That Which Endures: A Myriad of City Building, A Half-Century of Space Syntax

A Keynote Address to the KAEBUP Final Event/3rd CyNUM Regional Conference

Mark David Major[1]

Abstract: We have been building sustainable, resilient cities for a long time. We know what they look like because they are all around us. We require more critical thought for – and less passion about – our cities today, using evidence-based design and planning. In this regard, fifty years of research and practical applications demonstrate that space syntax theory and methods work because the basis of its representations is us, i.e., people. It is one means of providing evidence-based design and planning tools to objectively measure and discuss the dual nature of our cities as physical and social things. Today, tools like Artificial Intelligence (AI) offer new ways to derive design solutions for settlements. However, they remain a helpful supplement, requiring human intervention and critical thinking to develop sustainable and resilient city solutions. We must guard against muddling those solutions because AI tools are not evidence-based or science.

Keywords: Artificial Intelligence, Resilience, Space Syntax, Sustainability, Urbanism.

Introduction

For evidence-based design and planning in human settlements, we must remain studious, rigorous, and attentive to where we have been in the past, where we are today, and where we are going in the future. It is frequently a mistake to allow tunnel vision – concentrating entirely on achieving a particular aim, usually profit and publicity, and not noticing or considering anything else, especially people and their needs – about some short-term concern or a narrow local perspective to obscure the strengths already present in the universal forms underlying human settlements for thousands of years worldwide. Sometimes, when we do so, it causes us to lose sight of what is valuable in favor of what is profitable or, at the very least, perceived as less costly in the short term. Settlements are not about profit or cost. These things are a notable feature of the capitalistic societies dominating the global economy since the end of World War II, especially after the collapse of most communist governments in the 1990s. Our settlements are about people. We are the ones who live, work, and play in them. In the 20th century, we often lost sight of this fundamental quality of cities and towns. In many ways, we are still trying to recover from the failed urban fallacies of Modernism. Governments and town planners have favored low-density built forms and technological solutions, especially suburban sprawl and the automobile, originally intended to supplement the city's quality of life and social mobility. Instead, they have dramatically transformed the city into a concrete landscape, isolating people in manicured enclaves and destroying the

1. Abu Dhabi University.

DOI: 10.36158/97912566918213

civic life of the public square. The explicit and implicit goal has been planning to move vehicles and goods at tremendous speed in a globalized world. Things occupied the center of city design and planning, displacing the subject that should be at its heart, i.e., people.

This paper will briefly take a step back from the latest fashionable debates in architecture, urban design, and town planning in an increasingly fractionalized political world seemingly desperate for solutions. We will take account of 'where we are' after more than ten thousand years of building settlements. The now-obsolete origins of the Ancient Greek root (*murti*) of the word 'myriad' in the title of this paper means '10,000' (Source: Oxford English Dictionary). We will then take stock of 'where we are' today after a half-century of evidence-based research and design and planning solutions based on space syntax theory and methodology. Space syntax is a worldwide research program of academics and practitioners investigating the role of built space as a product of (and influence on) society. Different people mark differently the beginning point of space syntax. However, the author points to the 1973 publication of Hillier and Leaman's "The man-environment paradigm and its paradoxes" in *Architectural Design* as its starting point, since this article lays out the problem definition and aim of space syntax to challenge and change the prevailing paradigm at the time – Modernism as indoctrinated via CIAM – about the built environment, i.e., how we think and see our architecture and cities. Finally, the paper will turn back to the latest fashionable debate about Artificial Intelligence (AI) to discuss 'where we are going' in the future. AI is the theory and development of computer systems using intelligent machines or software that can perform tasks usually requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages (Source: Oxford English Dictionary/Wikipedia). The paper conducts a simple exploratory exercise to test the underlying assumptions of generative AI software. The goal is to begin to understand AI's possibilities and limitations for designing future settlements. It is not intended to be an exhaustive exercise but merely to learn how we might begin with this startlingly innovative technology in the search for answers and, perhaps, new questions.

The argument of the paper is a simple one. We have been building settlements for more than ten thousand years. There are many cities older than two millennia, some more than five, in the world today. These are sustainable, resilient cities because they are proven to endure, adapt, and evolve over time. In the past half-century, space syntax has developed an extensive research profile, helping us to understand why such cities endure via the construction of the social logic of space (Hillier & Hanson, 1984). Space syntax theory has evolved concepts to help us deal with the 'myriad of complexities' in cities by anchoring our questions – and evolving evidence-based design and planning solutions – in the physical construction of built space. In this sense, the word 'myriad' is used in its more contemporary setting, i.e., a countless or considerable number of people or things (Source: Oxford English Dictionary). Finally, we argue that AI is still only a tool, like any other, to help us design and plan our cities in the future. However, so far, AI lacks the capacity for critical thinking that architects, urban designers, and town planners bring to the city's problems today, even if we sometimes deploy those faculties to address the surface symptoms of a problem instead of using them to adequately understand its substance in depth.

2. We Know How to Build Sustainable, Resilient Settlements

Based on the oldest dated archaeological remains in the world today, Göbekli Tepe ('Potbelly Hill' in Turkish) in modern-day Anatolia of Turkey, we have been building settlements for at least eleven and a half thousand years (Figure 1, left). Almost simultaneously, the agricultural revolution led to the origins of widespread urbanization in the Fertile Crescent, most

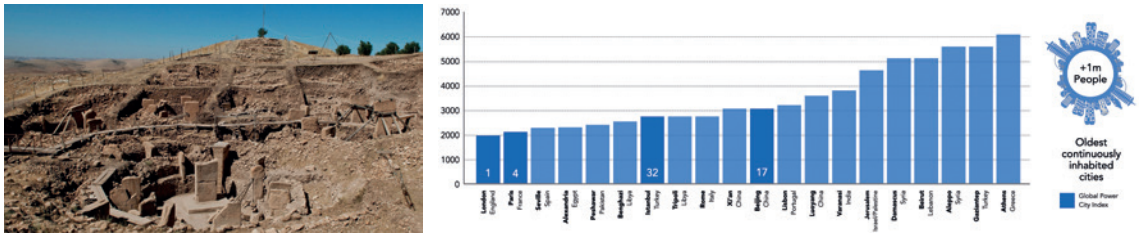

Figure 1. *Archaeological remains of Göbekli Tepe date to circa 9,500 BCE (Pre-Pottery Neolithic Period) in Anatolia, Turkey (left; Source: Wikipedia), and (right) a bar chart from youngest to oldest of the twenty oldest continuously inhabited cities of the world with a population of more than 1 million people today including those listed (highlighted in dark blue) in the Global Power City Index (Source: author updated after Major & Al-Nabet, 2018 and Major* et al.*, 2023).*

notably in the Sumerian city of Ur in ancient Mesopotamia (modern-day Iraq), which is popularly regarded as the world's first city, later abandoned in early 5th century BC perhaps due to drought and the altered ecology of the area (Carter, 1983). Whether it was the first city or not is open to debate. There are still settlements today dating their origins to the 1st Millennium BC or earlier, though not necessarily continuously inhabited, such as Sidon in Lebanon, Jericho in Palestine (destroyed and abandoned several times), and Aleppo in Syria. Major and Al-Nabet (2018) compiled a list of the twenty oldest continuously inhabited cities with a population of more than 1 million people today, later updated by Major *et al.* (2023) (Figure 1, right). The list is not definitive but informative while remaining open to debate. Half of the list are cities in the Middle East North Africa (MENA) region, ranging from Mauritania and Morocco in North Africa to Pakistan in Central Asia. Again, the definition of the MENA region often varies based on whom you ask. The rest of the list are cities in Europe (6) and India/China (4). Of these twenty cities, only four (Beijing, Istanbul, Paris, and London) appear in the 2021 Global Power City Index (GPCI). The GPCI evaluates and rates major international cities according to their magnetic attraction of people, capital, and enterprises worldwide (IUS, 2021).

By definition, these are sustainable, resilient cities (Major & Al-Nabet, 2018). Sustainable means to continue for an extended period or without interruption (Source: Oxford English Dictionary). Resilient refers to change, adaptation, and transformation in response to stress based on Davoudi's (2021) definition of evolutionary resilience. We know what sustainable, resilient cities look like. They are all around us. Most of us like to visit some of these cities as tourists – if we can or do not already live there – such as London in England, Paris in France, Istanbul in Turkey, Jerusalem in Israel/Palestine, Damascus in Syria, and arguably the oldest, Athens in Greece (Figure 2). Yet, researchers often ignore many of these cities when researching sustainability and resilience in cities, especially those of the MENA region. It is unclear why this is the case, though short-term concerns and skewed localized perspectives seem to be the culprit. However, these cities have much to teach us.

Let us take an example from Cairo, Egypt. It would be #21 on Major and Al-Nabet's (2018) list of the oldest continuously inhabited cities in the world due to its brief abandonment in the late first century BCE and the subsequent founding of a settlement that would become modern Cairo in the 1st century CE. Today, when first visiting Cairo, a visitor might be initially shocked by the city's public streets, if they are compared to the modern transportation planning standards of the Western world based on strict enforcement of road sections and signalization. There is little or no striping of lanes. Striping that does exist has faded to faint impressions. There are few traffic lights. Many pedestrians and all kinds of vehicles use the road, i.e., cars, trucks, motorcycles, motor scooters, tuk-tuks, bicycles, and donkeys with carts. These vehicles crowd the streets, sometimes within centimeters of each other, squeezing the concept of a driving lane to its breaking point. Traffic crashes are a common sight. The author of this paper witnessed three crashes in only five days on the

Figure 2. *The sustainable, resilient cities around us today include (youngest to oldest from left to right) London, England (Source: Janno Nivergall/Pixabay); Paris, France (Source: Pixabay); Istanbul, Turkey (Image: Author); Jerusalem, Israel/Palestine (Source: Author); Damascus, Syria (Source: Bernard Gagnon/Wikipedia); and Athens, Greece (Source: George E. Koronaios/Wikipedia).*

streets of Cairo. Initially, crossing the street is also intimidating for a pedestrian new to Cairo. However, after becoming accustomed to the situation, it becomes clearer that something else is happening on the streets of Cairo. The traffic almost always moves but slowly, i.e., around 20 kilometers per hour or less. It is easy for a pedestrian to cross the street by selecting your moment. You never see drivers holding up and using their cell phones while driving in Cairo. Doing so would be a disaster because the public road system demands the driver's attention in Cairo. Streets do not forgive stupidity. Traffic crashes usually fall into a 'minor fender bender' category, i.e., there might be a small amount of damage to the vehicle but not involving the people or animals. Cairo streets are a living organism of shared space writ large (Figure 3, left). Shared space is an urban design approach minimizing the segregation between modes of road users. People regulate themselves. It is how other cities used to be in the early twentieth century before modern transportation planning sidelined pedestrians to sidewalks in road sections to move vehicles quickly through city streets. There is plenty of evidence for this, such as a 1910 photograph of State Street in Chicago, Illinois, in the United States, where pedestrians, horses and carriages, streetcars, and automobiles all share the street (Figure 3, right).

Such a viewpoint contrasts starkly with the consensus about Egyptian traffic in popular media and elsewhere. Let us look at an example based on a 2021 article, "19 Killed in Truck-microbus Collison Outside Cairo", in the online Arabic newspaper *Asharq Al Awsat*. It is published in London by the Saudi Research and Media Group. Please note that we are not specifically 'calling out' – draw critical attention to someone's unacceptable actions or behavior – the Saudi Research and Media Group, *Asharq Al Awsat*, or anyone else with this review. The author came across the article while searching for photographs of Cairo traffic, which led to delving deeper into the article's statements in a search for the truth. The article originally stated (later revised and edited out) that "Egypt ranked 30th worst in the world for congestion, according to TomTom, the Dutch vehicle navigation systems maker" (*Asharq Al Awsat*, 2021). Of course, a navigation systems maker for vehicles has an economic interest in promoting the idea of traffic congestion anywhere in the world, i.e., they want to sell navigation systems. As they say, this statement should be 'taken with a grain of salt', i.e., skepticism. The fact that *Asharq Al Awsat* later edited out this statement from the article indicates that it is unreliable. The article goes on to state, "Traffic accidents kill thousands every year in Egypt, which has a poor transportation safety record. Crashes are mostly caused by speeding, bad roads or poor enforcement of traffic laws" and concludes, "Egypt's official statistics agency says around 10,000 road accidents took place in 2019, the most recent year for which statistics are available, leaving over 3,480 dead. In 2018, there were 8,480 car accidents, causing over 3,080 deaths" (*Asharq Al Awsat*, 2021). The article paints a grim picture. A World Health Organization (WHO) (2012) report paints a similarly gloomy picture about road safety in

Figure 3. *The living organism of shared space (left) today in Cairo, Egypt (Source: Author licensed by Alamy) and (right) in a 1910 view of State Street in Chicago, Illinois, USA (Source: Library of Congress).*

Egypt. There is evidence this WHO report is based on 2003 data, but the sourcing is unclear. It might warrant action to alter the circumstances. But is it accurate?

If we sample the data about traffic fatalities available in Egypt, primarily from the Egyptian Central Agency for Public Mobilization and Statistics, and the United States of America (USA), from the U.S. Highway Traffic Safety Administration, over twenty years, then a different picture of the situation emerges (Figure 4). In 2003, there was a 66% greater chance of a traffic fatality in the USA than in Egypt. In 2011, it was more than a 53% chance. The rate rose to about 83% more in the USA than in Egypt in 2020, then skyrocketed to more than twice as likely in 2021 before falling slightly below 2020 levels two years later (+81%). Over twenty years, on average, this indicates there is a more than 64% greater chance of a traffic fatality on American streets compared to Egypt. We must allow for a difference in the reporting standards of the sources. Nonetheless, the overall picture is that American roads are more dangerous than Egypt's over the last two decades. However, MENA countries continue to import Western, mainly American, transportation planning principles when there is evidence that they are much more dangerous for people.

The reason that false narratives emerge about things such as dangerous Egyptian roads is simple. It is human nature. We need to delve deeper into the problem to test out our assumptions. We do not apply critical thought to that circumstance, defaulting to our intuition, especially in the popular media with its maxim 'if it bleeds, it leads', attributed to the American newspaper publisher and businessman William Randolph Hearst in the late 1890s. It is the myriad of complexities about our cities that make it possible. Our cities have a dual

Country	Year	Population[1] (millions)	Fatalities[2]	Per Capita	% Difference
Egypt	2022	111.0	7,762	1/14300	
USA	2022	338.3	42,795	1/7905	**+81%**
Egypt	2021	109.3	6,164[2]	1/17732	
USA	2021	331.9	42,915	1/7734	**+124%**
Egypt	2020	107.5	7,101[4]	1/15139	
Egypt	2020	107.5	6,722[3]	1/15992	
USA	2020	329.5	38,824	1/8487	**~ +83%**
Egypt	2011	80.4[3]	7,101[5]	1/11332	
Egypt	2011	89.2	~12000[5]	1/7433	**?**
USA	2011	311.6	32,367	1/9627	**+53%**
Egypt	2003	80.4[3]	7,101[5]	1/11332	
USA	2003	290.1	42,643	1/6803	**+66%**
Mean (Egypt)	**2003-2022**	**98.6**	**7,498**	**1/13150**	
Mean (USA)	**2003-2022**	**320.8**	**39,909**	**1/8038**	**+64%**

[1] World Bank
[2] U.S. National Highway Traffic Safety Administration for USA figures.
[3] Al-Monitor citing Egypt's Central Agency for Public Mobilization and Statistics.
[4] Reuters citing Egypt's Central Agency for Public Mobilization and Statistics.
[5] World Health Organization (WHO) citing Egypt's Central Agency for Public Mobilization and Statistics and Ministry of Public Health. The WHO Report also claims 'around 12,000 Egyptians lose their lives as a result of a road traffic accident," though the report is unclear about the sourcing for this claim. The WHO total population for Egypt of 80.4 is equivalent to the population in 2003.

Figure 4. *Sampling of traffic fatality data in Egypt and the United States, 2003-2023, based on various sources, including the per capita, percentage likelihood of dying in a vehicular crash, and mean for each country over 20 years (Source: Author).*

nature related to their form and function. Architects have argued about form and function for over a century, i.e., form follows function per Louis Sullivan, less is more per Mies van der Rohe, or less is a bore per Robert Venturi. It would be more practical to think that form and function are a symbiosis instead of engaging in 'chicken-and-egg' arguments – a metaphor describing situations where it is not clear which of two events should be considered the cause and which should be considered the effect (Source: Wikipedia) – about the built environment, and especially about our cities. The city is both a physical and social thing, constantly in flux and stabilized, ordered and chaotic, familiar and strange, and easy to use but difficult to discuss (Major *et al.*, 2023). Once we come to grips with the dual nature of our cities, it becomes much easier to understand, research, and discuss them. This is where space syntax can help by providing us with the tools and concepts to implement evidence-based design and planning for the future of our settlements.

3. The Many Dualities of Space Syntax

The physical and the social, form and function, exist in a state of simultaneity, i.e., the fact of something happening or being done at the same time as something else (Source: Oxford English Dictionary). Often, it is because the built environment is a physical manifestation of mediating between different scales of experience. Hillier (2003) argues that "the city constructs, in effect, a series of probabilistic interfaces between scales of movement", a concept which he attributes to John Peponis in *Space is the Machine* (Hillier, 1996). We could argue that in its totality, the built environment constructs a series of probabilistic interfaces between different scales of encounter and avoidance through seeing, moving, and occupying in the second and third dimensions of space (Major *et al.*, 2023). We can see this in the first-floor balconies overlooking the public space on the streets of Havana, Cuba, or in the interior of many buildings, such as Zaha M. Hadid Architects' (2009) MAXXI National Museum of 21st Century Art in Rome, Italy or Frank Lloyd Wright's (1959) Guggenheim Museum in New York in the United States.

Since 1973, space syntax researchers have built a massive body of research at all scales of the built environment, from the home and housing to complex buildings, and from the public square to the metropolitan and regional scale of urban agglomerations. Space syntax has been so successful that researchers have begun to look back to chart the impact and evolution of its theoretical concepts and intellectual contributors using various metrics (Krenz *et al.*, 2023; Mohamed & van der Laag, 2023). The reason is that space syntax works. In hindsight, it is also apparent why. The basic representations of space syntax underlying its topological measurements of built space are based on us. The representations of a grid element (akin to a point in space such as the standing area for the typical human being, e.g., 0.28 m^2) for visibility graph analysis (VGA), the axial line or lines of movement because people tend to walk in a straight line, mainly used in urban analysis, and the convex space where everyone can see and be seen in human occupation for the configurational analysis of space are generic to human nature (Figure 5) (Hillier & Hanson, 1984; Hillier, 1996; Major, 2018; Tannous *et al.*, 2021; van Nes & Yamu, 2021). At the urban scale, it has led to robust representations of spatial structure at different scales based on through-movement (i.e., choice) and to-movement (i.e., integration) in many cities worldwide. For example, we can see representations with the mathematical measurement of global choice in the spatial network for the major road network in Doha, Qatar, or evidence of emergent neighborhoods in the localized spatial structure at integration, 800 m in Athens, Greece (Figure 6).

In the last half-century, space syntax theoreticians have collectively developed a conceptual framework to discuss the dual nature of cities as an interface between different scales of the built environment. They are based on a set of dualities, which often but not necessarily

Figure 5. *The basics of representation of space used in space syntax research: (left) a point in space using grid elements, such as the average standing area of a human being (0.28m²), (center) a line of movement, and (right) the convex space for human occupation of space where everyone can see and be seen by everyone else (Source: Tannous* et al., *2021).*

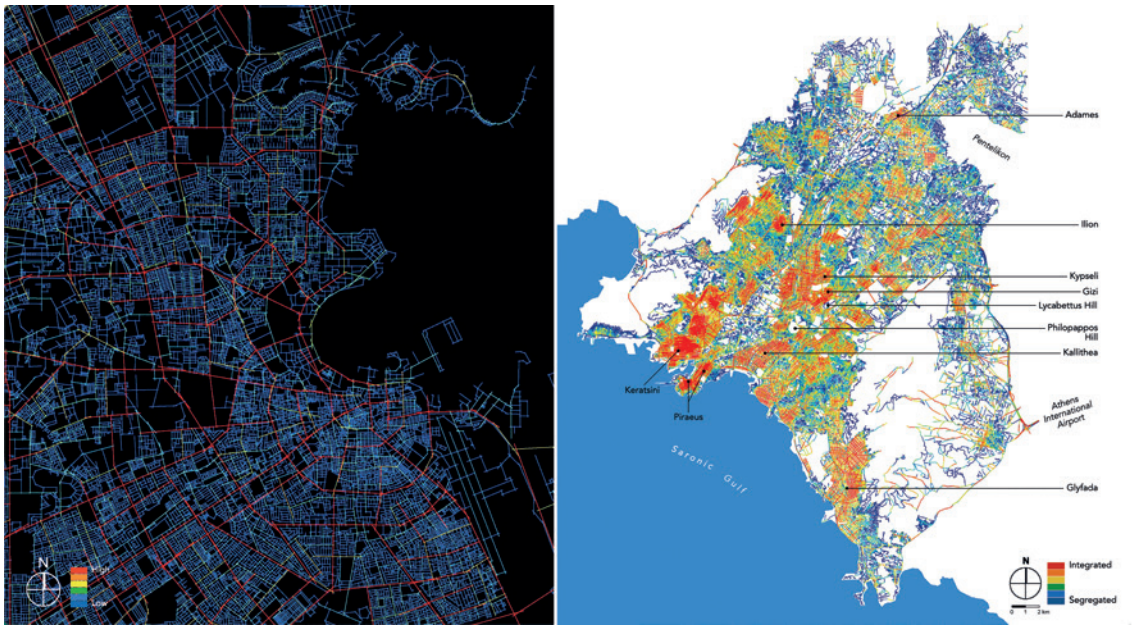

Figure 6. *Pattern of global choice (or 'through-movement') in Metropolitan Doha, Qatar, in 2020 (left; Source: QUCG-CENG-22/23-472) and (right) integration, 800 m radius in the Greater Athens, Greece in 2018 (Source: Street network segment model ©Space Syntax Ltd. and analyzed by Major* et al., *2023).*

always form opposites. It includes concepts such as transpatial (across space) and spatial (located in space); choice (through-movement) and betweenness (to-movement); global and local, integrated and segregated; shallow and deep; rings or ringy and trees or tree-like; mechanical and organic solidarities adapted from Durkheim (1893); intelligibility and synergy; linearity or axiality and centrality or compactness (Major, 2018 after Hillier, 1996); order and structure (Hanson, 1989); and, genotypes (general types) and phenotypes (phenomena types) derived from Leroi-Gourhan's (1964) universal tendencies and ethnic specifications (Hillier & Hanson, 1984).

Hillier's (1996) law of spatial emergence, i.e., local changes have predictable global outcomes, is of particular importance. It now seems evident to state this must be true. Otherwise, why would anyone ever bother hiring an architect or urban designer for any project unless it was to implement local design changes to manage such global outcomes better? Tied to emergence is Hillier's (1996) law of spatial convergence: emergent patterns converge on universal types, i.e., the ortho-radial grid (Figure 7, left). It is why space syntax enables us to understand different cities in different geographical, social, and cultural contexts. Space syntax helps us to see what is universal in all settlements ('allocentric') so we can better

comprehend what is specific to each ('egocentric') (Carvalho & Penn, 2004). Building on the research of Conroy (2001) and Conroy Dalton (2001), Major *et al.* (2023) later supplemented Hillier's (1996) laws, arguing for laws of spatial conservation (people will conserve their spatial strategies without intervention) and optimization (people will optimize their space use if allowed) as the conceptual basis for progressive and regressive strands of town planning (Figure 7, right). These theoretical concepts of space syntax define the role of the architect, urban designer, and town planner across the different scales of the built environment profession, from the single home to the entire metropolis and their interfaces in between. More importantly for evidence-based design and planning, space syntax researchers have developed models of how architects, urban designers, and town planners can intervene in urban environments to understand better the global outcomes of their local changes. Major (2018) and Major *et al.* (2023) laid out these spatio-formal processes with predictable design outcomes for streets and blocks in settlements, including the extension, expansion, subdivision, deformation, marginal separation by linear integration, and discrete separation by linear segregation (Figure 8). These concepts and models of space syntax derive from evidence-based research, leading to their implementation in evidence-based design and planning since the 1980s, beginning with the Foster & Partners' (1989) unrealized Kings Cross project in London (Hillier, 1993; Major, 2018).

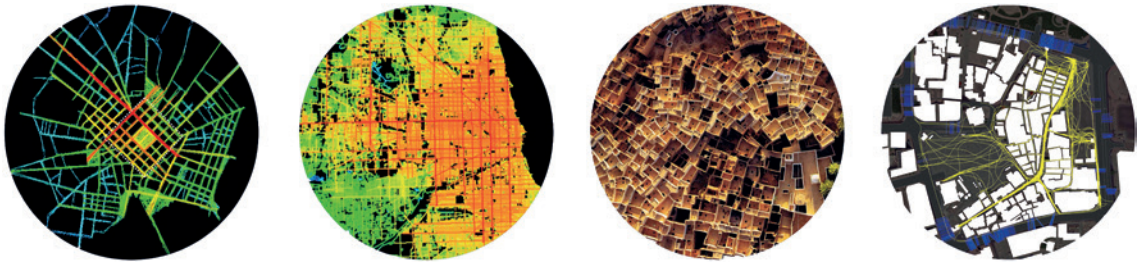

Figure 7. *Emergence and convergence in the pattern of global integration in the urban grid for (far left) all-line axial analysis of New Haven, Connecticut, USA, in 1864 (Source: Major, 2018, 136), and (left) ortho-radial grid of Chicago, Illinois, USA in 2002 (Source: Major, 2018, 183). Conservation and optimization in (right) an aerial view of Ghadames, Libya in 2013 (Source: Steinmetz, 2013) and (far right) unprogrammed street crossings (in blue) in Souq Waqif in Doha, Qatar in 2020 (Source: Major* et al.*, 2021, 10).*

Figure 8. *Spatio-formal processes with predictable design outcomes: (left to right) extension, expansion, block subdivision, deformation, marginal separation by linear integration, and discrete separation by linear segregation (Source: Major, 2018; Major* et al.*, 2023).*

4. Fearing and Worshiping in Artificial Intelligence

Over the previous year, after the public launch of ChatGPT in late 2022, there has been a great deal of angst and optimism about the future of AI across various fields in popular media outlets like the *New York Times*, and the *Washington Post* among others. AI poses the risk of extinction, screams one headline while another heralds the start of the AI gold rush (Rosse, 2023; Verma, 2023). One can find almost any argument about AI that might fit a range of biases, from fear to worship. The potential benefits and pitfalls for architecture, ur-

ban design, and town planning have not escaped notice with the launch of several generative AI tools such as DaVinci, Wonder AI, AutoDesk Forma (formerly SpaceMaker), PromeAI, Imagine, Adobe Firefly, and Architechtures. They all offer some form of AI-assisted design and planning. Many academics and practitioners are trying to understand what this innovative technology might mean for them and their professions. The reaction in higher education covers a similar spectrum, ranging from educators embracing the possibilities of AI to outright fear about it, often centered around student cheating. Like most things, the truth falls somewhere between these two extremes.

To this end, we conducted a simple exercise to explore if there might be any inherent biases built into the programming underlying the technology for the built environment using two generative AI programs: DaVinci and Wonder AI. DaVinci is a state-of-the-art AI Photo Generator app. Using the latest artificial intelligence technology, it can create unique artworks, photos, and images based solely on your descriptions (Source: DaVinci). Wonder AI is a new AI system that can create realistic images and art from a description in natural language. Wonder can create original, realistic images and art from a text description. It can combine concepts, attributes, and styles (Source: Wonder AI). The aim was to test the most straightforward text description for generating these images using keywords commonly associated with the built environment across a varied scale – from a dwelling to a planetwide city – and compare the outputs using three distinctive styles for each. The keywords utilized while maintaining a strict sequence for image generation throughout the exercise were:

> city > metropolis > megalopolis > ecumenopolis > town > village > neighborhood > building > house > dwelling

Ecumenopolis is a word invented by Greek architect C.A. Doxiadis to describe the hypothetical concept of a planetwide city (Doxiadis, 1975). We had to place the adjective 'future' in front of these keywords as the image results without the qualifier – in this case, a word limiting another word's meaning –was easily identifiable based on historical or cultural precedents. For example, Hobbiton from *The Lord of the Rings* movies when only using the word 'village'. For Wonder AI, the three styles selected for the exercise were: Cinematic, meaning of, relating to, suggestive of, or suitable for motion pictures or the filming of motion pictures; No Style, simply meaning the lack of a particular manner or technique by which something is done, created, or performed (Source: Merriam-Webster Dictionary); Steampunk, which is a type of science fiction set in a time when machines used steam for power, often in the 19th century (Source: Oxford English Dictionary). For DaVinci, the selected three styles were: Futurism, meaning extremely modern and unusual in appearance, as if belonging to a future time; Cyberpunk, which is a science fiction genre that focuses on a blurring of distinctions between humans and machines in bleak dystopias with lawless subcultures; and again, Steampunk (Source: Oxford English Dictionary). Since the last is the only standard style in both, it serves as a *de facto* benchmark for comparison. Crucially, Wonder AI does not allow reviewing the default text description after generating the image, at least as far as we could figure out. DaVinci does. As we shall see, this is a significant difference. We are interested in a few simple questions for this exercise, such as how many people are included in the image, whether there are many cars or any other distinguishing factors of the built environment. Wonder AI produces two images per text description. DaVinci produces three. Overall, it means we generated 300 images for this exercise and selected the one image that is most representative of each text description per program. Several hundred more images were generated during initial testing to define the keyword text description parameters and their sequencing precisely and finalize the selection of the styles for this exercise.

The primary takeaway from the Wonder AI output is the almost complete lack of people in the images (Figure 9). In this sense, the future seems full of things but devoid of people. Only 3 of the 30 representative images (outlined in red in Figure 9), or 10%, include people for cinematic metropolis and steampunk town and village. Four images explicitly show automobiles, and two implicitly do so based on light trails (long exposure photography highlighting the movement of light such as car headlights or taillights) on the city streets, e.g., cinematic neighborhood and megalopolis. This means that 20% of the images include automobiles at twice the rate for people depicted, even though today there are approximately (~) 7.9 billion people and ~1.47 billion vehicles worldwide, i.e., 5.4 people for every vehicle (Sources: World Bank/Hedges & Company). More vehicles will likely be seen in an urban setting, so whether this means anything is unclear. Collectively, nine images include rivers (30%), but only 3 or 10% have boats. The only other distinguishing factor is that 3 of the 30 representative images (again, 10%) are explicitly night-time views beyond the architectural stylistic differences. By far, the most featured architectural style is some variation of Modernism for cinematic and no style except for village, town, and neighborhood. The cinematic village features architecture with Asian rooflines. The cinematic town and neighborhood images feature single-family housing. Still, the town includes driveways to these homes, whereas the neighborhood does not, perhaps implying that the social sense of a neighborhood does not include garages and driveways. All the steampunk images possess a distinctive 19th-century industrially-inspired architectural style. There is a reason for this, which we will discuss shortly.

DaVinci produced some more interesting results (Figure 10). More people appear in the DaVinci images, especially for cyberpunk (70%). Overall, 53.3% (16 of 30) include people in all three styles. 33.3% (10 of 30) include automobiles, but 30% are due to cyberpunk style (9).

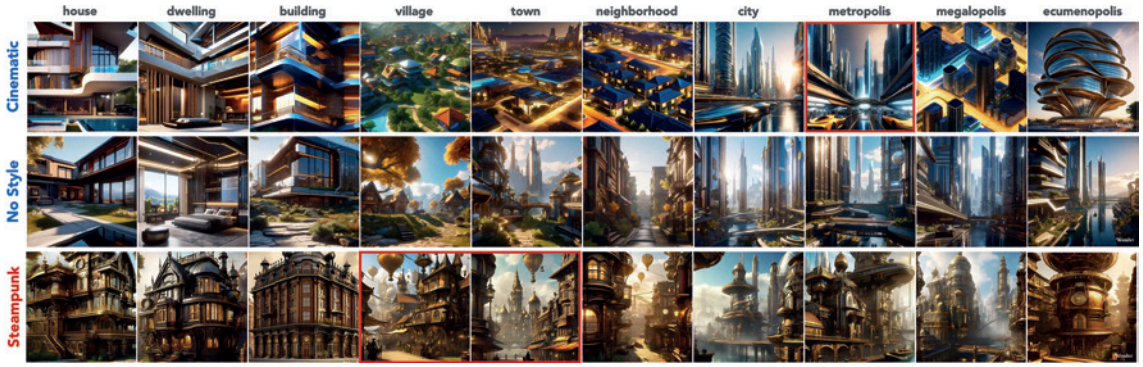

Figure 9. *The generative image results of Wonder AI in November 2023 testing the generic description of "Future (Insert here, see the top row above the images)" in the style of Cinematic, No Style, and Steampunk with only three images (outlined in red) including people (Source: Wonder AI/Author).*

Figure 10. *The generative image results of the DaVinci AI in November 2023 testing the generic description of "Future (Insert here, see the top row above the images)" in the style of Futurism, Cyberpunk, and Steampunk (Source: DaVinci/Author).*

The rate of showing people versus cars is better than Wonder AI. Overall, only three images show a river or waterway, and only one has a boat. According to DaVinci AI, water is not a significant feature of the future. All the Futurism images feature more organic shapes as a characteristic of parametric design. Steampunk again features its 19th-century industrially-inspired architectural style. It is almost impossible to distinguish an architectural style associated with cyberpunk since all are night-time images. Cyberpunk's characteristics are primarily pink and blue lights with lots of signage featuring mostly Asian-inspired text except for one (future village) where the word "FUTURE" predominates.

Reviewing the default text description after generating the DaVinci images clarifies that the program has altered our generic text descriptions, i.e., future city, future neighborhood, future dwelling, etc. The default text description for Futurism now reads "future (insert here), futuristic, new age, highly detailed, digital painting, concept art, masterpiece ArtStation.com". For cyberpunk, it now reads: "future (insert here), *Blade Runner* (our emphasis), cyberpunk, neon lights, highly detailed, digital painting, ArtStation.com". Finally, for steampunk, it reads: "future (insert here), steampunk, industrial, arcane, octane beautifully detailed render, extremely hyper-detailed, intricate, epic composition, epic cinematic lighting, trending on ArtStation.com, *art by Greg Rutkowski* (our emphasis), crispy quality". By implication, it seems likely that the same thing occurred using Wonder AI due to our use of a benchmark group, i.e., steampunk, and their stylistic similarities. It implies that we have engaged via the AI program in pseudo-plagiarism, specifically of the 1982 film *Blade Runner* for the cyberpunk images, the artist Greg Rutkowski for steampunk ones, and, in a more derivative form, any image generated using another website like ArtStation.com as a resource. At the very least, it is good that the DaVinci AI allows you to review the default text description after image generation to trace the source of the plagiarism. Wonder AI seems to hide this from the user. Many people are unhappy about how generative AI uses online resources for learning without attribution or licensing (Heikkilä, 2022).

What else did we learn from this simple exercise? It was hardly definitive but informative. First, the future is urban. It is unsurprising since ~56% of the world's population – 4.4 billion inhabitants – live in cities today (Source: World Bank). The future is also empty, primarily vehicular, and literally bright. The latter is because the default style filter takes over, representing a 'style over substance' process. For example, it is always daytime for utopian visions, such as Futurism. It is almost always night-time for a dystopian vision of the future, such as cyberpunk. In night-time images, especially cyberpunk ones, light pollution appears to be a severe consequence of the built environment in the future. Generally, apartments are considered dystopian, and free-standing or single-family houses are utopian, even within other structures for these AI-generated images (see DaVinci's steampunk building and dwelling outputs), which seems to contradict the first point. This is not a repeatable scientific process but a heuristic, trial-and-error one. Several attempts were made to replicate remarkably similar images using more detailed text descriptions. They failed.

Nonetheless, it is clear: the more specific the text description, the better. However, even then, the DaVinci AI is always complemented with additional descriptive text. Presumably, so is Wonder AI. It is the role of the architect, urban designer, and town planner to translate the abstract to the concrete in real-world solutions (Hillier, 1996; Evans, 1997). All these AI-generated images are two-dimensional representations. For an architect to take an AI-generated building and translate it into a real-world solution, it would involve shaping it into a three-dimensional form, i.e., making suppositions about what is hidden in the image. In doing so, the architect translates the abstract idea into a concrete, constructible form. Only then do they own the product as a creator. This indicates that AI cannot replace built environmental professionals. AI remains only a tool for sparking ideas in the creator to develop enduring solutions for architecture and cities.

Conclusion

We have been building sustainable, resilient cities for a long time. We know what they look like. We require more critical thought and less passion about our cities. Space syntax works because the basis of its representations is us, providing the evidence-based design and planning tools and concepts to objectively measure and discuss the dual nature of cities. Today, AI is only an emerging helpful tool. It may evolve into something else in the future. However, it still requires human intervention and critical thinking to create solutions for the real world that are sustainable and resilient. We must guard against AI muddling those solutions because they must still be evidence-based design and planning with a rigorous scientific approach in order to endure.

Acknowledgments

Thank you to Nadia Charalambous, Ilaria Geddes, and all the conference organizers, including the University of Cyprus and the Cyprus Network of Urban Morphology, for the opportunity to give this Keynote Address to the *KAEBUP Final Event/3rd CyNUM Regional Conference* on the 6th of December 2024 at the University of Cyprus in Nicosia.

References

"Egypt: 19 Killed in Truck-microbus Collision Outside Cairo", *Asharq Al Awsat*, 21 October 2021, https://english.aawsat.com/home/article/3258156/egypt-19-killed-truck-microbus-collision-outside-cairo (Accessed 13 September 2023).

Carter, H. (1983), *An Introduction to Urban Historical Geography*, London: Edward Arnold (Publishers) Ltd.

Carvalho, R., Penn, A. (2004), "Scaling and universality in the micro-structure of urban space", *Physica A*, 32: 539-547.

Conroy, R. (2001), *Spatial Navigation in Immersive Virtual Environments*, PhD Thesis, The Bartlett School of Graduate Studies, University of London.

Conroy-Dalton, R. (2001), "The Secret is to Follow Your Nose: Route Path Selection and Angularity", in Peponis, J., Wineman, J., Bafna, S., *Proceedings of the 3rd International Space Syntax Symposium*, University of Michigan, 47.1-47.14. ISBN: 1-891197-18-5.

Davoudi, S. (2012), "Resilience: A Bridging Concept or a Dead End?", *Planning Theory & Practice*, 13(2): 299-333.

Doxiadis, C.A. (1975), "Economics and the ekistic grid", *Ekistics*, 40(236): 1-4.

Durkheim, E. (1893), *The Division of Labour in Society*, Translated by W.D. Halls (1984 Edition), New York: Macmillan.

Evans, R. (1997), *Translations from Drawing to Building and Other Essays*, Cambridge, Mass.: MIT Press.

Hanson, J. (1989), "Order and Structure in Urban Design", *Ekistics*, 334/335: 22-42.

Heikkilä, M. (2022), "This artist is dominating AI-generated art. And he's not happy about it", *MIT Technology Review*, 16 September 2022, https://www.technologyreview.com/2022/09/16/1059598/this-artist-is-dominating-ai-generated-art-and-hes-not-happy-about-it/amp/ (Accessed 22 November 2023).

Hillier, B. (2003), "The Knowledge that Shapes the City: The Human City Beneath the Social City", *Fourth International Space Syntax Symposium Proceedings*, London: University College London, 26.

Hillier, B. (1996), *Space is the Machine: A Configurational Theory of Architecture*, Cambridge: Cambridge University Press.

Hillier, B. (1993), "Specifically Architectural Knowledge: A Partial Account of the Ascent from Building to Cultural Transmission to Architecture as Theoretical Concretion", *Harvard Architectural Review*, 9: 9-27.

Hillier, B., Hanson, J. (1984), *The Social Logic of Space*, Cambridge: Cambridge University Press.

Hillier, B., Leaman, A. (1973), "The man-environment paradigm and its paradoxes", *Architectural Design*, 78(8): 507-511, ISSN 0003504.43.

Institute for Urban Strategies (IUS) (2021), *Global Power City Index 2021*, Tokyo: Mori Memorial Foundation, https://mori-m-foundation.or.jp/pdf/GPCI2021_summary.pdf (Accessed 14 November 2022).

Krenz, K., Psarra, S., Netto, V.M. (2023), "Mapping the conceptual system of an urban theory and its evolution: a text analysis of space syntax conference papers over 20 years", *Urban Morphology*, 27 (2): 161-177. DOI: 10.51347/UM27.0014.

Leroi-Gourhan, A. (1964), *Geste Et La Parole (Gesture and Word)-Tome 1* (Le) (Collections Sciences-Sciences Humaines), Paris: Albin Michel.

Major, M.D., Atour, R., John, D. (2022), "Chasing the 'Ghost' of Entopia: Doxiadis, Ekistics, and Placemaking in Cities", *Ekistics and the New Habitat: The Problems and Science of Human Settlements*, Special Issue: Ekistics-related Research in Greece (Part 2 of 3): A Critical Approach to the Ekistics Legacy: Dedicated to Panayis Psomopoulos (1926-2017), 82(2), 29-42, DOI: 10.53910/26531313-E2022821650, https://www.ekisticsjournal.org/index.php/journal/article/view/650. Published in 2024.

Major, M.D., Atour, R., Tannous, H.O., Albatarani, L.H., John, D. (2023), "Doxiadis' Ekistics Imperative and the Paradox of Ecumenopolis. Special Issue on Greece Today: Ekistics Related Research", *Ekistics and the New Habitat: The Problems and Science of Human Settlements*, Special Issue: Ekistics-related Research in Greece (Part 1 of 2): A Critical Approach to the Ekistics Legacy: Dedicated to Panayis Psomopoulos (1926-2017), 82(1): 50-63, DOI: 10.53910/26531313-E2022821, https://ekisticsjournal.org/index.php/journal/issue/view/346.

Major, M.D., Atour, R.M., Tannous, H.O. (2021), "Organized Complexity of the Urban Object", *Journal of Design for Resilience in Architecture & Planning (DRArch)*, 2 (01-18) (December 2021), Special Issue: Space Syntax, Selçuklu/Konya: Konya Technical University, 1-17, E-ISSN: 2757-6329, DOI: 10.47818/DRArch.2021.v2si032.

Major, M.D., Al-Nabet, S.F. (2018), "Buildings Don't Bounce: The Design Paradox of Urban Resilience. New Urban Research Session", *Congress for New Urbanism* 26, 16-19 May 2018, Savannah, https://www.cnu.org/new-urban-research/papers.

Major, M.D. (2018), *The Syntax of City Space: American Urban Grids*, New York: Routledge/Taylor & Francis.

Mohamed, A.A., van der Laag, C. (2023), "Space Syntax has Come of Age: A Bibliometric Review from 1976 to 2023", *Journal of Planning Literature*, 0(0): 1-15. DOI: 10.1177/08854122231208018, https://journals.sagepub.com/doi/full/10.1177/08854122231208018 (Accessed 2 December 2023).

Rosse, K. (2023), "A.I. Poses 'Risk of Extinction,' Industry Leaders Warn", *New York Times*, 30 May 2023, New York, https://www.nytimes.com/2023/05/30/technology/ai-threat-warning.html (Accessed 3 November 2023).

Steinmetz, G. (2013), "Photo of the Day", *National Geographic Magazine*, 27 March 2013, https://www.nationalgeographic.com/photo-of-the-day/photo/ghadames-aerialsteinmetz (Accessed 14 September 2021).

Tannous, H.O., Major, M.D., Furlan, R. (2021), "Accessibility of Green Spaces in a Metropolitan Network: Using Space Syntax to Objectively Evaluate the Spatial Locations of Parks and Promenades in Doha, State of Qatar", *Urban Forestry & Urban Greening*, 58(2021), DOI: 10.1016/j.ufug.2020.126892, https://www.sciencedirect.com/science/article/abs/pii/S1618866720307093.

van Nes, A., Yamu, C. (2021), *Introduction to Space Syntax in Urban Studies*, Cham: Springer.

Verma, P. (2023), "The AI 'gold rush' is here. What will it bring?", *Washington Post*, 20 January 2023, Washington, D.C., https://www.washingtonpost.com/technology/2023/01/07/ai-2023-predictions/ (Accessed 3 November 2023).

World Health Organization (WHO) (2012), *Egypt Road Safety*, WHO Office for Egypt, https://www.emro.who.int/images/stories/cah/fact_sheet/road_safety.pdf (Accessed 16 September 2023).