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Editorial

Research Methods in Urban Design: A Framework for Researching the Performance and Resilience of Places †

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1. Introduction

Research is the systematic investigation into and study of materials and sources in order to establish facts and reach new conclusions. (Oxford English Dictionaries, 2020.)

What exactly is research in the broad field of performance of urban design, and what methods have proven to be appropriate and useful? There can be very narrow definitions of what constitutes “proper” research and natural scientists will most likely give a different answer from that provided by social researchers or engineers. Some may insist that research is only research when it proves or disproves a hypothesis and uncovers new facts, for example, about the performance of a specific neighbourhood, group of buildings or the work of a particular architect. Research is a systematic investigation and is likely to be an important factor in any urban design process. Geoffrey Makstutis [1] (2018; 20) notes, “It is seldom, if ever, that an architect begins to design without first undertaking some form of research”. Urban design itself is an interdisciplinary research process in that, throughout the process, information from a variety of sources is gathered and evaluated continuously to develop an appropriate design proposition. Understanding the requirements for the future performance of a place or neighbourhood, gathering information, and understanding the local conditions of the site context or the history of the area all constitute elements of the initial research.

Research usually has its foundation in asking a pragmatic question. Aksamija [2] (2021) notes that “The ways in which the researcher asks that question are important, and if one applies the most appropriate and rigorous methods, the answers are likely to represent an original contribution to knowledge”. Muratovski notes that research in the performance of a building or a particular public place is “the process by which one can understand the world in a verifiable and consistent manner” [3] (Muratovski, 2016). This means that merely collating existing information is not in itself enough to constitute research; the aim is to say something meaningful and new because of the data gathered and analysed. For example, a new interpretation or evaluation of the performance data collected. In this context, the term “originality” denotes examining material that has never been studied previously or providing new interpretations of well-known material [4] (Lucas, 2016).

This paper discusses the appropriate methods that can be used when researching place performance in urban design; thereafter, it explores the process of inquiry in the research-informed environmental design of green urban futures.

2. Appropriate Research Methods

The purpose of research is to learn what has never been known before; to ask a significant question for which no conclusive answer has previously been found; and by collecting data and interpreting relevant data, to find an answer to that question. (Leedy & Ormrod, 2010.)



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Research in urban design is closely connected to the challenge of innovation, e.g., to enhance a neighbourhood or building's performance and the effective integration of innovation into practice (a field that is still poorly understood). The growing role and importance of research in the field of urban design have been widely acknowledged [2,4–6] (Hensel & Nilsson, 2016; Lucas, 2016; Aksamija, 2021; Lehmann, 2021, 155f), and the strategic use of research in the urban design process will most likely lead to more effective and better-performing design solutions. However, there remains always the challenge of integrating the research findings meaningfully and effectively into the actual design process.

In the future, urban designers will need to be better trained in the skills with which to gather, assess, record and comparatively evaluate relevant information and data on the performance of different project scenarios to support conclusions for a specific project proposal, be it a place, a group of buildings or a proposed neighbourhood. Currently, most architects, designers and planners lack these skills and have received little or no training in thoughtful, considered data collection that could help their work be more innovative and perform better, including the synthesis of research findings for the development of meaningful conclusions that could inform and guide the performance of their projects positively and optimise positive impact.

There are two fundamentally different approaches that an urban designer might adopt [7,8] (Yin, 2013; Fraser, 2013):

- *Research through urban design*, including the creation of new knowledge and an improvement in design practice;
- *Research into urban design*, contributing new knowledge to the discipline's knowledge base.

The common characteristics of urban design research that focus on performance enhancement can best be described as follows:

- The research activity creates new knowledge, new information or a new interpretation of the environmental performance of a place or neighbourhood.
- With a focus on performance, it makes an original contribution to the knowledge of the operation of the place or project (e.g., assessing its operational and embodied energy).
- It is original, in that it is undertaken by a researcher, yet it also acknowledges other people's ideas and works appropriately and is cited clearly.
- It applies some interpretive or analytical framework and a rigorous method in exploring a particular performance theme (e.g., the whole-life-cycle carbon footprint of a new neighbourhood, the water management of a public space or the environmental performance of a particular construction system), asking very specific questions.
- It has the wider potential to influence future urban and architectural thinking and attendant culture.
- It explores measurable performance that can be replicated and scaled up in other cities and projects.
- It is widely disseminated and communicated through peer-reviewed publications, as well as being publicly presented at conferences, so that it has a positive impact on future thinking and transforms practice.

However, the creative process of urban design is often based more on intuition, assumptions and personal preferences. A more systematic and analytical approach that is evidence-based (using a clear research framework) will most likely improve the urban design process. Let us compare, for example, the natural cooling performance of different green spaces at varying urban densities, in a particular climate and in a specific city (this will be very different in Los Angeles compared to London, for instance). The benefits of such research are obvious, as greening public spaces will help to future-proof urban settlements for an increasingly hot urban environment, which has been widely documented and discussed [9,10] (Wong & Yu, 2005; Sailor, 2014). Urbanism today aims increasingly to fuse the city with nature by reintegrating greenery into the public space network; however, there is still a knowledge gap in terms of which nature-based solutions are most effective

and perform best in different densities and climatic conditions. The term *nature-based solutions* refers to the use of nature in addressing environmental, cultural and societal challenges, while also increasing biodiversity and balancing urban temperatures. These solutions include green roofs, green walls and sustainable drainage systems [11–14] (Alberti & Marzluff, 2004; Meerow et al., 2016; Xing et al., 2017; Lehmann, 2018).

Cities are centres of consumption: 75% of our natural resources are consumed in and by cities, while cities are responsible for 50% of the world's waste and emit over 60% of global greenhouse gases. Moreover, by 2030, metropolises must meet the challenge of accommodating more residents, offering a better quality of life and buffering against the consequences of climate change. This is a considerable list of challenges. At the same time, urban ecosystems are increasingly under stress, as they must withstand more frequent and longer dry periods, with concomitant increasing heat, air pollution and water shortages [15,16] (IPCC, 2018, 2022). However, over recent years, the quality of life in many cities has declined. The reasons for this decline include many factors: air pollution, urban heat, increasing traffic and housing that has become unaffordable. Therefore, we must plan better, including a further increase in green spaces, so that we do not lose the liveability of our cities that we currently enjoy.

3. How to Get Started

The most basic starting point is the study and analysis of precedents (case studies) and the conducting of a literature review that identifies a possible knowledge gap, to formulate appropriate research questions, including ethical research questions, and a theoretical position regarding a complex design problem. Based on their training, urban designers and planners should excel in understanding, organising and visualising technical data and determining various parameters, e.g., by using urban diagrams, or the translation of quantitative and technical data into simple diagrams as a basis for better-informed decision making, as well as documenting observations and learning through drawings and diagrams.

Urban design is, by nature, an interdisciplinary activity, and the challenges of cross-disciplinary design research can inform any design process positively. It is key to formulate a compelling research question early that is based on a preliminary precedent analysis and a thoroughly conducted literature review. This can include comparative case studies that compare the effectiveness and performance of various types of neighbourhoods or buildings against an established benchmark (baseline).

Research in urban design refers to conducting a systematic investigation of some kind, which includes selecting the most suitable method from the different types of research, such as quantitative or qualitative research methods. A *method* is a particular procedure for approaching and accomplishing the research challenge.

Logical research is always based on valid procedures and principles. Some of the different types of urban research methods include:

- *Quantitative research*, which is the process of collecting and analysing numerical data (e.g., urban census or microclimate data for statistical analysis). It is highly structured and follows strict procedures and rigorous rules based on principles of validity, through experiments and statistical surveys.
- *Qualitative research*, which involves collecting and analysing non-numerical data (e.g., observations, texts, video or audio of interviews with users—what do they think?) to understand concepts, opinions or real experiences. There are no strict rules for this.
- *Empirical research*, which is based on direct experience and qualitative observation by the researcher.

Mcleod (2023) further explains the differences: “Quantitative research collects numerical data and analyses it using statistical methods. The aim is to produce objective, empirical data that can be measured and expressed in numerical terms. Quantitative research is often used to test hypotheses, identify patterns, and make predictions. Qualitative research, on the other hand, collects non-numerical data such as words, images, and sounds. The focus

is on exploring subjective experiences, opinions, and attitudes, often through observation and interviews. Qualitative research aims to produce rich and detailed descriptions of the phenomenon being studied, and to uncover new insights and meanings.” Thematic analysis can be used to make sense of a large amount of qualitative data by defining and naming themes, as described by Braun and Clarke (2006) [17,18].

Therefore, the urban designer must be aware of the differences between the various methods available (e.g., qualitative, quantitative, experimental, visual, applied, historical and ethnographical—from desk research to action research to surveys to mixed methods) and select the most appropriate and useful method for a particular study. This includes decisions on data collection and analysis. For example, will the researcher conduct interviews with users, carry out archival research or find other ways to gather relevant new data?

Some of the key steps that the researcher has to follow include:

1. Framing the research problem (e.g., which type of environmental performance will be examined?).
2. Developing a compelling research question and hypothesis.
3. Conducting the literature review.
4. Compiling a glossary of key terms.
5. Selecting the methods: the different research approaches and multimethod research (by combining different methods), selecting the most suitable methods.
6. Structuring the research procedure and reporting on the findings.

The most common method in urban design and social science is qualitative research; it is a different approach and can be the opposite of quantitative research (which is mainly used in engineering and science). In a convincing qualitative study, the research question drives the purpose of the research through the identified knowledge gap and the selected methodology for collecting and analysing the performance data. Once the researcher has identified the research problem, the next step is to articulate the problem in a way that is carefully phrased and represents the goal of the research effort: the formulation of the research aims and objectives in order to produce results. The research question might be combined with a hypothesis. A hypothesis is a “logical supposition, a reasonable guess, and educated conjecture” to address the research problem [19,20] (Leedy & Ormrod, 2010; Lehmann, 2010).

Here, the researcher in urban studies will also need to develop a clear understanding of the limitations of the problem (the exact performance aspect). For example, some research problems might be overly ambitious, too complex or require unreasonable resources for their investigation in terms of time, funding, logistics, data or equipment. A statement is needed that explains how the researcher will deliver the results promised. If the problem is too large or complex, one can:

- Reduce the range of the problem to a point where the problem becomes feasible in terms of study, simply by setting narrow limits for the problem.
- Choose to focus on only a part of the problem instead.
- Break the problem down into several smaller subproblems.

Questions about the performance of places and public spaces have recently emerged at the forefront, as urban designers want to know how the performance and resilience of future urban places might best be predicted, analysed and measured. One might ask:

- What was the original intended use of the place and is it being used as planned? (e.g., does the place perform well?)
- What is its actual use and who are the different user groups? (e.g., one might conduct interviews with end users).
- What resources are used and what environmental impact do they have on the place?

The performance (or efficiency) of a place or neighbourhood is a measure of how well it functions according to certain designated criteria such as physical, social or environmental considerations. The effective use of the resources necessary to design and construct a particular place and whether it performs as intended can be measured. Urban design

performance standards aim to enhance the performance of different aspects of a place, neighbourhood or public park. These include the project's requirements regarding energy or water use, carbon emissions or user comfort during extreme climatic conditions (e.g., during heatwaves). The resilience of a place or neighbourhood is a measure of its adaptive capacity and how well it can recover from an unexpected major disruption or crisis.

High-performance urban design integrates and optimises on a lifecycle basis all major high-performance attributes (defined criteria), including resource efficiency, energy conservation, environment, safety, comfort, health and well-being, durability, accessibility, cost and benefit, productivity, sustainability, functionality and operational considerations. It is about how well a place or neighbourhood fulfils its functions, its resource efficiency when compared to other standard places or neighbourhoods, and the resilience (adaptive capacity) of the place to unexpected disruptions [21] (Lehmann, 2019). Thus, researching urban design performance is a way to describe and measure how well a place performs—or the benefits that it offers to residents, users, workers, owners and maintenance managers (to name just a few stakeholders)—regarding a variety of performance criteria (parameters) that the researcher has specified.

As researchers, we must ask relevant questions and test different scenarios. A rigorous assessment and evaluation of the performance of different urban density scenarios must follow: which one will deliver the most effective, sustainable and resilient outcome? Common themes on performance are urban health and opportunities for physical activity, urban form, ecology, mobility, connectivity and other urban design quality criteria [2] (Aksamija, 2021). Questions about the creation of new knowledge in the performance of urban design could also include critical explorations that discuss contemporary issues in urban studies, such as:

- The “meaning of place” and its relationship with nature and technology (e.g., the excessive surveillance of public space).
- The future role of public space and the notion of the “civic” in an increasingly privatised or commercialised city.
- The important role of urban informality versus the master-planned formal city.

In universities, there has been good progress in integrating research activities into the educational design curricula. In the context of urban design, it is common for design research studios to be devoted to an in-depth investigation of a defined design research project of the student's conception through an iterative structured methodology common in most graduate programmes. The research usually focuses on understanding design methodologies through a series of explorative projects based on precedent analysis and the comparison of cases. Advisors shape the research agenda, define milestones and play a supporting role in suggesting possible approaches, techniques, methods, directions or resources. New conceptual frameworks for design research are constantly evolving. With cities becoming hotter and experiencing heatwaves more frequently, the dangerous urban heat island effect has emerged as a serious research field that will have a direct impact on numerous future urban design decisions, such as density considerations and the use of greenery. Related to this is the question of the effective greening of urban spaces to keep cities cool: for example, which tree species are most effective in cooling the urban microclimate? Therefore, the following part of this article looks at some metrics for performance measuring and quality criteria that are relevant for greening strategies, urban resilience and ecology.

4. Practice-Oriented Research with Impact

Practices are always transforming due to changing needs, different conditions and circumstances to be met, emerging new design problems, and therefore new questions to be asked and new inquiries to be made. Practice must meet these new challenges, which now require advancement of, and through, modes of inquiry that differ from those employed thus far, which are frequently shown to be ineffective in addressing an increasing complexity. (Hensel & Nilsson, 2016, ix.)

While a plurality of theories of scientific research have been articulated, these often lack relevance to practice and decision-making mechanisms to guide the profession. Applied research, today often termed “practice-oriented research-by-design”, has become one of the most popular research approaches for urban designers as it promises to have a positive impact. The desired impact can vary and could include the following impact types:

- Scientific impact: knowledge creation and dissemination.
- Economic impact: a successful business model.
- Environmental impact: avoidance and reduction in CO₂ emissions.
- Instrumental impact: the formulation of new policies.
- Capacity building impact: skills development.
- Cultural and social impact: change in mindsets leading to behaviour change.
- Conceptual impact: uptake of new theoretical concepts.

While other approaches focus on understanding the problem and identifying a possible solution, applied research is more practice-related and focuses on developing a specific solution in detail. Integrating research into urban design practice is essential for developing and applying new knowledge and finding better-performing solutions. For innovation to take place, it requires a much stronger correlation between research per se and urban design strategies, and it is pertinent for the future of urban design practice that research becomes an integral part of the profession. Research can also give a practice a competitive advantage, regardless of a firm’s size [22] (Lehmann, 2023).

For designers to develop themselves as professionals of broader significance, they will need to embark on a journey of lifelong learning and train how to incorporate scientific research into their practice [4,23] (Schoen, 1984; Lucas, 2016). Although scientific and analytical, design research has emerged as the basis of most good design work. Some professional firms are taking this seriously and have invested in research activities related to their projects and developed expertise within their practice—just think of leading firms KieranTimberlake, Perkins & Will, Renzo Piano Building Workshop, Foster and Partners or Kengo Kuma (to name but a few research-driven practices). This research expertise could be in materials research, the adaptive reuse of existing structures, the use of a particular construction method or other areas.

Philadelphia-based firm KieranTimberlake [24] offers the following statement on research:

KieranTimberlake takes a holistic view to designing for sustainability. It is our belief that current standards can result in a checklist approach to environmental design. We advocate designing for the integrity of the structure as a whole rather than a sum of individual parts, and we utilize integrated systems that work together for greater gains. Whenever possible, features serve multiple purposes: a pond on site may serve as a leisure amenity, a stormwater management strategy, and a source for landscape irrigation. We understand the need to balance the ideals of resource conservation, energy efficiency, and environmental stewardship with the realities of performance criteria, constructability, and budget. (KieranTimberlake, website, 2022.)

5. Discussion: The Performance and Resilience of Urban Spaces

The performance and resilience of green spaces are a relevant research theme and an important topic to analyse. Trees provide cities with substantial potential for carbon capture, ecosystem services and shade. In the green city of the future, all flat roofs of buildings will need to become roof gardens and act as water reservoirs for plants. This requires knowledge from a series of experts, including landscape architects, ecologists and facility managers. In my own research, I always support cross-disciplinary approaches, as no single discipline can address the grand design challenges we face—we must combine environmental, economic and social concerns.

There are different definitions of performance in urban design research. While energy codes around the world get stricter every year, useful metrics for performance measurement of urban design projects include energy efficiency, energy use intensity (EUI measured in

kBtu/sqm or ft²/year), water use intensity (WUI measured in gal/sqm or ft²/year), and embodied and operational carbon emissions (both measured in kg or tonnes/CO₂e/year).

A project's EUI refers to the annual energy required to operate and sustain the project once it is occupied and in use, and an integrated research-informed design concept can lower operating and maintenance costs, improve thermal comfort and access to daylight and reduce water usage. When running energy simulations, one must understand the possible ramifications of each urban design decision on altering the EUI. By calculating the EUI of a project, urban designers can better predict the project's yearly utility cost.

The WUI determines how much water a project or public space design will require during its lifetime. It is important to design efficient water systems, as potable water consumption constitutes a large proportion of the world's finite freshwater reservoir. Collecting rooftop rainwater and stormwater runoff, treating wastewater and reusing greywater are all ways to reduce water consumption. Site strategies that allow for the greater infiltration and storage of stormwater enable water to be returned to the source, either with or without treatment.

The *waste generation and material flow* of a neighbourhood examines the amount of material that goes to landfill or incineration, instead of being sent to a recycling centre; it is measured in kg or tonnes/household/year. In 2010, to define the relationship between urban development and material flow and to better assess the impact of waste flows, I defined the term and parameters of a *Zero Waste City* [25] (Lehmann, 2011).

Embodied carbon emissions refer to the greenhouse gases emitted during the extraction, manufacture, transportation, assembly, replacement and deconstruction of the materials used for a project, together with the end-of-life profile. This is the most complete boundary condition, i.e., measuring from cradle to grave. If considered early in the design phase, up to 80% of a project's embodied carbon can be reduced. In the future, all construction materials should have a "material passport" that gives reliable information about their place of original extraction, sourcing, manufacturing, transportation to the site and other information relevant to assessing the embodied carbon.

Operational carbon emissions refer to the greenhouse gases generated annually during the operational or in-use phase of a project. This includes the use, management and maintenance of a district or structure, along with the energy consumed to use and run the project's systems.

Much research highlights how access to daylight can benefit the health, happiness and productivity of users and occupants. The geometry, orientation and compactness of a project play a key role in its efficiency and daylight autonomy. Shade and glare control is important, as too much direct sunlight can produce glare and overheating, creating discomfort. It can increase cooling loads due to the creation of overheating hot spots. The view from inside is also an important performance factor: building occupants and users who can visually connect with outdoor natural environments experience greater satisfaction and productivity. For example, in healthcare facilities, views and access to nature can shorten hospital stays, and reduce both stress and the use of pain medication, and this is also critical for school buildings and workplaces.

To ensure that cities work better for their residents, a people-centric approach with access to green space is essential. In post-pandemic times, urban living means people getting outdoors more to walk, cycle and spend time in nature. We have noted an increase in outdoor activities and people getting more physically active, with numerous health benefits that result from applying the concepts of renaturalisation and greening. Nevertheless, more research is needed: Which are the most efficient solutions? How can cities use nature-based solutions to confront the challenges posed by unhealthy conditions effectively, including decreasing air quality, the loss of biodiversity and excessive urban heat?

Vegetation and, in particular, tree planting, green roofs, greening and rewilding offer multiple benefits to the urban climate, health and personal well-being by helping to reduce levels of harmful pollutants in the air, ambient temperatures, the urban heat island effect and heat-related mortality. Evidence shows that people who live in neighbourhoods with

more trees and easy access to green spaces experience lower levels of stress and mental illness, affirming the concept of biophilia—the idea that humans have an innate desire to connect with nature [26–28] (Wilson, 1984; Roger, 1993; Kellert, 2011). Establishing and reinforcing people’s connection with nature are recognised as critical to their mental and physical health.

The term *urban heat island* (UHI) is used to describe an urban area that is warmer than the rural areas that surround it. Local-scale temperature increases will accompany future population growth, putting more people in danger from the negative health effects of extreme heat [29] (Santamouris & Osmond, 2020). The main causes of the UHI effect are urban development, the loss of green space and building materials that absorb and trap heat (rather than reflect it). The cooling effect of urban parks, gardens and urban forests can be experienced easily during hot summer days in cities (see Figure 1).



Figure 1. A “good” urban place with significant tree cover providing shade and a comfortable microclimate. How can we measure the quality and performance of “good public space” quantifiably? (Image: by the author, 2023).

Post-occupancy evaluation (POE) has gained methodical significance among researchers. It leads researchers to visit, measure and monitor the “real” performance of built projects. Nevertheless, POE-related data can be difficult to interpret and easily skewed. Privacy concerns can also limit these kinds of investigations because no company wants to see a report published that says their headquarter offices are inefficient and making people sick, or some other negative report. Employees might be reluctant to correctly report problems or dysfunctional aspects at their workplaces. One of the goals is to remove the stigma, because there is a need for high-quality data to address important questions about workplace efficiency, health and comfort. Some researchers have faced misleading comments, hindering the scientific process or discouraging others to study this important subject matter, for example, covering up that the built project performs less well and not as it was promised. What is needed is a new era of research where these kinds of investigations are supported with a commitment to transparency in monitoring the operational efficiencies of the built cases.

6. Four Selected Examples of Regenerative Design Research

Over the past 30 years, the author has led numerous design research studios at different universities in six countries. A design research studio is based on the assumption that all good design is research-informed, applying research strategically. A considerable part

of teaching such studios includes principles of urban regeneration and the greening of cities [21] (Lehmann, 2019). Students are asked to apply principles of regenerative design, which is an approach to designing systems and solutions that aims to work with the natural ecosystem processes. This approach goes beyond being restorative and self-sustaining; it aims to reverse and repair the damage made to the site's ecosystem.

Students in the graduate programme of the Master of Architecture degree are asked to design a significant urban design project and write a comprehensive 20,000-word research thesis related to the design project to demonstrate the depth of the investigation. In parallel to the design research studio, the author teaches the same cohort of students on research methods, which provides the theoretical underpinnings graduate students need to conduct a proper work of research. The thesis consists of a literature review, carefully considered research questions and a hypothesis (which the design project then either proves or disproves). A yearlong capstone project develops over two semesters, evolving from concept design to developed design and an in-depth technical study. All urban design projects must include a public space that contributes to the urban regeneration of the wider area. In the following part, four selected design research projects are introduced that deal with the urban regeneration of a substantial part of downtown Las Vegas.

- **Design Research Project 1:**

A new public park, reconnecting two communities.

This urban design research project creates a new public park and green space on top of a freeway tunnel. A clear landscape strategy identifies “windows” for the placement of five new buildings in a continuous cultural landscape. One research question was: How can one create a new public park, a resource-efficient place on top of a freeway tunnel that brings people together for community wellness? (See Figure 2; student: Mirella Garcia.) Research approach: As part of the design process, qualitative interpretations were constructed and various techniques were used in comparative case study and thematic analysis, to make sense of the data from numerous other precedents. It even allows for ambiguity and contradictions in the design, which reflects social reality.

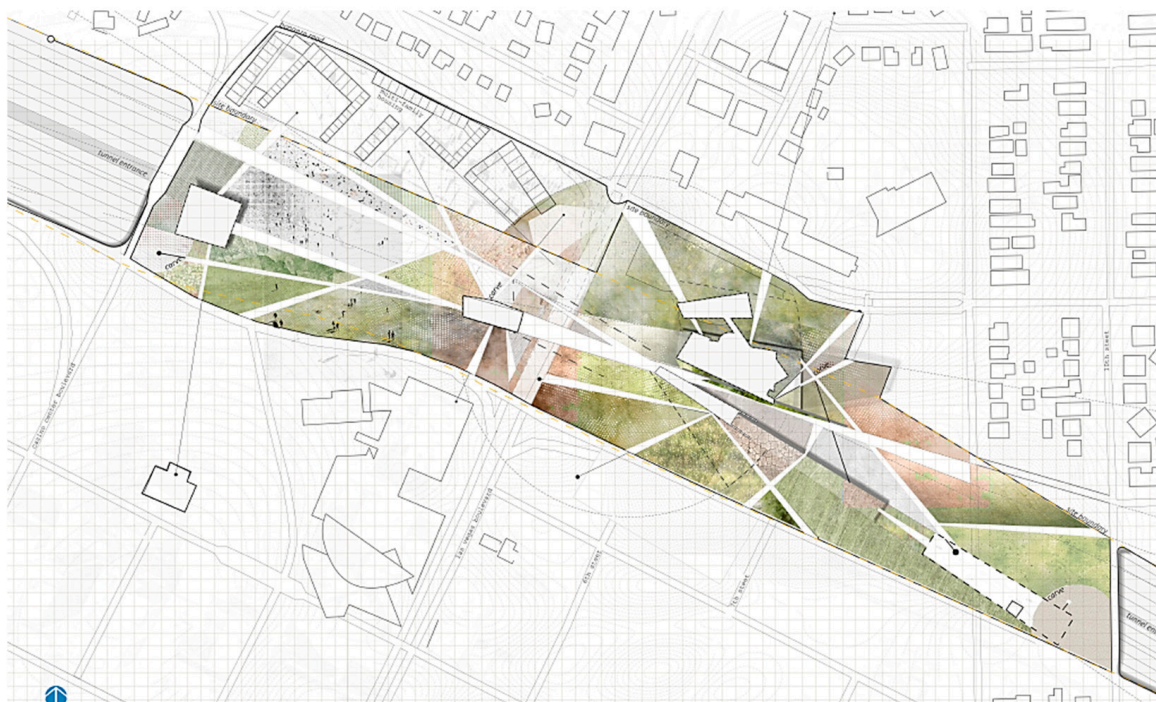


Figure 2. Master plan of a new park and cultural facilities on top of a freeway tunnel in downtown Las Vegas. (Image: courtesy of Mirella Garcia and the author, 2023.)

- **Design Research Project 2:**

An urban food hub: vertical food production and distribution centre.

This urban design research project includes three growth towers and a drone delivery port. One research question was: How can the new technologies of urban farming help create a food distribution centre in downtown Las Vegas? The hypothesis: by using new technologies in robotics and AI, the integration of urban farming methods with a robust local delivery system can create a sustainable future-proof neighbourhood by reducing its carbon footprint of food transportation, while increasing access to fresh and healthy produce and creating a localised food system that promotes public health and food justice. (See Figure 3; student: Antonio Trejo.) Research approach: The design is based on extensive urban farming precedent studies and supported by personal experience and contextual observations. Because of the subjective nature of the qualitative data and its origin in a single context, it is difficult to apply conventional standards of reliability and validity. For example, because of the central role played by the design researcher in the generation of the data and project design, it is understood that it is generally not possible to replicate such a specific qualitative study elsewhere.

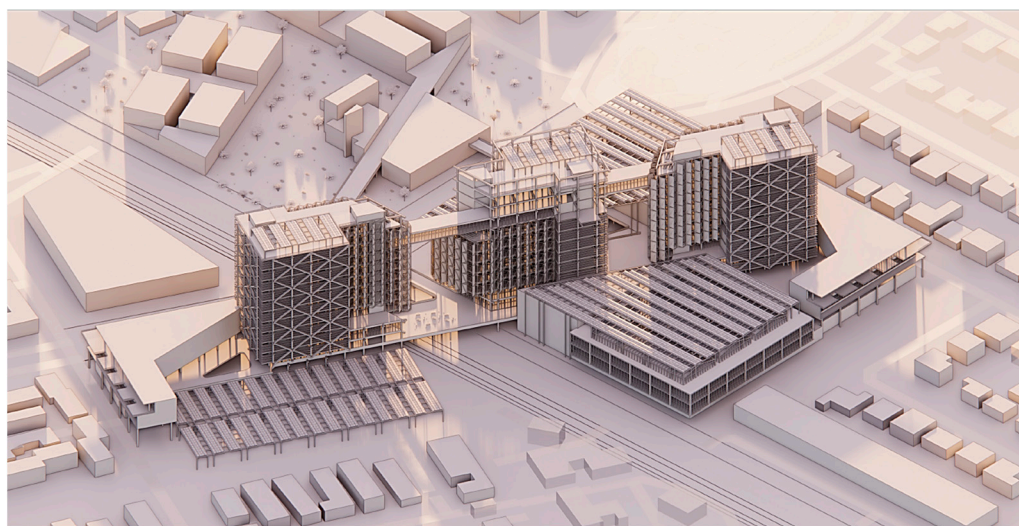


Figure 3. The three growth towers of the downtown food hub with a food distribution centre, drone port and bus terminal. (Image: courtesy of Antonio Trejo and the author, 2023.)

- **Design Research Project 3:**

A new gateway to the Las Vegas Arts District.

This urban design research project proposes a significant new public plaza that serves as an outdoor events and exhibitions venue as well as the entrance to a new cultural facility. The research question: How can art and architecture, in unison, serve as a powerful catalyst in the revitalisation efforts in the Las Vegas Arts District? (See Figure 4; student: Andrya Mojena Cutie.) Research approach: Qualitative observational data were analysed to gain insights into social phenomena, such as human behaviour and social interactions at various art galleries and culture-led regeneration projects; suggesting possible relationships between urban space, circulation and the spatial organisation of the project.

- **Design Research Project 4:**

Neo-Metabolism: a modular micro-housing system for urban infill.

This urban design research project explores why the Metabolist designs of the 1960s have rarely worked. Modular construction using standardised components that can be assembled on-site can greatly reduce construction time and costs, while reducing waste and minimising the building's carbon footprint. Therefore, one research question was: what is the most efficient and flexible approach for revitalising vacant sites and parking

lots downtown to optimise their social, economic and cultural impacts? (See Figure 5; student: Bijan Damavandi.) Research approach: Since nothing was predefined or taken for granted, the researcher immersed himself during the design process in the field, in contextual surroundings. For the qualitative researcher, there is no single reality. This means that the study's design evolved during the research; it illustrates one of a variety of possible scenarios and was adjusted as it progressed.

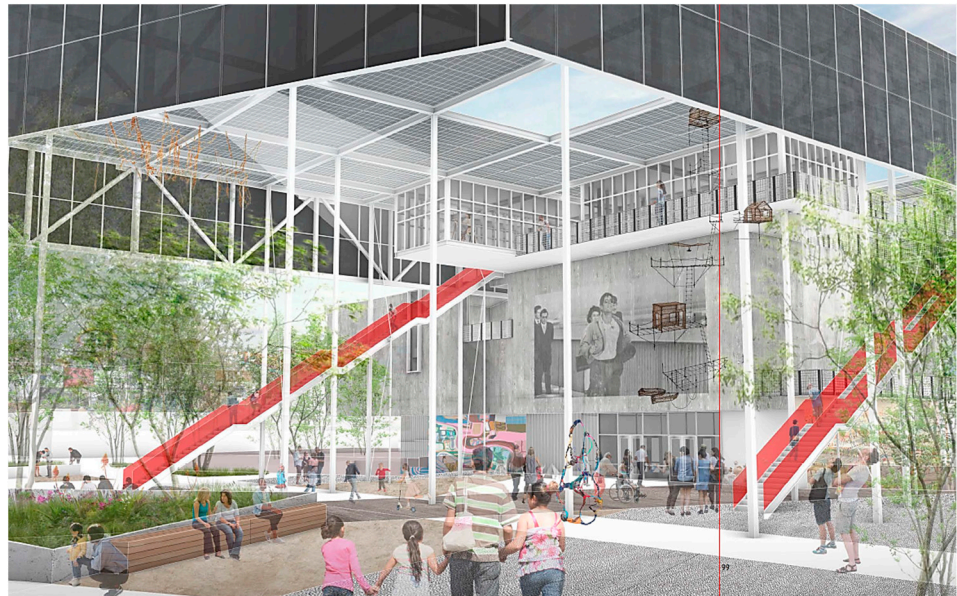


Figure 4. A shaded public space with a cultural facility above that reorganises a currently neglected, left-over urban space. (Image: courtesy of Andrya M. Cutie and the author, 2023.)

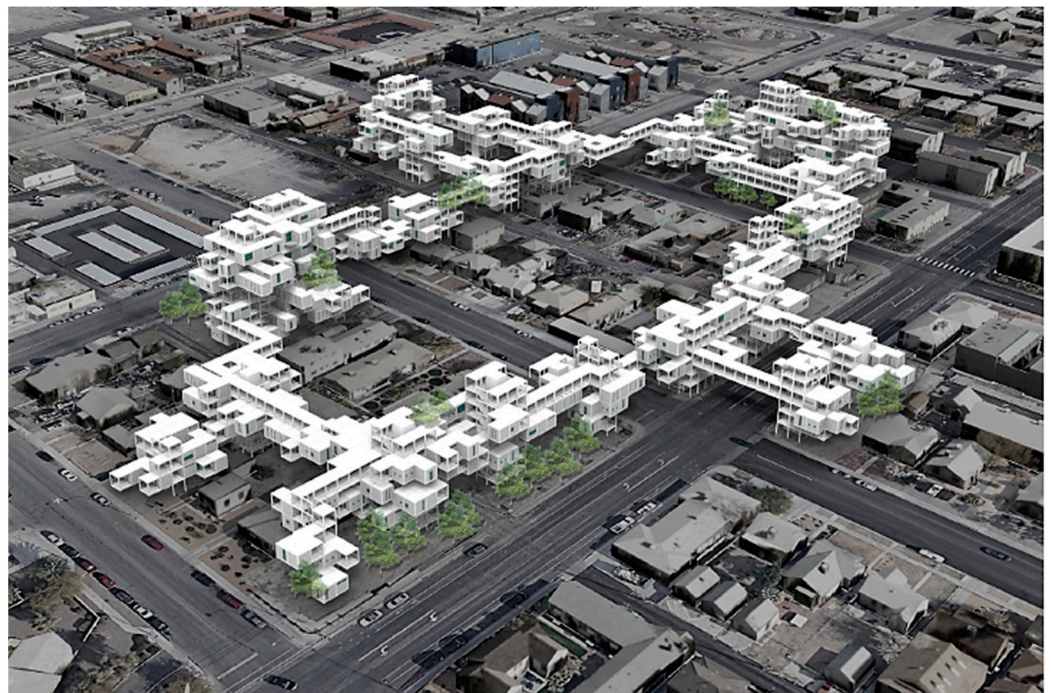


Figure 5. A perspective view of downtown Las Vegas illustrating the “new city built above the existing one”, using a low-carbon, modular, off-site-manufactured construction system. (Image: courtesy of Bijan Damavandi and the author, 2023).

7. Conclusions

This article first explored methods used to research the performance of places in urban design and then introduced four examples of design research projects for such public spaces recently proposed for the urban revitalisation of downtown Las Vegas. There is now increased interest in new knowledge on resilient urban planning, density, affordability, sustainable transportation and green space. Cities must adapt existing knowledge and develop novel tools to accommodate a growing number of residents and respond to ever-changing threats, such as climate change, supply chain disruptions and other issues. Threats affect cities of various scales, and new research-driven trends in urban planning arise to address poverty and inequality, mitigate and adapt to climate change, develop resilient urban economies, secure green spaces and reduce urban health risks. More research in urban design and planning is required that strengthens the evidence base for better decision making and expands the knowledge of place performance. Research-led design and design-led research are very important approaches toward making the necessary improvements to our urban places and spaces. Critical analysis in design-led research is applied to develop new understandings and realise new opportunities, as exemplified by the four individual design research approaches. Comparative case studies are seen as a useful tool in qualitative and quantitative research [30] (Denscombe, 2010).

The four examples of urban design research projects are accompanied by deep and thorough research studies on the potential for the urban regeneration of downtown Las Vegas. In all four examples, research was used to test a theory, a hypothesis and ultimately support or reject it. Each of the projects explores a different area and aspect of regeneration. In urban design research, it is unlikely that any one study will provide a definitive, complete answer to all questions asked. Research in urban design is always part of a continuing journey of enquiry, analysis and scenario testing. At the outset, this paper discussed the various aspects and methods of applied research in urban design. There is now a growing awareness of the importance of new knowledge and innovation in practice and the need for its constant development. Therefore, one of the driving forces behind today's education of urban designers and architects is research-informed critical systems thinking, not the creation of "architectural objects". Relating theory to methodology and making informed design decisions will lead to evidence-based, research-informed urban design, rather than stylistic manoeuvres. Conducting research can make all the difference between a great design and a good design. Therefore, one of the conclusions is that the profession of the urban designer is one of lifelong learning and self-directed inquiry to kick-start a continuous cycle of self-improvement.

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