aspects.

Over time, BPE transitioned to encompass technical aspects related to energy conservation, and the promotion of low-carbon designs. However, this led to the neglect of users’ psycho-physiological needs and compromised the understanding of how buildings profoundly impact people. BPE, rooted in the realm of environment–behavior studies, systematically evaluates both interior and exterior environments, proactively identifying and addressing social and environmental challenges while offering guidance to resolve them.

4.2.3. Habitability

The concept of habitability, which emerged in the 1960s [44,45], centers on the quality of environments and the relationships between individuals or groups and their immediate surroundings. Habitability, subject to cultural interpretation, primarily addresses the spatial fitness of interior volumes as human habitats [46]. Aligned with sustainability, habitability

emphasizes equitable resource allocation and minimizing adverse impacts on the natural environment [47]. Person–environment relationships within habitability encompass entire buildings, specific key spaces or settings, and occupants’ engagement with these spaces. Emphasizing psychological comfort and satisfaction, habitability considers factors such as spatial adjacencies, dimensions, orientation, and proportions. Within the habitability component, the concepts of sociopetality and sociofugality [48] further investigate elements influencing social interaction and engagement with the spatial environment.

4.3. Operationalization of Building Anatomy Research

The building anatomy research scenario combines architectural criticism, building performance evaluation, and habitability as essential components for a comprehensive understanding of the architectural or urban environment. This multifaceted approach enables a holistic analysis by considering the impact of the built environment on society and inhabitants’ well-being. The triadic scenario underwent rigorous validation using various tools that demonstrate its effectiveness in comprehensively evaluating the spatial environment of the Riverside Museum, Glasgow, Scotland [30]. The multimodal scenario broadens the scope to encompass the experiential and sociocultural dimensions. It employs tools like content analysis, walking tour assessments, direct observation, behavioral mapping, and an exploration of emotional experiences to provide a more comprehensive perspective on how the built environment is perceived, used, and valued by their users (Figure 3). A number of tools that demonstrate possibilities for operationalizing the building anatomy research scenarios can be outlined as follows:

- *Content Analysis for Architectural Criticism:* Content analysis served as an invaluable approach involving a selection of 33 articles and clippings representing diverse perspectives, including those of the architect/design team, the client/Glasgow City Council, professional organizations, architects, and critics. Through systematic examination, content analysis effectively confirmed the framework’s ability to critique various dimensions including the museum’s role in the city, its position within the architectural community, design metaphors, building form, and the overall design quality.
- *Walking Tour Assessment (PLANDES) for Performance Evaluation:* The utilization of PLANDES (Planning, Landscaping, Designing) for structured walking tour assessments involving a six-point Likert Scale validated the framework’s effectiveness in evaluating performance aspects such as planning and zoning, landscaping, and designing. The engagement of 25 postgraduate students in the assessment demonstrated the capability to provide a structured assessment of the spatial environment.
- *Examining Emotional Reactions:* Soliciting responses from 22 participants who had visited the museum and analyzing their emotional reactions at 12 identified locations confirmed the framework’s ability to assess habitability and user perspectives. The tool efficiently assessed user satisfaction and emotional reactions.
- *Direct Observation, and Behavioral and Navigational Mapping:* Mapping users’ behavior and activities, coupled with direct observation, efficiently documented the spatial experience, providing valuable insights into attitudes and behaviors. Structured observations of activities, settings, and timings, essential to avoid redundancy [49], have been implemented. Employing contemplating settings (place-centered) and navigational mapping (user-centered) [50–52] reinforced effectiveness in establishing a clear relationship between architectural criticism (what is writing about the building), performance evaluation and habitability (how it performs).

The coordinated application of content analysis and walking tour assessment (PLANDES) ensured the robust operationalization of this scenario. Collectively, these approaches strengthened its capacity to generate findings relevant to building anatomy research.

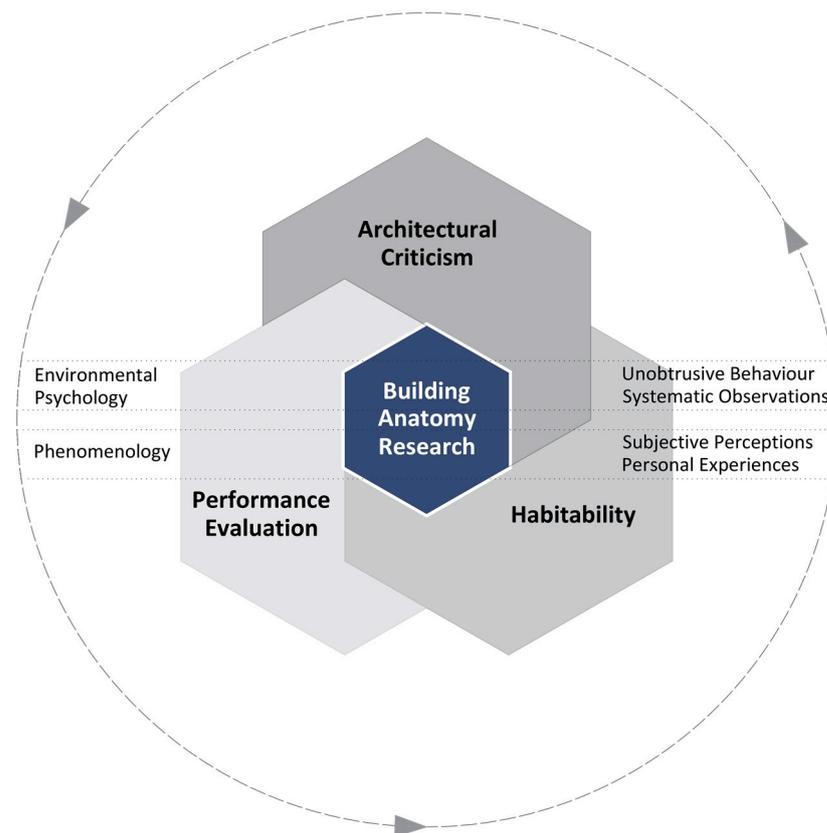


Figure 3. Transdisciplinary building anatomy research scenario: criticism, performance evaluation, and habitability (source: the authors).

5. Scenario 3: City Dynamics Research

This scenario encompasses the comprehensive analyses of decision-making processes at the city level and employs interlocking network models to investigate how urban space is used by companies or key employers within knowledge-intensive economic sectors. It acknowledges the significance of employee perspectives and their role in shaping the understanding of contemporary urban conditions. This scenario utilizes several empirical research methods, including survey studies, focused interviews, systematic observations, and behavioral and cognitive mapping. Furthermore, it considers the evolutionary aspects of the city's urban structure, leveraging GIS data and space syntax analyses to provide a comprehensive picture of urban dynamics.

5.1. Theoretical Tenets of City Dynamics Research

The theoretical foundation of this scenario is anchored in Lefebvre's triadic conception of space that delineates urban space into three dimensions: conceived space, perceived space, and lived space [53]. Based on this theoretical standpoint, this research scenario strategically navigates four key factors that probe the realm of urbanism by interweaving economic, social, and spatial transformations. Beyond being an intellectual undertaking, this scenario is a deliberate response to the urgent need for a holistic understanding of urban dynamics, identity metamorphosis, economic diversity, urban livability, and effective governance.

Urban governance embodies the conceived space by providing a critical examination of decision-making processes and encapsulating the essence of development visions, strategies, and planning organizations [54]. This encompasses intentional and strategic decisions in the public sector and highlights optimized resource allocation and sustainable practices for urban efficiency. Spatial practice exemplifies the perceived space by dissecting tangible behaviors that make the urban landscape—from the ebb and flow of inhabitants'

movements to the web of company networks. The identification process represents the lived space by systematically weaving a tapestry of images of success, livability, and values, as understood by the inhabitants which lead to findings on the ever-evolving urban identity [9]. This scenario represents a call to action—a methodical exploration inspired by Lefebvre’s theories which ensures a nuanced understanding of the interplay between urban structures, economic activities, and societal dynamics in emerging urban environments.

5.2. Components of City Dynamics Research

The city dynamics research scenario is divided into three components: the urban governance triad, which dissects decision making for urban efficiency; the spatial practice triad, which explores tangible behaviors and leads to insights on urban diversity; and the identification process triad, which deciphers aspirations, aspects of quality of urban life, and social values that form urban identity (Figure 4).

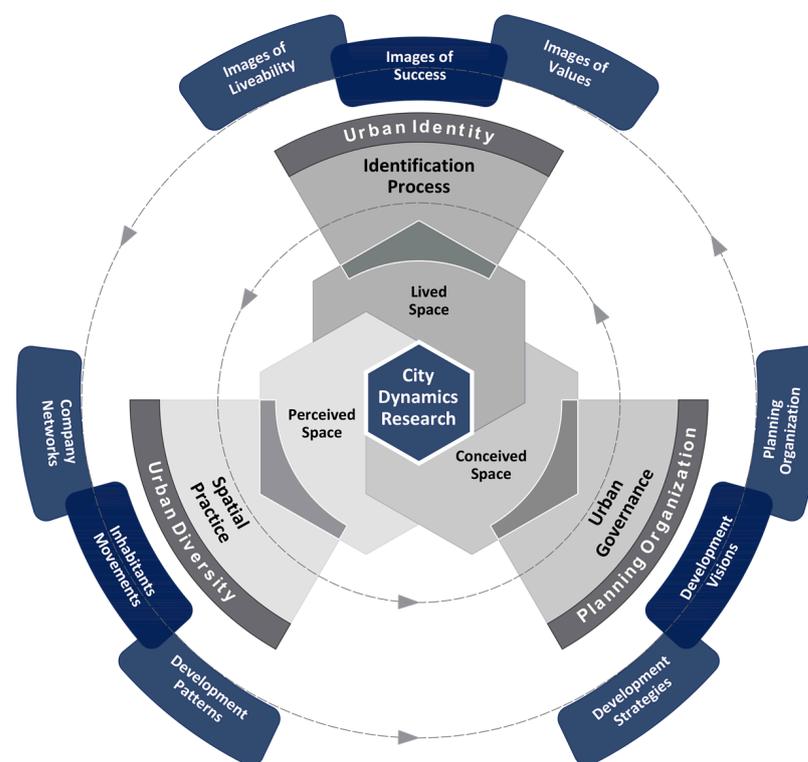


Figure 4. Transdisciplinary city dynamics research scenario: urban governance, spatial practice, and identification process (source: the authors).

5.2.1. Urban Governance Triad

Urban governance systematically examines the decision-making structures and associated processes. It comprises three vital components [9]. Firstly, “development visions” encapsulates aspirations and long-term goals held by urban authorities, policymakers, and city leaders guiding the city’s trajectory. Secondly, “development strategies” involves actionable plans fostering economic growth, improving infrastructure, enhancing livability, and achieving sustainability. The final element is “planning organizations”, which encompasses government agencies, urban planning departments, and various institutions responsible for strategically planning and executing urban development projects. Effective urban governance aims at achieving “urban efficiency” to optimize resource allocation, promote sustainable practices, and streamline urban processes, resulting in a well-coordinated urban environment.

5.2.2. Spatial Practice Triad

This triad is concerned with tangible behaviors and actions of city inhabitants, companies, and developers who collectively shape the urban landscape. It comprises three interconnected components [54]: “inhabitants’ movements” studies daily routines, travel patterns, and mobility choices, encompassing aspects such as commuting, the locations of leisure activities, access to amenities, and how inhabitants navigate the city; “company networks” explores the relationships and interactions between businesses, educational institutions, research centers, and the broader economic ecosystem; and “development patterns” investigates manifestations of urban dynamics through the physical development of a city. This involves examining patterns of construction, land use, and infrastructure development, encompassing the design of urban spaces, architectural styles, and the implementation of planning strategies. The culminated “urban diversity” reflects how collective spatial practices contribute to the dynamic nature of urban environments.

5.2.3. Identification Process Triad

Crucial to shaping the urban identity of cities, the identification process triad examines the way in which residents, stakeholders, and decision-makers envision the future of their city. It comprises three interconnected components [9]: “images of success” delves into the collective aspirations and definitions of success held by city inhabitants which encapsulate a sense of attachment to economic achievements, innovation, and societal progress; “images of livability” focuses on residents’ perceptions considering various factors such as quality of housing, transportation, safety, healthcare, education, and the overall well-being; and “images of values” explores the ethical, cultural, and environmental values dear to society and influencing the urban fabric. The concluded “urban identity” emerges from the accumulated subjective attachments and reflects the city’s character, ambitions, and shared values.

5.3. Operationalization of City Dynamics Research

The Lefebvrian triadic conception of space was advanced from a theoretical agenda into a robust research framework which was envisioned through the formulation of research objectives to offer a multi-dimensional perspective on the interdependencies among economic, urban, and spatial transformation processes [11,54]. It was validated in the city of Doha.

- *Understanding the Historical Evolution of Urban Governance:* Conducting a historical analysis was critical in tracing the impacts of urban governance on urban transformation processes in Doha. This involved the examination of archival records, policy documents, and historical data to map the introduction of investment strategies, new development visions and master planning processes. This approach assisted in identifying and anticipating the new challenges that lead to the establishment of a diversified economy to address them.
- *Analysis of Company Networks in a Knowledge Economy Context:* This objective investigated the networks of multi-branch companies that established offices in Doha. Employing comprehensive network analyses, this entry investigated the structures and role of these companies at local, regional, and global levels. This analysis served as a key indicator of the current state of economic transformation in Qatar’s capital city revealing connections and complexities in the new knowledge economies.
- *Understanding the Role of the “Expatriate Professionals” in Urbanism:* This objective examined the burgeoning “creative class” in Doha, which comprised migrant professionals and was a consequence of the emergence of new economic sectors. The approach included sociocultural surveys and interviews to explore how individuals from diverse backgrounds perceive and experience their urban surroundings. It validated the importance of various socio-cultural groups in redefining urbanism in emerging cities, shedding light on the social dynamics that result from its development and evolution.

- *Analysis of the Spatial Transformations to Accommodate Economic Growth*: The spatial analysis of the urban fabric provided insights into how urban structures in Doha transformed to accommodate the needs of companies, inhabitants, and acclimatize to the visions of rapid urban growth. This approach examined the formation of new urban centers, spatial accessibility, and transformation in urban areas and residential neighborhoods to align with new economies and emerging spatial practices.

In employing these diverse methodologies, this framework's components demonstrated their applicability in real-world scenarios within emerging cities. This framework enhances our understanding of urban dynamics, identity transformation, urban diversity, and effective governance in emerging cities.

6. Scenario 4: Housing Dynamics Research

Methodological discourse on housing has changed over time to include six approaches: formal and aesthetic interpretations; the typological approach; evolutionary theories; explanations of the physical characteristics of dwellings; sociocultural factors; and religious practices [9]. However, discussions about housing in many parts of the world have historically diverged into two distinct domains: technical considerations concerning mass housing challenges and stylistic discussions on cultural authenticity [9,55]. Unfortunately, these discussions have often taken place in isolation, resulting in a superficial treatment of factors crucial for understanding the existing housing initiatives and the dynamics involved [9].

6.1. Theoretical Tenets of Housing Dynamics Research

This scenario is underpinned by philosophical perspectives that focus on the societal, cultural, and individual influences on housing dynamics. The theoretical foundations draw inspiration from key concepts introduced by social scientists and anthropologists such as Pierre Bourdieu and Mary Douglas.

Pierre Bourdieu's [56] concept of habitus plays a crucial role in shaping the framework. Habitus refers to the ingrained dispositions, skills, habits, and subjective schemes of perception that individuals develop over time due to their experiences within specific social contexts [56,57]. This concept recognizes that housing choices are not arbitrary but rather are deeply rooted in past experiences, cultural backgrounds, and social environments. Habitus is the result of long-term evolution and has a profound impact related to personal history and cultural context on housing preferences.

The British anthropologist Mary Douglas introduced the "group and grid" model in her book *Natural Symbols* [58]. A group implies a general boundary around a community, which is based on choice, and a grid includes the outer forces and regulations. Douglas distinguishes between four main group-grid types: the "isolate", the "positional", the "individualist", and the "enclave". While the "isolate" only includes social groups that have been isolated by the system, such as prisoners, and therefore hardly has any impact on developments, the "individualist" is primarily concerned with private benefits and is, therefore, a product of an increasingly commercial society. Therefore, social status and its expression can play an important role in housing dynamics. The "positional" is rooted in a distinct group following a clear grid-given structure and thus often supports tradition and order [58,59]. Finally, the "enclave" includes all groups that refuse to participate in any given framework and follow their own structures. These four fundamental types offer an enhanced understanding of key lifestyle dynamics. By incorporating this theory, the scenario recognizes housing typologies based on societal boundaries and regulations.

Following the clear positions within Douglas's "group and grid" model, other scholars have introduced pragmatic models on how to distinguish certain life modes that shape lifestyle trends today. In his book *State, Culture, and Life-Modes: Foundations of Life Mode Analysis*, Thomas Hojrup [60] introduced three pragmatic life modes: the "self-employed" life mode, the "wage earner" life mode, and the "career-oriented" life mode. These life modes show that housing preferences are likely to be different depending on income, work sector and work style [61–63].

6.2. Components of the Housing Dynamics Research

The scenario addresses the existing knowledge gap resulting from a lack of research that integrates the evolutionary (the habitus triad), the spatial (the group–grid structure triad) and the socio-cultural dimensions (the life mode triad). These triads explore the diverse influences on housing choices encompassing habits, traditions, social status, and evolving needs, wants, and values. From communal living and positional arrangements to considerations regarding leisure, work, and family life, this framework provides nuanced insights into housing dynamics. It addresses the varied housing needs and preferences of communities effectively [9] and is valuable for researchers and decision makers.

6.2.1. The Habitus Triad

The habitus triad recognizes the multifaceted nature of housing typologies and underscores the critical role that personal habits, social status, and evolving needs play in shaping housing choices. Firstly, the examination of habits and traditions seeks to understand how individuals either maintain or adapt their housing choices to established practices and customs. Secondly, the concept of “*status*” elucidates the intrinsic connection between housing choices and the social standing and aspirations of an individual or a group that often stem from a desire to represent one’s position in society. This factor evaluates the complex connections between housing design and the pursuit of social recognition and distinction. Lastly, the concept of “*needs*” recognizes the fundamental desires of individuals and the adaptation of housing environments to meet evolving requirements [9]. The examination of needs probes into how housing design impacts the quality of life, convenience, and the overall well-being of residents. This triad suggests that perception of housing is influenced by past experiences, current needs, and future aspirations.

6.2.2. The Group–Grid Structure Triad

Housing research is a nuanced exploration of the relationship between individuals or groups and the built environment and is centered on three distinct aspects of housing typologies. First, it recognizes the “*enclave*” as a housing typology that accentuates communal living and fosters a strong sense of shared identity and belonging. It is characterized by close-knit communities, shared amenities, and a dedicated focus on collective well-being, but in isolation from the wider society. Second, “*positional*” housing typologies revolve around the intersection of social status and location and the individual’s desire to demonstrate social prestige. This reflects social standing and incorporates features that serve as status symbols. “*Individualist*” housing typologies prioritize personal space and autonomy, offering residents a high degree of control over their living environment. These typologies emphasize privacy and customization, and examine how housing design influences individual well-being, self-expression, and lifestyle choices [58,59]. This triad places emphasis on “*social attitudes*” towards housing typologies and in turn represents preferences for specific housing typologies based on attitudes towards integration with the community.

6.2.3. Life Mode Triad

The life mode triad recognizes that life roles greatly affect housing needs and preferences. It consists of three interconnected components. “*Leisure*” revolves around the need for relaxation, entertainment, and recreational activities and deals with how housing spaces are designed to cater to leisure activities and provide comfort by incorporating amenities tailored for leisure-specific pursuits. The “*work*” component explores the alignment of housing with professional life. This entails an examination of factors such as proximity to workplaces, the availability of home offices, and the overall suitability of housing for various work-related activities. “*Family*” is a crucial component that focuses on how housing meets the needs of families by examining considerations for space dedicated to children, communal areas for family interactions, and the adaptability of housing environments to accommodate changing family dynamics [60–63]. This triad examines personal attitudes

towards housing and in turn represents an individual's housing perception shaped by changing needs and spatial preferences.

Collectively, the preceding three triads serve as a robust foundation for housing research by recognizing the multifaceted nature of housing dynamics (Figure 5). Investigating the interplay of habits and traditions, status, and needs enables researchers to gain valuable insights into the diverse typological preferences exhibited by individuals or groups.

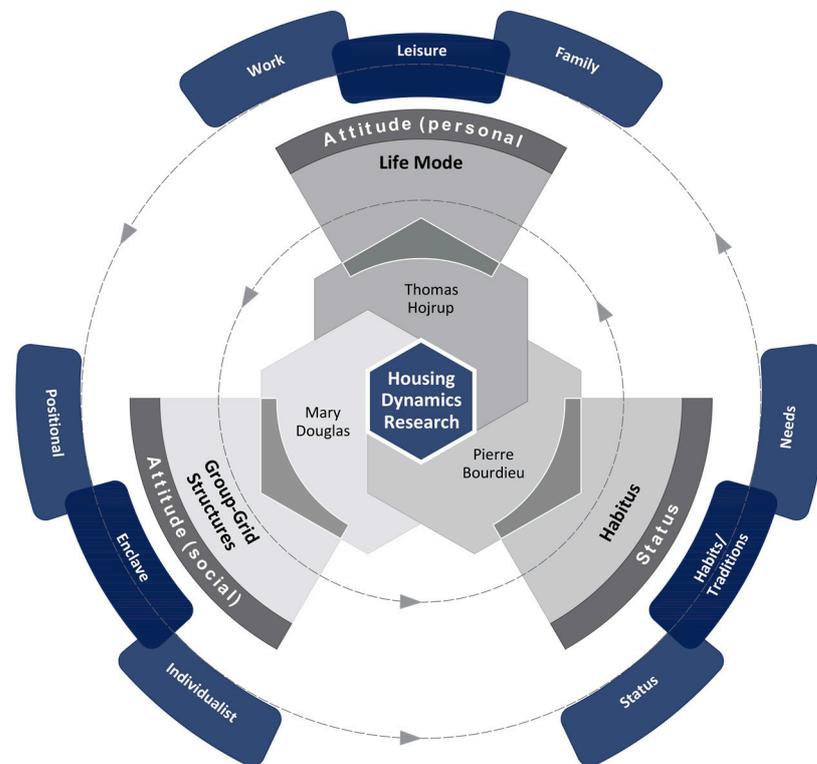


Figure 5. Transdisciplinary housing dynamics research: the habitus, the group–grid structure, and life modes (source: the authors).

6.3. Operationalization of Housing Dynamics Research

This scenario underwent operationalization in Gulf cities, aiming for a comprehensive examination of housing dynamics by addressing three questions: (a) How have the rapid changes affected housing developments and typological changes? (b) What lifestyles do new housing typologies reflect? (c) How can housing types be developed to support quality of life in the Gulf? [9,64]. The approach combined spatial analysis, community engagement, scenario planning, and real-time data insights to provide a holistic perspective that considered both historical trajectories and future possibilities in housing. The integration of multiple disciplines and engagement with diverse stakeholders ensured a contextually relevant exploration of housing dynamics scenario in Gulf cities. The operationalization encompassed the following actions and tools:

- *Understanding Housing Typological Transformations:* A thorough literature review was conducted to identify contextual factors affecting housing typological transformations in Gulf Cities. The review examined global housing development trends and scientific theories related to lifestyles.
- *Analysis of New Lifestyles in Housing:* Employing attitude surveys and ethnographic studies, this phase measured neighborhood satisfaction and perceptions of societal changes relevant to housing choices. It identified emerging lifestyle dynamics within local housing market and urban development while mapping them to various sociocultural and socio-economic groups. This offered a validation of the concept of evolving lifestyles and emphasized the need for adaptable housing types.

- *Scenario Planning*: The introduction of housing guidelines, considered in diverse Gulf contexts, facilitated the development of approaches for future housing development. This validated the framework's effectiveness in anticipating changes in socio-cultural, economic, and environmental factors which further emphasized the framework's capacity to address multiple factors amenable to improving housing projects.

The integration of diverse perspectives, spanning historical contexts to future possibilities, validates the adaptability of housing types. These findings not only apply across various Gulf contexts but also provide valuable insights for shaping future housing research in other similar contexts.

7. Scenario 5: A Multidimensional Examination of User Perceptions

This scenario combines architecture, urban studies, and environmental psychology disciplines to examine how people perceive and use their built environment. It emphasizes multisensory design and cultural influences for a holistic understanding of user experiences. This scenario explores architectural aesthetics, sensory factors, and social influences using the perception triads framework. It encourages professionals to move beyond traditional assessments to enable the creation of spaces aligned with the dynamic nature of human perceptions.

7.1. Theoretical Tenets Guiding the User Perceptions Research

The exploration of user perceptions within the built environment is grounded in robust theoretical foundations which draw insights from influential figures in urban studies and environmental psychology. On the one hand, Kevin Lynch's seminal work, *The Image of the City*, significantly contributes to the theoretical framework by introducing the concept of mental mapping, which examines how individuals construct cognitive maps of their environments [65]. This notion guides the investigation into how users mentally navigate and construct their understanding of urban spaces based on their perceptions of the built environment. Likewise, Amos Rapoport's contributions to the cultural factors of built forms enrich the theoretical underpinnings of this scenario. His exploration of the relationship between cultural patterns and the physical environment provides a lens for analyzing how users' cultural backgrounds shape their perceptions of the environment [66,67]. This aligns with the scenario's focus on understanding the socio-cultural influences on user experiences.

On the other hand, Moore's [68] exploration of environmental aesthetics adds another layer to the theoretical framework, emphasizing the importance of aesthetic experiences in shaping individuals' responses to architectural and urban elements. This perspective contributes to unraveling the visual dimensions influencing user perceptions. Nasar's [69,70] contributions to environmental psychology play a pivotal role in shaping the theoretical foundations of this scenario. Nasar's research on the psychological dimensions of the built environment, including factors like visual aesthetics, wayfinding, and sensory experiences, informs the exploration of how users psychologically engage with and respond to the physical environment. Further insights are drawn from Kaplan and Kaplan's attention restoration theory [71], which highlights the role of the environment in cognitive restoration.

Additionally, Ewing's [72,73] perspectives on walkability in urban environments and Clemente's [73] examination of the impact of urban morphology on human behavior also contribute to the multifaceted theoretical framework. These additional dimensions enhance the understanding of user perceptions and incorporate aspects of cognitive restoration, walkability, urban morphology, and architectural psychology into the comprehensive framework. Collectively, these theories provide a multidimensional approach to unravel how users perceive and interact with the built environment and offer important insights for architects, urban planners, and researchers.

7.2. Components of the User Perceptions Research

This scenario stands as a robust approach to uncover the way in which individuals perceive and interact with the built environment. In essence, it is driven by the postulation that user experiences are deeply influenced by visual aspects, sensory elements, and the broader social and cultural context (Figure 6).

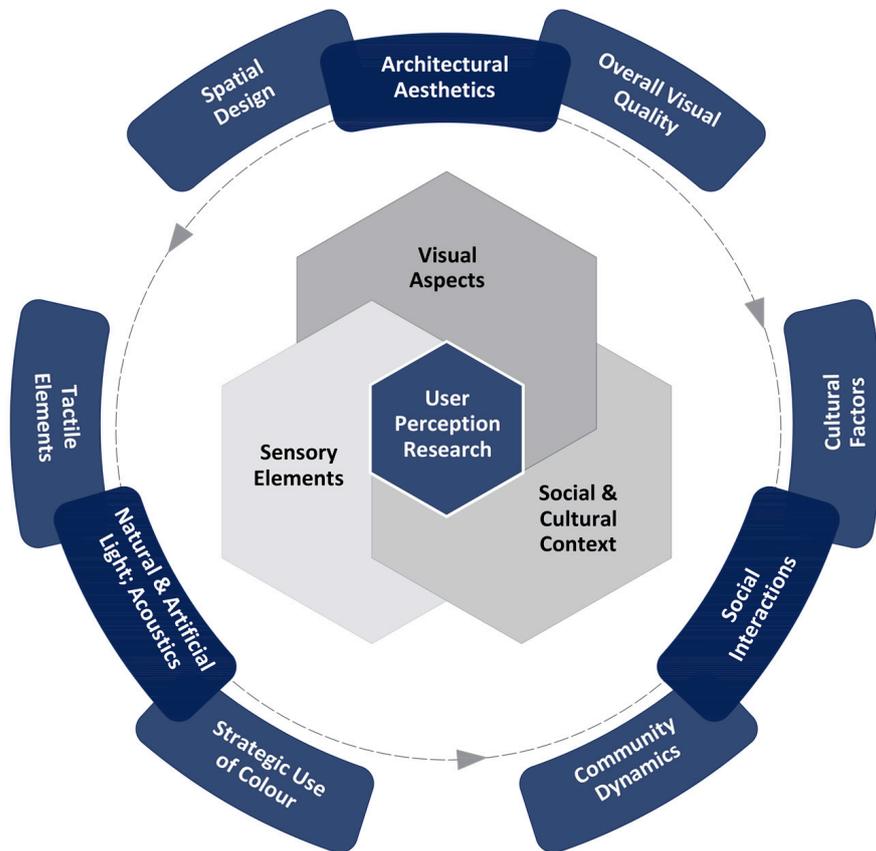


Figure 6. User perception research scenario: visual aspects, social and cultural context, and sensory elements (source: the authors).

- **Visual Aspects:** This triad engages in a comprehensive examination of how individuals interpret the visual attributes of their built surroundings. It delves into the realms of architectural aesthetics, spatial design, and the overall visual quality of the environment [69,70,74]. Researchers undertaking this exploration can discover the subjective aspects of what individuals find visually appealing in their built environment. This encompasses a nuanced analysis of building design, urban landscapes, streetscapes, and aesthetic preferences to uncover the elements that captivate and enhance the visual experience of users.
- **Sensory Elements:** Shifting the focus to the sensory realm, the second triad probes into the interplay between individuals and their environment [66,67]. It investigates the profound influence of sensory factors on user experiences. This includes a detailed examination of the interplay of natural and artificial light, the acoustic environment, tactile elements such as textures, and the strategic use of color [74–77]. In this sense, it aims to disclose how these sensory elements dynamically shape users' perceptions and evoke specific feelings.
- **Social and Cultural Context:** This triad expands the exploration to encompass the broader societal and cultural context in which the built environment exists. It explores the complex network of social interactions, community dynamics, and cultural elements that significantly impact the way in which people perceive and engage with their

environment [76–78]. Researchers can examine the relationship between the social environment, local community norms, and cultural context and how they shape users' perceptions and behaviors. This holistic understanding acknowledges that user experiences are not isolated but intricately connected to the social and cultural fabric of the community.

Through the amalgamation of quantitative data, qualitative insights, and rigorous behavioral observations, this scenario paves the way for a thorough understanding of user experiences within the built environment. It urges architects, urban planners, and researchers to transcend conventional assessments towards developing spaces that harmonize the diverse and dynamic facets of human perceptions. In doing so, it aspires to contribute to the creation of an enriched and inclusive built environment that resonates with the tapestry of human experience.

7.3. Operationalization of the User Perceptions Research

The operationalization of the scenario for studying user perceptions of urban density underwent a rigorous validation process in the city of Glasgow, UK [79]. This process aimed to ensure the reliability, applicability, and effectiveness in capturing the dimensions of user experience. The operationalization methods and their outcomes can be identified as follows:

- *Sorting Tasks:* These tasks [80,81] were conducted to evaluate the framework's ability to categorize and prioritize visual and social/cultural aspects of user perception of density. Participants sorted various images representing different degrees of density (low, moderate, high) based on their perceived significance and similarity of the content. The results demonstrated the capacity of this approach to effectively capture the multidimensional nature of user perceptions. This entry identified 63 factors covering built form, site organization, emotional responses, and other aspects, which would have not been identified using traditional methods.
- *Situation Judgment Tasks:* These tasks [82] were designed to assess the framework's applicability in practical decision-making situations related to urban planning and design. Participants were presented with situations depicting different density situations, and their judgments (positive or negative) were analyzed against the established factors. The outcomes indicated that this technique provides a practical and relevant tool for making informed decisions, aligning with user perceptions in diverse urban contexts.
- *Image Segmentation Analysis:* Employing image segmentation techniques [82], the effectiveness of the framework in dissecting and interpreting visual components within urban environments was rigorously tested. Image datasets comprising diverse built environments with varying density levels were segmented into eight components: buildings, vegetation, sky, streets, people, vehicles, pavements, and streetscape elements. The framework demonstrated accuracy in identifying and categorizing these visual elements, showcasing its robustness in analyzing the visual aspects of user perception. Additionally, it facilitated the identification of the proportion of each element relative to the respective density level.
- *Applications to Real-World Cases:* The framework underwent practical application to real-world cases, encompassing high-density situations globally, with a specific focus on the city of Glasgow. The objective was to validate whether the results align with those derived from Glasgow's urban environment, considering the contextual variations in built environments and user perceptions of density. While the factors influencing user perception of density remained consistent, the proportion of the built environment varied. This variability is attributed to the relative nature of density, often dependent on the visual composition within a specific frame of reference [82]. The findings derived from these applications underscored the framework's capacity to uncover meaningful insights and offer valuable inputs for informing urban planning and design strategies.

The key inference resulting from the operationalization of this scenario is that the validation process confirmed the robustness and versatility of the framework for studying user perceptions of the built environment. The combination of sorting tasks, situation judgment tasks, image segmentation analyses, expert reviews, real-world applications, and reliability testing supports the framework's efficacy in providing a comprehensive understanding of how users perceive and interact with their surroundings.

8. Conclusions: Prospects for Research in Architecture and Urbanism

Providing a synthesis of the five transdisciplinary research scenarios in architecture and urbanism, this concluding section highlights their potential contributions to architectural and urban discourse. It also asserts the universal applicability of the methodologies adopted in the scenarios presented here while demonstrating their potential beyond specific research contexts or domains of inquiry.

8.1. Deriving Framework Components from Theoretical Foundations

Across the five scenarios, there is a common thread of theoretical foundations and philosophies that underpin the research approach and process. In Scenario 1, phenomenology, user-centered design, and participatory action research emerge as overarching standpoints that emphasize the subjective experience, user engagement, and collaborative processes. POE, BPE, and architectural programming in Scenario 2 apply sociological fundamentals to understand and develop recommendations about improving buildings. POE assesses user satisfaction while BPE extends the evaluation to performance metrics at the physical level. Architectural programming ensures user-centric and evidence-based design. These approaches integrate sociological and behavioral dynamics for planning and design solutions resonating with user needs and local resources.

Lefebvre's triadic conception of space serves as a foundational theory in the examination of urban dynamics in Scenario 3. The identification process, spatial practice, and urban governance triads emphasize the collective aspirations, tangible behaviors, and governance structures that shape emerging cities and rapidly growing urban contexts. This triadic perspective introduces a socio-spatial lens while highlighting the interconnectedness of economic, social, and spatial transformations.

Housing research in Scenario 4 demonstrates that the group-grid structure and the life mode echo theories, stemming from sociology and anthropology, that focus on social dynamics and the impact of life roles on housing preferences. The typologies within the group-grid structure align with sociological concepts of communal living, social status, and personal autonomy, while the life mode emphasizes the influence of leisure, work, and family needs and wants on housing choices. These underpinnings collectively contribute to a better understanding of housing as a reflection of societal structures and individual lifestyles.

Environmental psychology and multisensory design emerge as overarching bedrocks in Scenario 5, emphasizing the relationship between individuals and their built environment. The consideration of sensory experiences, cultural influences, and the holistic approach to user perceptions accentuates a psychological understanding of how the built environment influences human behavior, perceptions and emotions, and well-being.

8.2. Contribution to Architectural and Urban Discourse

The overarching theories which underpin the research scenarios stem from knowledge domains that extend beyond the built environment. They collectively contribute to advancing the contemporary discourse in architecture and urbanism. The emphasis on user-centric design, participatory processes, and adaptive solutions aligns with a human-centered approach to research in architecture and urbanism.

The acknowledgment of sociological factors in housing preferences and the socio-spatial lens in urban dynamics enhances the role of architecture and the urban environment in the construction of social reality. The recognition of the dynamic nature of the built

environment and the importance of flexibility in design principles contributes to a discourse that values adaptability and resilience in the face of evolving societal, economic, and cultural dynamics. This resonates with ongoing discussions on the need for sustainability, inclusivity, and responsiveness to diverse user needs.

The application of multisensory design and environmental psychology in user perception investigation expands the discourse on the psychological impact of architecture and the overall urban environment. It underscores the significance of creating environments that not only meet functional needs but also contribute to positive experiences, emotional well-being, and a sense of cultural identity.

In essence, these scenarios integrate theoretical foundations with practical applications while fostering a nuanced understanding of the complexities inherent in shaping the built environment and in influencing human experiences within it.

8.3. Transforming Theories into Research Frameworks

The discussion on components derived from theories to actions across the five scenarios demonstrates a cohesive approach rooted in relevant theories that are drawn from different disciplines. In Scenario 1, the programming, post-occupancy evaluation, and community design components are intricately linked to the theoretical tenets of phenomenology, user-centered design, participatory action research, and adaptive design principles. These components overlap with those covered in Scenario 2 and manifest as practical approaches that embody the essence of subjective experiences, user-centric approaches, community collaboration, and adaptability.

Rooted in Lefebvre's triadic conception of space, Scenario 3 materializes through the identification process, spatial practice, and urban governance triads. These components embody the theoretical emphasis on collective aspirations, tangible behaviors, and governance structures. The triadic framework ensures an integrated exploration of economic, social, and spatial transformations within emerging urban environments. Likewise, in Scenario 4, the components of the group-grid structure triad (enclave, positional, individualist) directly emerge from the theoretical foundation that acknowledges the role of social dynamics in housing formation and transformation. The enclave, positional, and individualist typologies reflect the lived experiences of communal living, social status considerations, and personal preferences, respectively. The attitude component completes the framework and aligns with the theoretical understanding of typological preferences based on social attitudes. The components of the life mode triad (leisure, work, family) derive directly from the theoretical tenets which recognize the impact of life roles on determining housing needs. Each component mirrors the theoretical understanding of how leisure, work, and family aspects intricately shape housing preferences, offering a nuanced exploration of the dynamic relationship between individuals' lives and their housing choices.

The components of Scenario 5 (visual aspects, sensory elements, social and cultural context) engage with the theoretical foundation of environmental psychology and multisensory design. These components capture the essence of how visual, sensory, and socio-cultural dimensions collectively influence user perceptions, translating theoretical principles into a practical and holistic framework for studying user experiences within the built environment.

The preceding discussion suggests the careful articulation of components in each scenario and underscores the connection between theoretical underpinnings and the practical frameworks which were conceptualized to explore the complexities of research in architecture and urbanism. The alignment between the theories adopted and the components established ensures a robust approach to examining, analyzing, and comparing diverse facets of research in architecture and urbanism.

8.4. Operationalizing Theoretical Frameworks in Architectural and Urban Research

The extensive array of approaches and tools employed in the scenarios demonstrates their adaptability and versatility (Table 1). In particular, building analysis, programming,

post-occupancy evaluation and community design stand out as important research approaches. Yet, within these approaches, there are a significant number of tools, including GIS analysis, attitude surveys, focused interviews, scenario planning, content analysis, walking tour assessments, examination of user perspectives, sorting tasks, situation judgment tasks, image segmentation analysis, historical analysis, network analyses, sociocultural surveys, and ethnographic research tools. All stand out as versatile tools that reveal various aspects of the physical and social realities being studied.

Table 1. Approaches and tools utilized in the five transdisciplinary research scenarios. Each scenario employs a specific set of approaches and tools, some of which are shared across the five scenarios (source: the authors).

Approaches and Tools	Transdisciplinary Research Scenarios				
	Practice-Based Research	Building Anatomy Research	City Dynamics Research	Housing Dynamics Research	User Perception Research
GIS Analysis					
Surveys					
Scenario Planning					
Content Analysis					
Walking Tour Assessments					
User Perspectives					
User Participation					
Sorting Tasks					
Situation Judgement Tasks					
Image Segmentation Analysis					
Historical Analysis					
Network Analysis					
Sociocultural Surveys					
Ethnographic Studies					
Community Design					
Architectural Criticism					
Programming					
Post-Occupancy Evaluation					
Performance Evaluation					

What makes these tools particularly impactful is their transdisciplinary nature. They transcend the boundaries of specific topics within research scenarios and demonstrate the potential to be seamlessly integrated into diverse contexts. Whether applied to understand the dynamics of housing in urban environments, to assess the historical evolution of governance, to analyze user perceptions of the built environment, to analyze and examine buildings, or to navigate the evolving role of architects in practice, these tools can deliver important and critical insights.

In the operationalization of this research, foundational methodologies are adeptly developed. Hybrid scenario development is exemplified in experiential spatial analysis, which combines GIS analysis and user feedback surveys with advanced tools like visual attention software (VAS) and offers a comprehensive understanding of architectural spaces. Integrated socio-spatial analysis is extended through psycho-geographic mapping and socio-spatial mapping and by utilizing sociocultural surveys and community engagement to deeply engage with users through understanding their emotional reactions and social interactions within urban settings. The revised experiential approach, augmented with VAS, plays a crucial role in developing post-occupancy and building performance evaluation protocols to enhance traditional assessment.

Additionally, community-centric design emerges under the integration of environmental psychology, applying psychological analysis to develop insights focused on community well-being. Integrating advanced methods like VAS into the core methodologies demonstrates the dynamic and fluid nature of transdisciplinary research and ensures coherence and consistency across varied research themes and contexts.

The introduction and articulation of five transdisciplinary research scenarios in architecture and urbanism reveals a strong alignment between theoretical foundations and practical frameworks. The characteristics of these scenarios in terms of their theoretical foundation and operationalization through live examples contribute to nuanced discourses, emphasizing user-centricity, socio-spatial relevance, and the dynamic nature of undertaking research in architecture and urbanism. Validated through real-world applications, the research approaches embedded within these scenarios demonstrate adaptability and flexibility. These findings not only advance academic knowledge but also provide valuable tools for researchers and decision makers to navigate the complexities of the challenges facing existing and future built environments.

Author Contributions: Conceptualization, A.M.S. and M.P.P.; methodology, A.M.S. and M.P.P.; validation, A.M.S. and M.P.P.; formal analysis, A.M.S. and M.P.P.; investigation, A.M.S. and M.P.P.; resources, A.M.S. and M.P.P.; data curation, M.P.P.; writing—original draft preparation, A.M.S. and M.P.P.; writing—review and editing, A.M.S. and M.P.P.; visualization, M.P.P.; supervision, A.M.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not Applicable.

Informed Consent Statement: Not Applicable.

Data Availability Statement: Data supporting the results are available upon request. Data from earlier studies conducted by the authors are available in their authored and cited works found this article.

Conflicts of Interest: The authors declare no conflicts of interest.

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