



Middle East  
Centre

# ROADS (DIS)CONNECTING CITIES AND NEIGHBOURHOODS

## A SOCIO-SPATIAL STUDY OF ABU DHABI

**Alexandra Gomes, Apostolos Kyriazis,  
Peter Schwinger, Clémence Montagne  
and Sepehr Zhand**



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Roads (Dis)connecting Cities and Neighbourhoods:  
A Socio-Spatial Study of Abu Dhabi

Alexandra Gomes, Apostolos Kyriazis, Peter Schwinger,  
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## Abstract

Road infrastructure has played a crucial role in the rapid urban development of Gulf cities. However, it has frequently taken precedence over urban planning leading to high car dependency. In Abu Dhabi, roads connect spaces afar while creating barriers between neighbourhoods.

This paper employs a mixed-method approach, combining observations, interviews and spatial analysis at both metropolitan and neighbourhood levels to investigate the relationship between technical road design, space and people. It highlights the significance of historical context, governance, planning and design tools in road design. The study aims to provide evidence-based analysis for policymakers and institutions, urging them to challenge car-centric development and prioritise people and the environment in road design. It concludes with reflections and policy recommendations to rethink road design and planning strategies, acknowledging their impact on Abu Dhabi's urban dynamics and local communities.

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## Introduction

This paper stems from a two-year academic collaborative research project between LSE Cities and Abu Dhabi University (ADU) researchers, supported and managed by the LSE Middle East Centre and funded by the Emirates Foundation. The aim of this project is to explore the socio-spatial impact of Abu Dhabi's car-centric development and to create solid evidence-based research that can influence policymaking towards a more sustainable urban development, informing national and international policy debates and place Abu Dhabi and the Gulf on the research agenda.

Road infrastructure has supported the city's rapid urban development, but in the process created barriers, imposed economic costs and promoted car dependency with high costs at the city and local level.<sup>1</sup> Land and oil availability, motorisation, land use zoning and modernist urban development have led to a prioritisation of roads over urban planning.<sup>2</sup> While these impacts are widely recognised by the literature on most Gulf cities, the relationship between the different factors and their spatial and social impacts within this cultural and climatic context remain under-researched.

In a city of circa 1.8 million people – of which 84 percent are non-Emirati migrant workers – Abu Dhabi's land and oil resources have played a crucial role in its development as a car-centric city as well as its distribution of wealth and urban form.<sup>3</sup> However, this development has also been impacted by such factors as extreme climate conditions, individual perceptions (e.g. speed, safety and status), limited investment in public transport infrastructure and policies that encourage the use of cars – subsidised petrol, favourable tax policies and low interest rates.<sup>4</sup>

Abu Dhabi has seen a strong growth in vehicle registration over the last decade, except for 2019 mostly due to COVID-19 (see Figure 1). Although the level of road-congestion in 2021 was low (11 percent) when compared to 19% in Kuwait and 20% in Dubai, Abu Dhabi still has one of the highest CO<sub>2</sub> emissions per capita, with cars being the dominant polluters within the transport sector.<sup>5</sup> Annually, only 76% of readings from pollutant measuring stations are within national air quality limits.<sup>6</sup>

<sup>1</sup> See the project page 'Roads (Dis)connecting Cities and Neighbourhoods: A Socio-spatial Study of Abu Dhabi' and the final outputs (exhibition and seminar). Available at: <https://www.lse.ac.uk/middle-eastcentre/research/collaboration-programme/2021-22/alexandra-gomes> (accessed 15 December 2023).

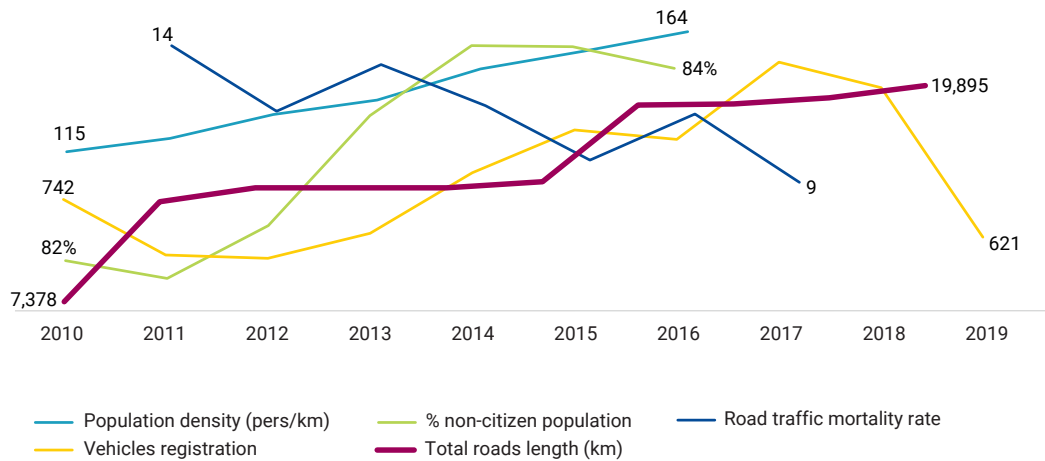
<sup>2</sup> Philipp Rode et al., 'Resource Urbanisms: Asia's Divergent City Models of Kuwait, Abu Dhabi, Singapore and Hong Kong', *LSE Cities*. Available at: <https://www.lse.ac.uk/cities/publications/research-reports/Resource-Urbanisms> (accessed 4 July 2022).

<sup>3</sup> 'SCAD Statistical Yearbook 2012–2020', *Statistics Centre Abu Dhabi* (2020). Available at: [https://www.sti.gov.ae/web/guest/related-publications?p\\_r\\_p\\_categoryId=206](https://www.sti.gov.ae/web/guest/related-publications?p_r_p_categoryId=206) (accessed 6 July 2022); Rode et al., 'Resource Urbanisms'.

<sup>4</sup> Meldone Ochieng and Mohamed Jama Mohamed, 'The Implications of Automobile Dependency in Abu Dhabi City', *21st International Conference on Urban Transport and the Environment, WIT Transactions on the Built Environment* (València, Spain: WIT Press, 2015). Available at: <https://trid.trb.org/view/1357561> (accessed 6 July 2022).

<sup>5</sup> 'Abu Dhabi Traffic Report 2021', *TomTom Traffic Index* (2021). Available at: [https://www.tomtom.com/en\\_gb/traffic-index/abu-dhabi-traffic/](https://www.tomtom.com/en_gb/traffic-index/abu-dhabi-traffic/) (accessed 6 July 2022).

<sup>6</sup> 'Abu Dhabi Air Emission Inventory 2018', *Abu Dhabi: Environment Agency* (2018). Available at: <https://www.ead.gov.ae/Knowledge-Hub/Resources-Materials> (accessed 6 July 2022).

Figure 1: Population and Road Related Indicators<sup>7</sup>

Car dependency is strongly reflected in the economy with 98% of goods transported by road and 88% of all non-commercial journeys made by car or bus.<sup>8</sup> Of that 88%, however, public transport contributed to only 4.8% of the total number of trips in 2021.<sup>9</sup> Taxis also play a dominant role in road transport, adding a significant number of vehicles on the road. Road length has been constantly growing and the minimum parking requirement is one of the highest in the world further encouraging the use of automobiles.<sup>10</sup> This dependence has cost Abu Dhabi approximately \$20 billion in road investment in a three-year period (before COVID), such as road widening, bridges and interchanges to manage congestion.<sup>11</sup>

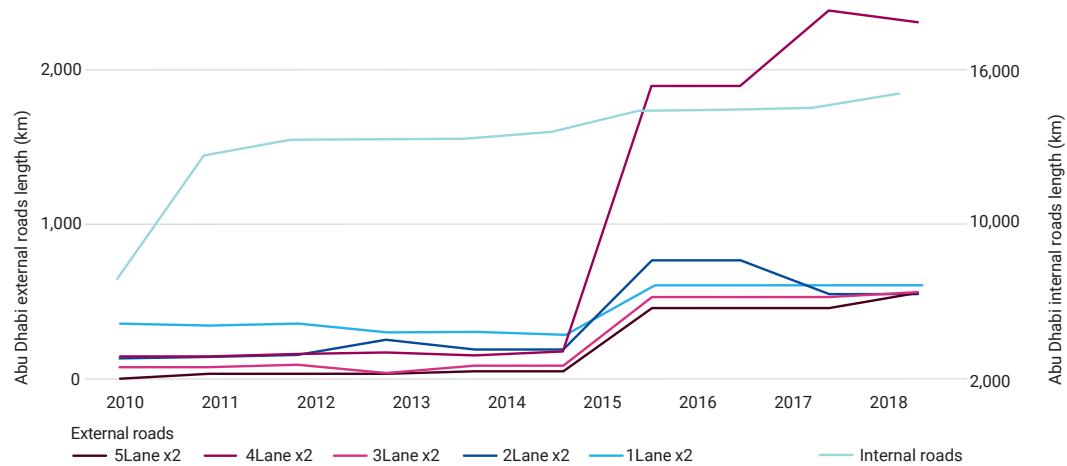
<sup>7</sup> 'SCAD Statistical Yearbook 2012\_2020'; *Statistics Centre*. Available at: [https://www.sti.gov.ae/web/guest/key-statistical-indicators?p\\_r\\_p\\_categoryId=227](https://www.sti.gov.ae/web/guest/key-statistical-indicators?p_r_p_categoryId=227) (accessed 6 July 2022).

<sup>8</sup> Ochieng and Jama, 'The Implications of Automobile Dependency in Abu Dhabi City'.

<sup>9</sup> 'Abu Dhabi Urban Street Design Manual', *Department of Municipalities and Transport* (2021). Available at: <https://addata.gov.ae/dataset/abu-dhabi-urban-street-design-manual> (accessed 15 January 2023).

<sup>10</sup> Oxford Business Group, 'Continued Expansion: Infrastructure Investment Drives Sector Growth', *UAE: Abu Dhabi | Construction* (2014). Available at: <https://oxfordbusinessgroup.com/reports/uae-abu-dhabi/2014-report/economy/continued-expansion-infrastructure-investment-drives-sector-growth> (accessed 25 August 2023); Apostolos Kyriazis et al., 'Rethinking Streetscapes for Abu Dhabi: A Roundtable on the City's Past, Present and Future', *LSE Middle East Centre Blog* (accessed 15 July 2022). Available at: <https://blogs.lse.ac.uk/mec/2022/07/15/rethinking-streetscapes-for-abu-dhabi-a-roundtable-on-the-citys-past-present-and-future/> (accessed 2 November 2022).

<sup>11</sup> Ochieng and Jama, 'The Implications of Automobile Dependency in Abu Dhabi City'.

Figure 2: Road Construction in Abu Dhabi Region<sup>12</sup>

At the same time, in a period of climate emergency, vehicle ownership rates are very high and ridership levels place Abu Dhabi together with Saudi Arabia in the top ranking of emission rates in terms of metric ton (MT) CO<sub>2</sub> equivalent per kilometre of road. In Abu Dhabi, roads contribute to about 63 percent of the direct greenhouse gas (GHG) emissions in the transport sector, of which more than 98 percent is attributed to CO<sub>2</sub> emissions produced by fuel combustion.<sup>13</sup>

Health related issues are another impact of motorisation. Though road traffic mortality is lower than in other Middle East countries, it is still one of the world's highest and in 2016 the World Health Organisation estimated that the estimate rate per 100,000 people, represented 6.4 times the value of Singapore and 5.8 times the value of the UK.<sup>14</sup> In total, traffic accidents cost the UAE AED 14 billion, which in 2009 corresponded to 1 percent of the city's GDP.<sup>15</sup> Another health related impact is the lack of physical activity car dependency encourages. In 2000, a third of the UAE population was obese and over 40 percent overweight.<sup>16</sup> Recent studies mention 19 percent of the citizens having diabetes.<sup>17</sup> Trying to mitigate these issues, Abu Dhabi has been heavily investing in cycling infrastructure (see section on the functional use of roads).

These dimensions and numbers are just the starting point to the analysis of a city that seems to be supporting a continuous cycle of growth for roads and motorisation (see Figure 2).<sup>18</sup>

<sup>12</sup> SCAD, 'SCAD Statistical Yearbook 2012–2020'. Note: The length of the roads is multiplied by the number of lanes. External roads are roads outside of settlements (urban areas).

<sup>13</sup> Francisco D. B. Albuquerque et al., 'Greenhouse Gas Emissions Associated with Road Transport Projects: Current Status, Benchmarking, and Assessment Tools', *Transportation Research Procedia* 48 (2020), pp. 2018–30.

<sup>14</sup> WHO, 'Global Status Report on Road Safety 2018', *Global Report* (2018). Available at: <https://www.who.int/publications-detail-redirect/9789241565684> (accessed 1 November 2023).

<sup>15</sup> Ochieng and Jama, 'The Implications of Automobile Dependency in Abu Dhabi City', p. 148.

<sup>16</sup> Nabil Sulaiman et al., 'Prevalence of Overweight and Obesity in United Arab Emirates Expatriates: The UAE National Diabetes and Lifestyle Study', *Diabetology & Metabolic Syndrome* 9/1 (accessed 2 November 2017), p. 88.

<sup>17</sup> Anam Rizvi, 'Special Report: Obesity Rate in the UAE Double the World Average', *The National* (2015). Available at: <https://www.thenationalnews.com/uae/health/special-report-obesity-rate-in-the-uae-double-the-world-average-1.74056> (accessed 2 November 2022).

<sup>18</sup> Rode et al., 'Resource Urbanisms'.



## Literature Review

Despite its emerging status as an ‘exemplar’ of a new Arab city in the Gulf region, Abu Dhabi is dwarfed by Dubai in terms of scholarly attention. Several sources attempt to depict this rapid transformation from a seasonal fishing post to a contemporary global hub, often under an empirical and romanticised approach.<sup>19</sup> Recently, a more critical gaze on the modernisation of Abu Dhabi has emerged, coinciding with an effort to document and preserve samples of late Modernism. Abu Dhabi’s people are the topic of even fewer scholarly works despite its special demographics, with limited literature describing the quotidian hardships and the spatial manifestation of the migrant population.<sup>20</sup> Instead, Abu Dhabi has been mostly scrutinised for its infrastructural properties.<sup>21</sup> Similarly, there is only a handful of critiques on automobile dependency and its role as a social indicator and a facilitator of post-modern imaginaries for both Dubai and Abu Dhabi.<sup>22</sup> The overarching question of the role of roads in (dis)connecting both space and people remains unexplored.

The significance of this literature gap is amplified once Abu Dhabi is viewed in reference to other cities in the region. The work on other Gulf cities highlights the fact that Abu Dhabi can be considered as a common vantage point for future studies and applications, due to morphological clarity, to a ‘tabula rasa’ urbanism and to the special political, economic and social urban growth characteristics.<sup>23</sup>

<sup>19</sup> Abu Dhabi Municipality, ‘Abu Dhabi: Dana of the Gulf, Planning and Urban Development (Studies and Research Section)’, Abu Dhabi Municipality & Town Planning Department, 2003; Mohamed Abduljalil Al-Fahim, *From Rags to Riches: The Story of Abu Dhabi* (London: London Centre of Arab Studies, 1995).

<sup>20</sup> See Khaled Alwadi, *Lifescapes Beyond Bigness* (London: Artifice, 2018); Yasser Elsheshtawy, *Temporary Cities: Resisting Transience in Arabia*, 1st ed. (Abingdon: Routledge, 2019); Apostolos Kyriazis et al., *Abu Dhabi Public Spaces: Urban Encounters, Social Diversity and (In)formality* (Abu Dhabi: Books Arabia, 2021); Florian Weidmann and Ashraf M Salama, *Building Migrant Cities in the Gulf: Urban Transformation in the Middle East* (London: I.B.Tauris, 2019); Deepak Unnikrishnan, *Temporary People* (New York: Restless Books, 2017).

<sup>21</sup> Rode et al., ‘Resource Urbanisms’; Martin Scoppa, Khawla Bawazir and Khaled Alawadi, ‘Walking the Superblocks: Street Layout Efficiency and the Sikkak System in Abu Dhabi’, *Sustainable Cities and Society* 38 (2018), pp. 359–69.

<sup>22</sup> For examples see Clémence Montagne, *Urban Development and Urban Planning at Abu Dhabi and Dubai: Politics, Actors and Mobility* (Paris: Paris-Sorbonne University, 2016); Apostolos Kyriazis, Ahmed Almehairi and Ibrhahim Seri, ‘The Morphology of Abu Dhabi’s Superblocks’, *Athens Journal of Architecture* 4 (2017), pp. 373–94; Apostolos Kyriazis, Ayesha Zahid and Shafaq Qamer, ‘A Cultural Paradox and the Double Shift of the Housing Typologies in the Arabic Gulf Area’, *ARCC Conference Repository* (ARCC, August 2019); Ahmed Kanna (ed.), *The Superlative City: Dubai and the Urban Condition in the Early Twenty-First Century, Aga Khan Program of the Graduate School of Design* (Cambridge, MA: Harvard University Press, 2013).

<sup>23</sup> For examples see Pascal Menoret, *Joyriding in Riyadh: Oil, Urbanism, and Road Revolt* (Cambridge: Cambridge University Press, 2014); Alwadi, *Lifescapes Beyond Bigness*; Alexandra Gomes, Asseel Al-Ragam and Sharifa AlShalfan, ‘Reclaiming Public Space in Kuwait’s Residential Neighbourhoods: An Applied Policy-Oriented Approach’, *LSE Middle East Centre Kuwait Programme Paper Series* 8, March 2021; Gustavo Linhares de Siqueira et al., ‘Where Omanis Walk? A Comparison Between the Perception and the Morphology of the Built Environment in Different Neighbourhoods of Muscat’, in Mohamed Elkaftangui (ed.), *Architecture Media Politics Society (AMPS) Conference 13: Constructing an Urban Future: The Sustainability and Resilience of Cities* (Abu Dhabi: AMPS, 2018), pp. 49–63; Roberto Fabbri and Sultan Sooud Al-Qassemi (eds), *Urban Modernity in the Contemporary Gulf: Obsolescence and Opportunities* (Abingdon: Routledge, 2021); Łukasz Stanek, *Architecture in Global Socialism: Eastern Europe, West Africa, and the Middle East in the Cold War* (Princeton: Princeton University Press, 2020).

## Research Approach and Methodology

This investigation uses a mixed-methods approach, incorporating a space syntax method of analysis based on a road network model and running it through DepthmapX and SSL toolkit in QGIS and CAD software to explore spatial patterns at different scales. Seven semi-structured interviews, three specialised workshops, fieldwork and observation (from March to June 2022) as well as photography were used to investigate individual perceptions and social impact. Technical and documentary review was undertaken to understand the effects of planning and policy guidelines.

The first section uses historical, technical, and institutional knowledge and documentation to provide an overview of how the road network historically developed including how governance influenced road policy and design. The second section explores the functional use of roads and undertakes a larger-scale analysis to provide insight into what is happening at the local scale.<sup>24</sup> At the metropolitan level, space syntax analysis is used to assess the role of the road network through a spatial network model for centrality measures – closeness centrality and betweenness centrality at various radii from global to local.<sup>25</sup> For the third section ten case study areas are examined, selected for their distinct social and architectural properties and the diverse relation between urban form and street layout, public space conditions and location. A series of thematic maps illustrates main urban morphology properties and a surface analysis. The fourth section explores the impact on individual and collective behaviour shaped by the existing road network, explored mostly through literature review, observations and the results of the semi-structured interviews. This investigation includes different dimensions and interrelations to reflect some of the main causes and consequences of car-centric development in Abu Dhabi (see Figure 3). This section examines the type of roads and their technical design (see section on technical design) including their characteristics, location, the impact on space and its functional use – considering the metropolitan and neighbourhood scale (see section on the functional use of roads) and the impact on people and their sociability (see section on the social use of roads). The final section looks at policy and planning options to lessen negative impacts of roads before the conclusion of the investigation.

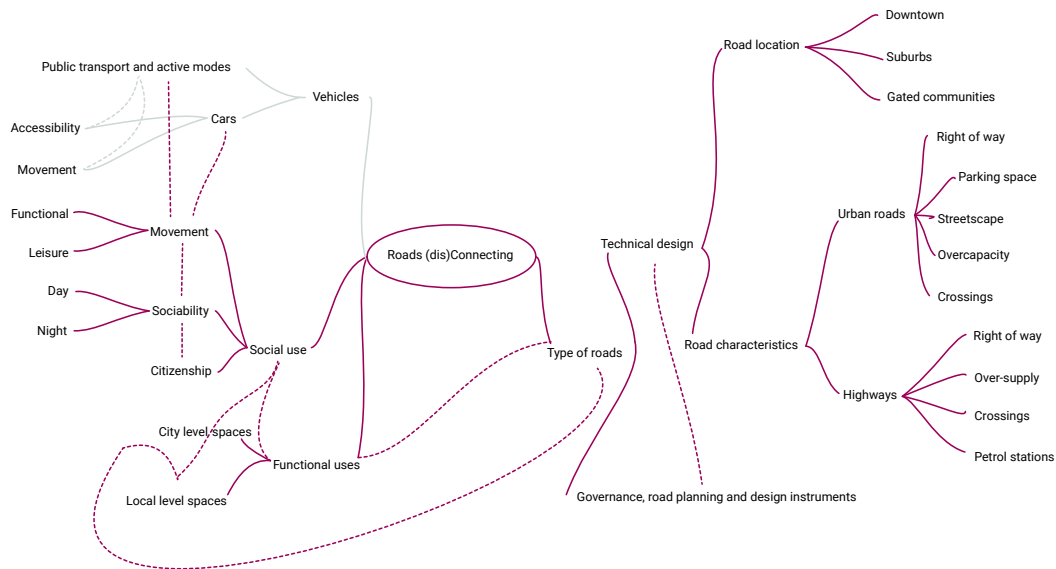
In this paper, ‘disconnections’ encompass both spatial and social barriers in Abu Dhabi’s road network, including road space, right-of-way, safety-related physical barriers and parking spaces. While examining historical, governance, and policy influences on the current network, we aim to tackle challenges affecting pedestrian, cyclist and driver mobility.

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<sup>24</sup> In this study, road and street are used interchangeably to refer to dedicated surfaces on the ground for vehicles, people or animals to travel on. However, a street is usually urban and designed for a mix of users and a road is mostly suburban and mostly designed for cars. In Abu Dhabi that distinction is not always clear.

<sup>25</sup> Closeness centrality, or integration, in space-syntax literature refer to to-movement and correlates with areas more likely to have active interactions. In betweenness centrality, or choice, refers to through-movement, highlighting the roads most likely to be used within a street network. Gert Sabidussi, ‘The Centrality Index of a Graph’, *Psychometrika* 31/4 (1966), pp. 581–603; Linton C. Freeman, ‘A Set of Measures of Centrality Based on Betweenness’, *Sociometry* 40/1 (1977), pp. 35–41.

Figure 3: Framework of Analysis and Inter-Relationships Between Elements



## Understanding Roads

This section examines the history and policy framework of Abu Dhabi's road network, including the organisational properties and relationship with urban agglomerations. It also focuses on selected neighbourhood areas, highlighting the dynamic thresholds between the street network, urban morphology and public space.

### The History of Roads and Urban Development

Abu Dhabi started as a seasonal seafront settlement, even after its first oil concessions in the 1950s. The power shift under Sheikh Zayed in 1962 led to the modernisation of the city that, having eradicated its pre-oil core, relied on urban planning to introduce a new national identity. Utilising a practical grid layout, the master plans of the consultancy firm Arabicon and City Planning Directors Katsuhiko Takahashi and Abdelrahman Makhoulouf – with a clear influence from Konstantinos Doxiadis' work in the region – were adopted.<sup>26</sup> Their plans also fit the political priorities for equity, uniformity and flexibility to rapidly channel the anticipated oil revenues into the production of urban space.<sup>27</sup>

<sup>26</sup> Namely Doxiadis' Master Plan revisions of Baghdad in 1958 and Riyadh in 1968.

<sup>27</sup> Kyriazis, Almehairi and Seri, 'The Morphology of Abu Dhabi's Superblocks'.

By the early nineties, development started pushing out from a saturated Abu Dhabi island to the mainland. The Atkins Comprehensive Plan of 1998 introduced the suburbia of low-density, extreme zoning and sprawl.<sup>28</sup> Through the Abu Dhabi 2030 Framework Plan,<sup>29</sup> the city upgraded from a federal capital to a global hub in tourism, sports and culture emphasising on leisure and ‘starchitecture’.<sup>30</sup> Urbanisms of exclusion<sup>31</sup> were created along the seashore, while ethnically distinct suburbs kept expanding horizontally, dominated by a pastiche of housing as a commodity and a social status indicator.<sup>32</sup>

The suburbs, with their subsidised Emirati neighbourhoods, currently represent the dominant landscape of the city.<sup>33</sup> Their rapid expansion and ‘leapfrog’ development have added costs of regional integration and transport infrastructure needs.<sup>34</sup> Sheikh Zayed’s initial investment in roads is now a challenge for those who cannot or do not want to drive. The suburbs’ infrastructures reflect the status of those who live there, with empty roads served by wide pavements often occupied by cars, while the poorer neighbourhoods provide little walkability for those who need it. These issues are often linked to planning and urban design but should also be examined in terms of citizenship, income and social segregation.

## Governance, Road Planning and Design Instruments

The city’s governance and management had a fundamental influence in prioritising road infrastructure and street design. Prior to 2004, planning codes and manuals in Abu Dhabi were either non-existent or had been quickly adapted from examples in the US. Road design was predominately under the control of one institution, the Abu Dhabi Municipality. Following the demise of Sheikh Zayed in 2004, a construction boom led to the rise of other players, urban development companies. These companies accommodated the fast-paced planned growth and implementation of large-scale urban developments with road design and streetscape, however, neither followed municipal guidelines nor coordinated with each other.

In 2007, the newly founded Urban Planning Council (UPC) developed the Plan Abu Dhabi 2030 and its subsequent Urban Framework Plan. Based on land-use and population forecasts of the UPC’s plan, the (also) newly established Department of Transport (DoT) developed a Transportation Master Plan in 2009. While the overall strategy and transport planning was

<sup>28</sup> Abu Dhabi Municipality, ‘Abu Dhabi’.

<sup>29</sup> Abu Dhabi Urban Planning Council, ‘Plan Abu Dhabi 2030: Urban Structure Framework Plan’, 2007. Available at: [https://faculty.uaeu.ac.ae/abintouq/GEO440\\_Spring2014/Capital-2030-en.pdf](https://faculty.uaeu.ac.ae/abintouq/GEO440_Spring2014/Capital-2030-en.pdf) (accessed 17 November 2022).

<sup>30</sup> Iconic architecture by architects that have reached a high level of popularity and fame.

<sup>31</sup> Apostolos Kyriazis et al., ‘Behavioral Mapping of Abu Dhabi’s Public Spaces: Urban Research Photography and Cultural Clashes’, *Sophia Journal 4, Visual Changes of Space: Unveiling the Publicness of Urban Space* (2019), pp. 75–85.

<sup>32</sup> Kyriazis, Qamer, and Zahid, ‘A Cultural Paradox and the Double Shift of the Housing Typologies in the Arabic Gulf Area’, pp. 89–96.

<sup>33</sup> Rode et al., ‘Resource Urbanisms’.

<sup>34</sup> Khaled Alawadi and Ouafa Benkraouda, ‘What Happened to Abu Dhabi’s Urbanism? The Question of Regional Integration’, *Journal of Urban Design* 23/3 (2018), pp. 367–94.

streamlined now under the Plan 2030's objectives, policies and strategies, on-the-ground road and street design was not. UPC, DoT and the Municipality competed over the planning strategies and manuals as well as the actual planning and implementation of streetscapes and parking spaces. Most notably, the Urban Street Design Manual developed by the UPC was – and is until today – inconsistent and competing with DoT's engineering manuals, transport impact study guidelines and parking strategies as well as some of the Municipality's standards and guidelines. Such competition between government agencies is not unique to the Gulf, and Abu Dhabi's government has addressed these issues with several ministerial reshuffles. The first reshuffle in 2015 merged the DoT and the Abu Dhabi Municipality under one umbrella. The second attempt in 2017 reversed the 2015 action and instead merged the UPC with the Municipality and split the DoT into a strategic planning and policy arm (DoT) and a new operational arm – the Integrated Transport Planning Centre (ICT). Furthermore, the Framework Plan 2030 has been withdrawn and is still under revision.

Despite these efforts, there are two governance issues, which are specific to Gulf countries. Firstly, the relatively high turnover of expatriate staff leads to lower degree of continuity in the planning process. This worsens the negative impact of governance failure as described above. Secondly, the major growth of the urban landscape often occurs in times of unbalanced planning regimes. Abu Dhabi, for example, has more than doubled in size and tripled in population since 2000 leaving an astonishing footprint of underregulated developments of roads.<sup>35</sup> This uncertainty – with its constant restructuring of institutions and staff, the power of private developers in shaping urban growth, and the often overlapping and conflicting manuals and guidelines – has a strong impact on how priorities are defined at both the city and local levels.<sup>36</sup>

## Roads on the Metropolitan Scale

The metropolitan analysis uses space syntax to explore how the current configuration of Abu Dhabi's road network shapes centres of activity.<sup>37</sup> The initial look at betweenness centrality at the highest radius of movement (global radius,  $m$ ) shows that the city of Abu Dhabi has a rigid grid of high-speed roads that are planned to facilitate movement and development in the city. The roads most likely to be used in the city-wide scale are at the intersections of Musaffah, Mohamed Bin Zayed City, Khalifa City and Al Maqta (Figure 4a). This analysis also shows that the network of highways divides the remaining city fabric, suggesting that these neighbourhoods are isolated within the grid in a way that in absence of a car, movement between neighbourhoods is difficult.

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<sup>35</sup> Rode et al., 'Resource Urbanisms', p. 32.

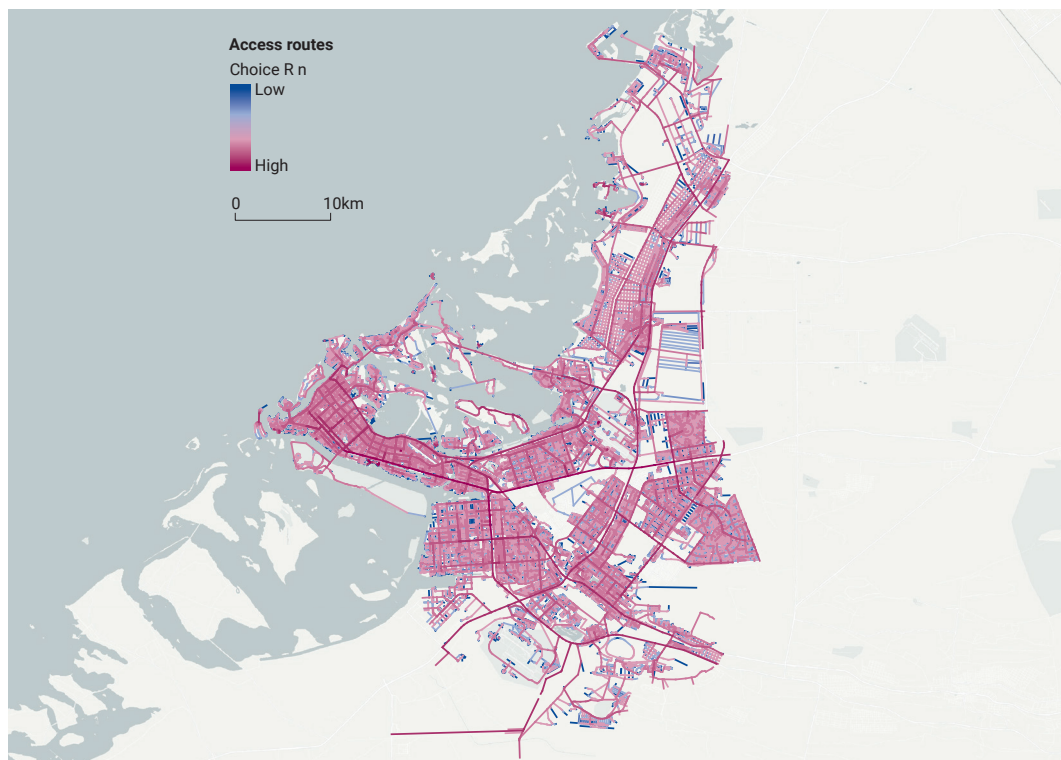
<sup>36</sup> For a better understanding of the spatial changes see the project's final event slides.

<sup>37</sup> This analysis investigates how each road segment of the city is related to other segments, exploring how the different roads facilitate movement and by effect enable activity. Highlighting the most used routes in relation to the rest of the city, and where the most integrated parts of the city are, while illustrating how the city has evolved and responded to planning strategies and a growing population.

Furthermore, to explore cores of integration in the fabric of the city, a closeness centrality analysis at different metric radii was implemented.<sup>38</sup> This highlights that integration and core of activity at the metropolitan level are on the main island (Figure 4c). The analysis at a lower radius of movement, representing distances related to walking and cycling (1200–2000m), shows that the city has developed local cores of activity that remain isolated and constrained by the grid of highways – a typical scenario for a car-centric city (Figure 4b and c). This supports the hypothesis that infrastructure of high-speed vehicular movement facilitates activity and movement in the city but segregates and isolates the organically developed cores of integration.

This conclusion is also supported by the distance analysis undertaken, using the same road network and the block typology dataset from ‘Resource Urbanisms’ project which compared Abu Dhabi, Hong Kong and Kuwait City.<sup>39</sup> The bar chart (Figure 4d) shows that the movement grid developed in a way that private planned villas are on average 4km further away from cores of activity compared to high-density, mixed-use and labour camps.<sup>40</sup> This also suggests that the road network has evolved in favour of those more likely to drive, discouraging cycling and walking.

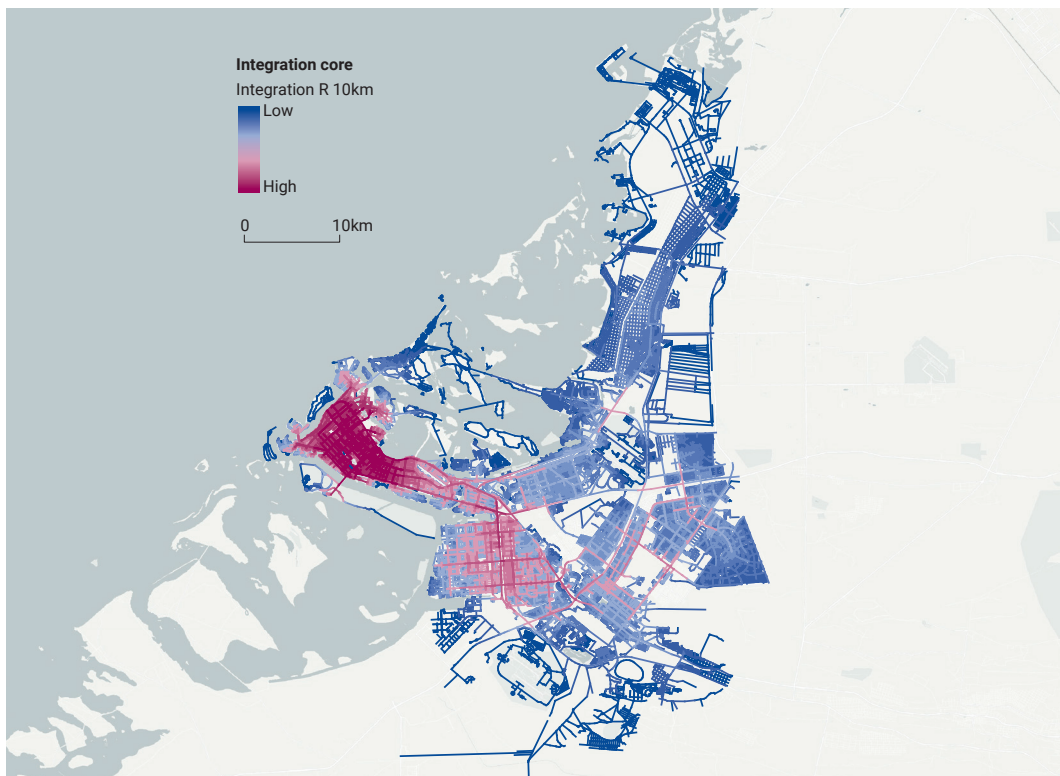
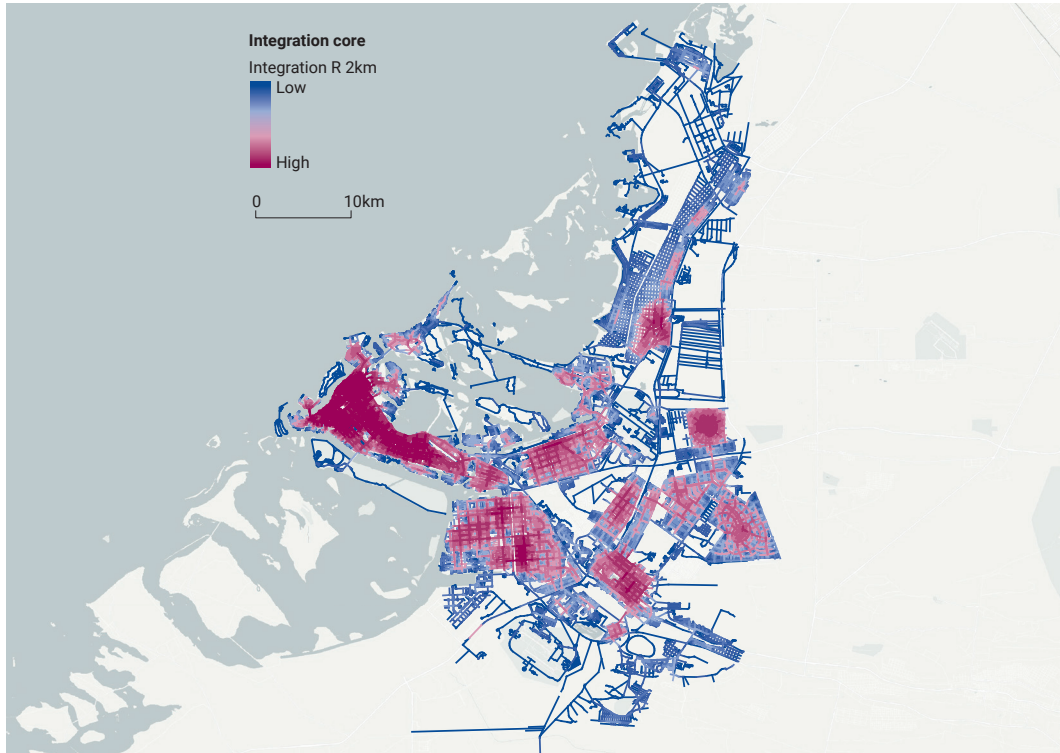
**Figure 4: (a) Betweenness Centrality Analysis at Global Radius (b) Local Cores of Integration (c) Global Integration Core (d) Distance Matrix Between Different Typologies and Cores of Integration and Activity in Different Radii of Analysis**



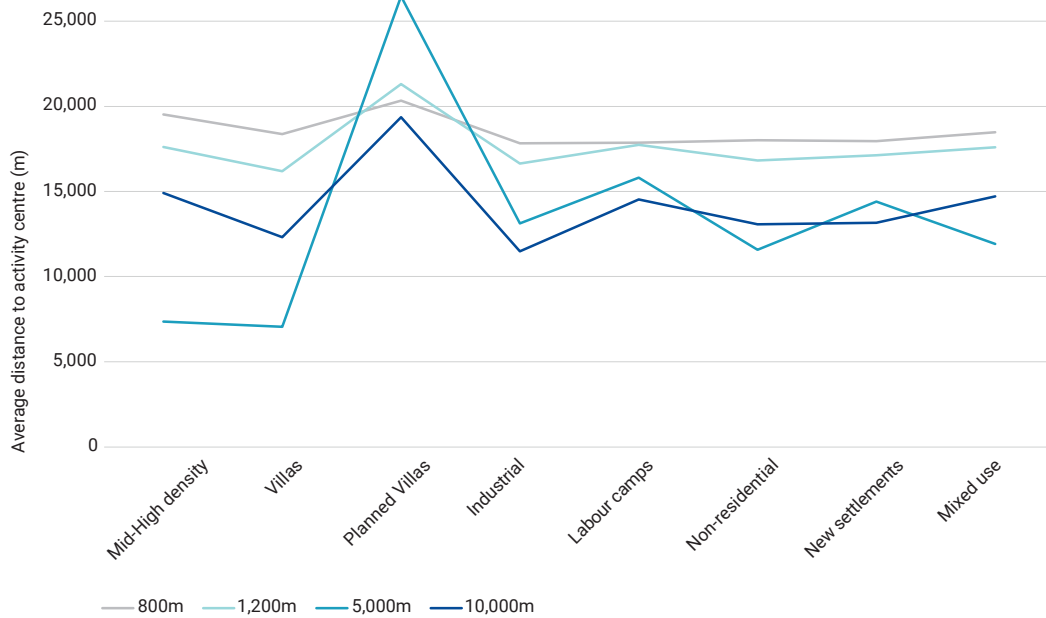
<sup>38</sup> M. Serra and P. Pinho, ‘Tackling the Structure of Very Large Spatial Systems - Space Syntax and the Analysis of Metropolitan Form’, *The Journal of Space Syntax* 4/2 (2013), pp. 179–96.

<sup>39</sup> Rode et al., ‘Resource Urbanisms’.

<sup>40</sup> These labour camps are municipality approved worker accommodation (construction workers) that provides basic facilities to residents. They are often overcrowded and located in the outskirts of the metropolitan area.



Average distance to different levels of accessibility centres per block typology



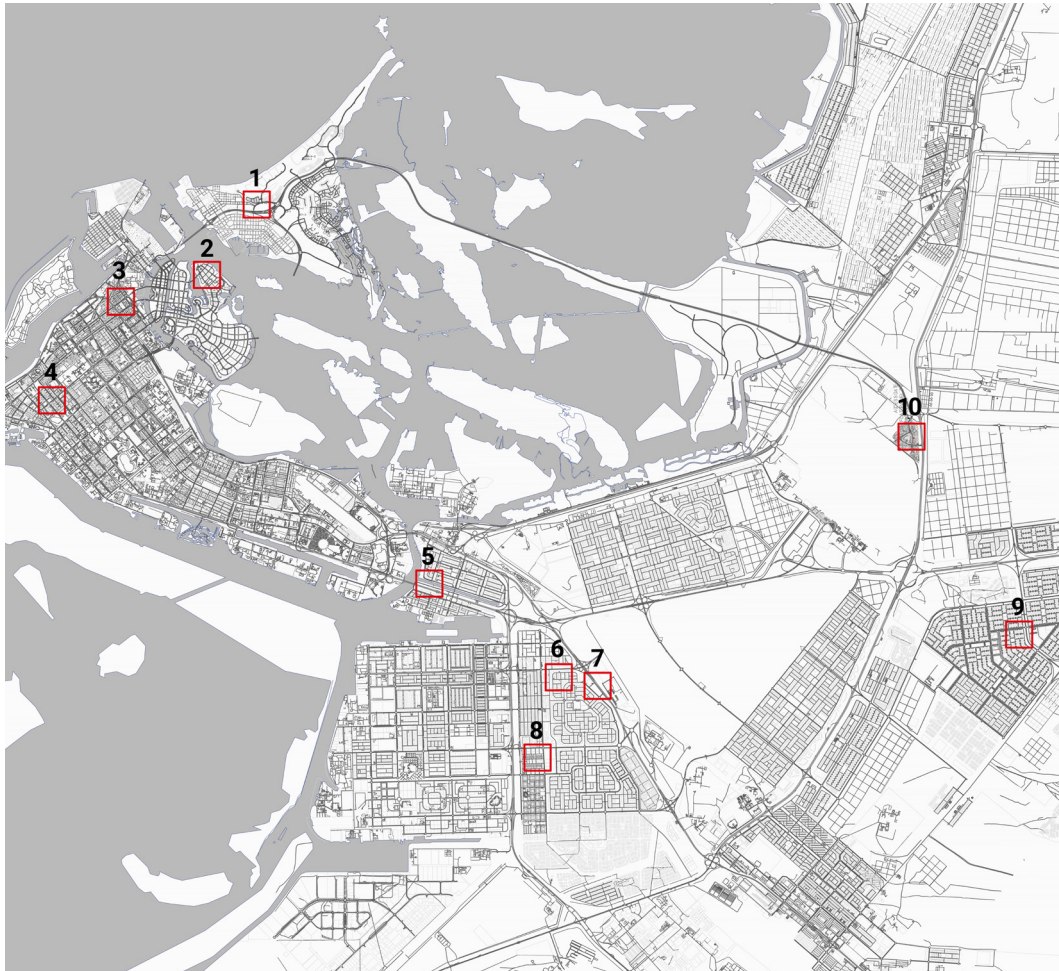
## Roads on the Neighbourhood Scale

Ten 1km<sup>2</sup> (at scale) areas of the city with distinct socio-demographic, urban morphology and road layout characteristics were chosen for neighbourhood spatial analysis (see Figure 5).<sup>41</sup> The areas include neighbourhoods developed by the municipality and by private developers, of higher and lower income housing, for nationals and mixed populations, and with high and low densities.

<sup>41</sup> Such as built/empty plots, building heights and existing land uses.



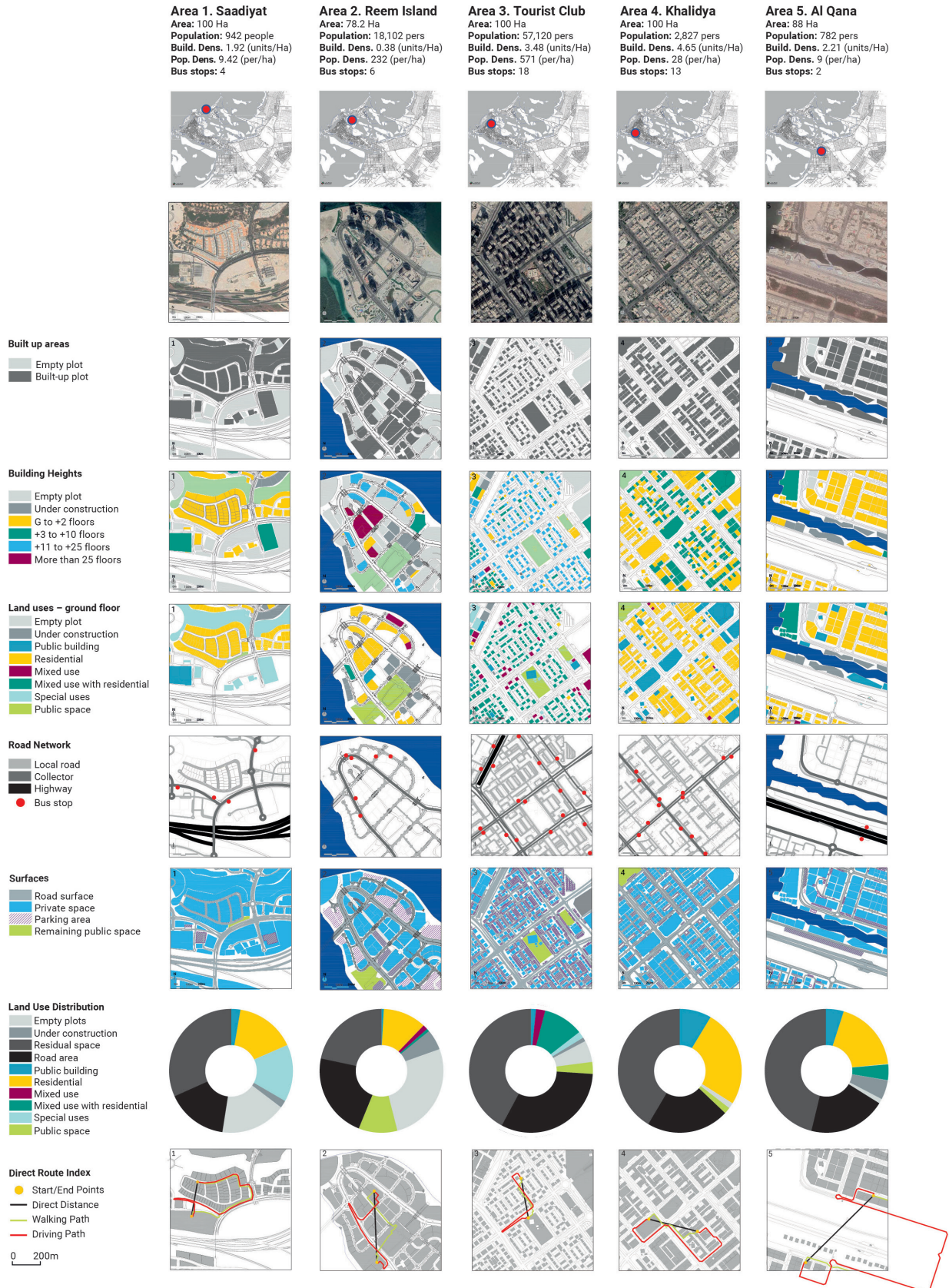
Figure 5: Selection of Neighbourhood Spatial Analysis Cases



Thematic maps reveal patterns of relations between the road networks and the main physical characteristics of their surroundings. Quantitative data on population, densities, and road and parking surfaces was collected on each 100Ha of selected area allowing for an investigation of the local spatial impact of the road infrastructure and how that relates to urban form and the surface networks.<sup>42</sup>

<sup>42</sup> The quantitative analysis of land use and other surface distribution among the ten selected areas – depicted in Figures 9 and 10 – was conducted using simplified (CAD) projections, in which minor superimpositions of cantilevered buildings over the waterfront or public space and of unclear boundaries between formal and informal parking were not able to be displayed without affecting the statistical outcomes.

Figure 6: Detailed Layered Analysis for Each of the Ten Selected Areas<sup>43</sup>



<sup>43</sup> Explore photography of these areas in the Abu Dhabi (Dis)connected exhibition website. Available at: <https://abu-dhabi-disconnected.squarespace.com/> (accessed 19 December 2023).

**Area 6. Mezyad Mall**  
 Area: 100 Ha  
 Population: 1,991 pers  
 Build. Dens. 2.99 (units/Ha)  
 Pop. Dens. 20 (per/ha)  
 Bus stops: 5

**Area 7. ADU**  
 Area: 100 Ha  
 Population: 1,774 pers  
 Build. Dens. 1.77 (units/Ha)  
 Pop. Dens. 18 (per/ha)  
 Bus stops: 4

**Area 8. Shabiya**  
 Area: 100 Ha  
 Population: 18,551 pers  
 Build. Dens. 3.14 (units/Ha)  
 Pop. Dens. 186 (per/ha)  
 Bus stops: 8

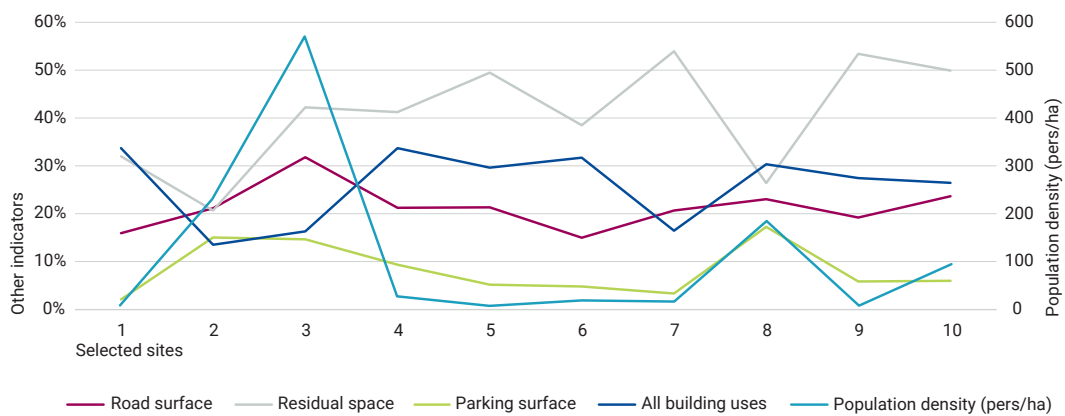
**Area 9. Shamka**  
 Area: 100 Ha  
 Population: 895 people  
 Build. Dens. 3.50 (units/Ha)  
 Pop. Dens. 8.95 (per/ha)  
 Bus stops: 4

**Area 10. Al Reef**  
 Area: 100 Ha  
 Population: 9,554 people  
 Build. Dens. 3.95 (units/Ha)  
 Pop. Dens. 95.54 (per/ha)  
 Bus stops: 4



This analysis shows a reasonable connection between low population density and high percentages of empty and residual space. It also suggests a link between the percentage of unbuilt plots and the development phase of each urban area (see Figure 6). High population density is more directly associated with high percentages of both road and car parking surfaces. Since car parking surfaces include both formal parking zones and informal solutions (sidewalks, private plots), a ratio of parking to road surface reveals a strong connection of informal parking patterns to high-density areas.

**Figure 7: Land Use Ratios and Population Density for All Selected Areas**



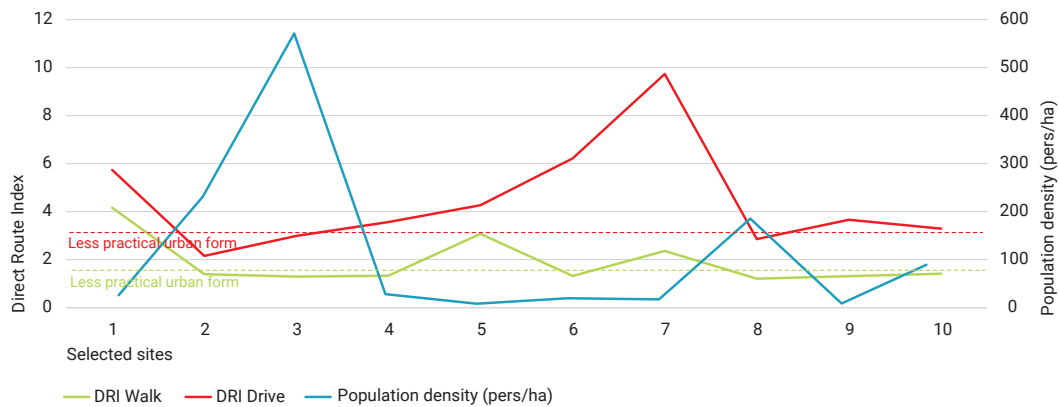
To understand the impact of the road network on movement flows in the ten selected areas, the Direct Route Index (DRI) values for pedestrians and vehicles were calculated using two locations per area, on different sides of a separating highway or collector (see Figure 8).<sup>44</sup> The analysis shows that (1) Saadiyat, (5) Al Qana and (7) ADU are 1.5 times higher than the maximum DRIs for a well-designed area, pointing to a dysfunctional urban form. In fact, in all ten areas, the driving DRIs are higher than the walking values and exceed the desirable driving DRI limit (1.5). This indicates an overall problematic road layout at this scale and a dysfunctional road network despite being designed for cars.

A relationship between the highest DRIs (in both walking and driving) and low population densities can also be observed. It illustrates how low-density areas are even less walkable and locked to car use. Finally, the calculation of DRI values provides an insight to how types of roads connect. Good connectivity is observed in the four denser areas, namely (2) Reem Island, (3) Tourist Club, (8) Shabiya and (10) Al Reef. This is partially due to the permeability of the sikka (narrow alley between buildings) system and to shorter distances between traffic lights that provide U-turns or left turns.<sup>45</sup>

<sup>44</sup> Direct Route Index (DRI) compares direct line distances on a map with true, walking or driving ones. It was introduced by the Abu Dhabi Urban Street Design Manual. Department of Municipalities and Transport, 'Abu Dhabi Urban Street Design Manual', Appendix B, page 1 (p.174). Available at: [https://vtpti.org/Abu\\_Dhabi\\_Street\\_Design\\_Manual.pdf](https://vtpti.org/Abu_Dhabi_Street_Design_Manual.pdf) (accessed 20 September 2023)

<sup>45</sup> Scoppa, Bawazir and Alawadi, 'Walking the Superblocks', pp. 359–69.

Figure 8: DRI Values and Population Density for All Areas



Abu Dhabi's growth can be characterised by the emphasis and prioritisation of vehicular movement through an iron grid road network in the main island and a system of urban highways in the mainland. While there have been cases of governance inconsistencies on the design and management of the road network, it displays levels of connectivity and efficiency. However, it has similarly contributed to the generation of disconnections within the fabric, equally both at the metropolitan and the neighbourhood scale, where design decisions have led to less cohesive urban forms.

## Dimensions of Roads

### Technical Design

With the modernisation of Abu Dhabi, early road infrastructure needed to be implemented quickly. Road design prioritised car-safety and traffic flow. As a result, roads mostly consisted of multi-lane main roads with an uninterrupted median, no left-turns and a right-in-right-out configuration. Roundabouts provided the only opportunity to turn left (at the main junctions) or to take a U-turn. This layout feature still shapes Abu Dhabi's roadscape, affecting car movement and distancing spaces.

Another common feature is the over-supply of capacity, both in terms of road as well as parking. For roads, the issue exists on two levels. Firstly, there is a pronounced approach of road hierarchy.<sup>46</sup> For example, many roads in the suburbs, although carrying little traffic, are classified as arterial or collector roads and often have three lanes per direction and medians. Secondly, and arguably a more serious issue that applies to the entire city, is over-forecasting. Most road and junction capacities are designed with future traffic demand in mind, using transportation models translating future land-use and population data into required peak load road capacity. While population forecasts have reduced over the last decade, the road network – as it exists today – has largely been designed based on earlier, more optimistic growth scenarios.

<sup>46</sup> Road hierarchy is defined in various guidelines and manuals. For more information on guidelines see the 'Abu Dhabi Emirate Guideline of Infrastructure Services Standards', 2017. Available at: <https://www.dmt.gov.ae/adm/-/media/Project/DMT/ADM/E-Library/Abu-Dhabi-Emirate-Guideline-for-Infrastructure-Services-Standards.pdf> (accessed 2 November 2023).

Wide right of ways (ROW) are another factor – with widths ranging from 300m to 850m for most highways such as the E11 highway between Shakhbout and Bani Yas. In some of the cases, other networks, such as pipelines for natural gas and oil, use the ROWs, increasing the impact of the obstacle. Wide ROWs also apply to most urban arteries both in the Abu Dhabi island and the suburbs adding more barriers to mobility.

In the central business district (CBD), relatively few main roads carry relatively high volumes of traffic because of the superblock structure.<sup>47</sup> Roundabouts were gradually replaced by signalled junctions and main roads were constantly widened and complemented by wide strips of service roads and parking. This unique downtown streetscape severely affects block-to-block walkability and accessibility. As main roads carry high loads of traffic and have fences installed on the median, pedestrians are forced to use uninviting, mid-block underground crossings (wherever they exist) or walk to one of the four signalled junctions at each corner of a superblock. Besides diminishing connectivity within the high-density CBD, the barrier effect of main roads has a negative impact on the accessibility of public transport.

Surface parking and non-continuous sidewalks are another barrier for pedestrians within the CBD. Over 90 percent of the non-built-up spaces within the blocks are dedicated to parking and access roads, leaving little space for pedestrian paths or recreational areas. Sidewalks often surround singular building plots within their precincts and do not provide continuous paths throughout the block nor any ramps at locations where crossing is necessary. Abu Dhabi also applies one of the highest minimum parking requirements worldwide.<sup>48</sup> Such requirements have led to an over-supply of parking spaces in most areas of the city, especially the suburbs. Extensive parking areas break urban connectivity and create spatial barriers for pedestrians as well as impact land use and the visual landscape.

**Figure 9: (a) Pedestrians Refuge Space; (b) Over-Supply of Road Capacity**



*Photo by Apostolos Kyriazis (a) and Alexandra Gomes (b)*

<sup>47</sup> The distinct urban blocks of Abu Dhabi with a 700m side in average with an internal road layout that discourages cross-block traffic.

<sup>48</sup> An urban development company or a private entity has to provide a certain amount of parking for each Gross Floor Area (GFA) it builds and is dependent on the use of the development (e.g. office, recreation, retail or private apartments).

## The Functional Use of Roads

The roads that shape Abu Dhabi's urban development are part of Sheikh Zayed's dream:

(...) he knew that it meant people can come together quicker, that you can supply a community faster and more efficiently by that way, and (...) he wanted roads from the outset but roads to be not complicated so that people can get around.<sup>49</sup>

However, this dream locked the city into a motorised path that became a hard reality to change. The previous sections explore how the grid emerged from historical and governance dimensions and framed urban development. The next section will explore how this development is now connecting and disconnecting spatial functions and people.

### Connecting Spaces

Sheikh Zayed's pragmatism combined with urban growth parameters and a highly monitored road network have contributed to a widely acclaimed 'easy-to-drive' city. In lack of competitive public transportation alternatives, road hierarchy and easy motorised accessibility is key to achieving such a friendly driving profile. The spatial distribution of several key points of interest (such as education institutions, hospitals and shopping malls) and new private developments highlight the added value of car accessibility, as most of these destinations are within a 1.5km distance from a highway.

On the mainland and the suburban islands of Saadiyat and Yas, most urban development and land use is directly associated with the nearby presence of major highways. However, within Abu Dhabi island, these are mostly scattered throughout the urban fabric, lying along the modernist grid of watermelon superblocks and its properties of equity of access and plot size.<sup>50</sup> This dichotomy is chronological and strategic, as post-modern and neo-liberal aspirations have been implemented since the 1991 Comprehensive Plan and the 2030 Framework Plan of 2007 with the proliferation of urban highways, suburban sprawl and a shift to tertiary services and zones of exclusion.<sup>51</sup>

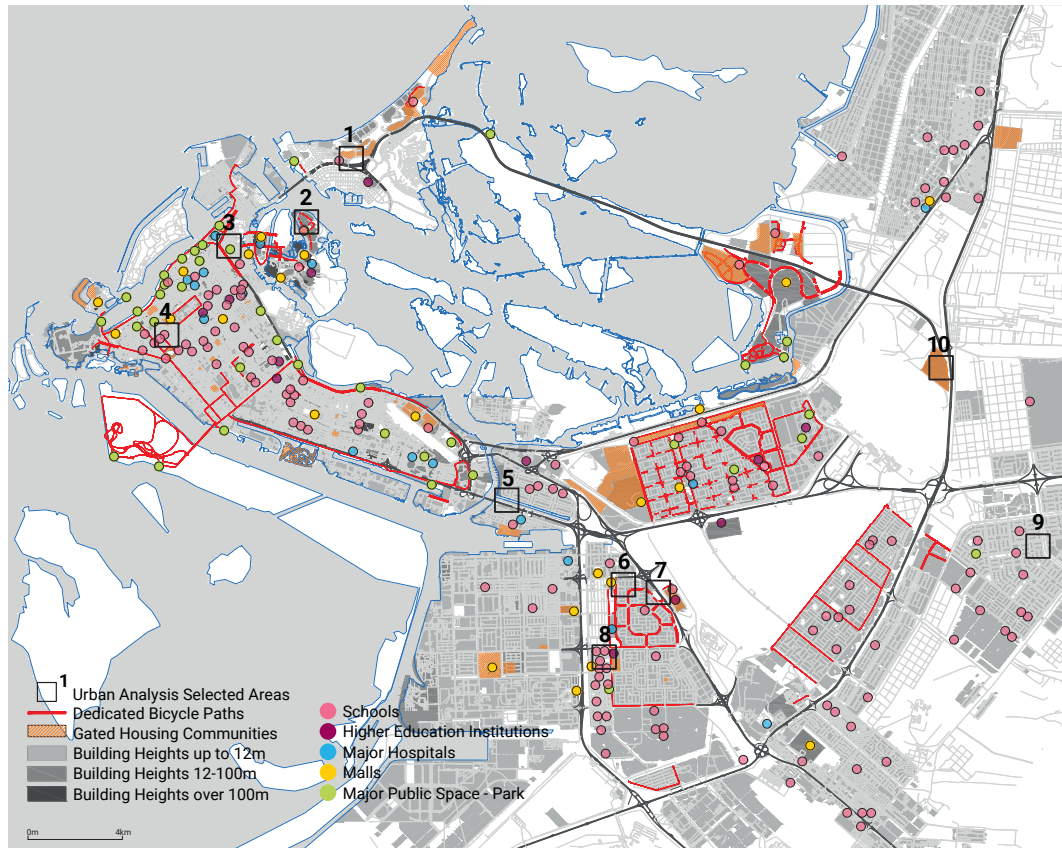
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<sup>49</sup> Alamira Reem Bani Hashim, *Planning Abu Dhabi: An Urban History* (New York: Routledge, 2019), p. 118.

<sup>50</sup> 'Watermelon' superblocks are the urban blocks of Abu Dhabi's CBD that showcase a high-rise, mixed-use building perimeter (peel) and a low-rise, single-use (usually housing) interior, a distinct urban morphology. Kyriazis, Almehairi and Seri, 'The Morphology of Abu Dhabi's Superblocks'.

<sup>51</sup> Bani Hashim, *Planning Abu Dhabi: An Urban History*, p. 155; Arab National Development Planning Portal, 'Plan Abu Dhabi 2030: Urban Structure Framework Plan', *United Nations Economic and Social Commission for Western Asia (UNESCWA)*, 2007. Available at: <https://andp.unescwa.org/plans/1274> (accessed 17 November 2022); Apostolos Kyriazis and Myrsini Apostolaki, 'The Abu Dhabi Waterfront; Evolution, Land Use Dynamics and the Question of the "Open City"', in Mohamed Elkaftangui (ed.), *Architecture Media Politics Society (AMPS) Conference 13: Constructing an Urban Future: The Sustainability and Resilience of Cities* (Abu Dhabi: AMPS, 2018), pp. 49–63.

Figure 10 : Points of Interest, Special Residential Areas, and Their Connectivity Correlated to Building Heights



Bicycle pathways are the latest addition to the city's transportation networks, with the oldest lanes less than ten years old. Today, following wide media campaigns for healthy lifestyles, the bicycle network has grown to a length of 312km (Figure 10) and all new urban districts and suburbs (MBZ South, Riyadh and Zayed City) are expected to create bicycle networks.<sup>52</sup> However, the network seems dedicated more toward leisure than commuting and is still spatially disconnected.<sup>53</sup> While dense urban areas still have zero to few dedicated lanes, many low-density suburbs already enjoy compact and well-connected networks. However, most dedicated bicycle lanes are interconnected through plot-access service roads. This gesture, while posing possible safety risks, seems to blend the incoming bicycle mode with the still-prevailing road network.

Connectivity improvements can be recorded at the neighbourhood scale. In the 1980s and 90s, the city struggled with traffic and parking congestion issues that were concentrated in the undeveloped spaces between buildings within the watermelon superblocs. The DoT

<sup>52</sup> Also including a 33km network at the undeveloped island of Hudariyat.

<sup>53</sup> Patrick Ryan, 'Abu Dhabi Sets Its Sights on a Cycling Revolution', *The National*, 2022. Available at: <https://www.thenationalnews.com/uae/transport/2022/07/31/abu-dhabi-sets-its-sights-on-a-cycling-revolution/> (accessed 25 August 2023); Panna Munyal, '53 Kilometres of New Cycling and Running Tracks in Abu Dhabi Are Almost Halfway Finished', *The National*, 2020. Available at: <https://www.thenationalnews.com/lifestyle/wellbeing/53-kilometres-of-new-cycling-and-running-tracks-in-abu-dhabi-are-almost-halfway-finished-1.1004872> (accessed 25 August 2023).



addressed the issue in 2009 with a project for parking areas' design, policing and management called MAWAQIF.<sup>54</sup> Today, parking areas cover almost a third of the Abu Dhabi island. However, the design approach combined with the absence of urban regeneration projects created 'parking deserts' within the superblocks, displacing public space users.<sup>55</sup> To address this issue and improve its touristic outlook, Abu Dhabi Municipality initiated a wide implementation of streetscape improvements across the downtown areas, with an emphasis on pedestrian prioritisation through shaded traffic islands, sidewalk reclamation and 'acupuncture' public space activation with inclusive urban furniture.<sup>56</sup>

Finally, Abu Dhabi's urban form provides some interstitial spaces that are used as spaces to walk, such as the sikka. Due to their nature, width and shade, they lack motorised traffic and provide permeability, physical conditions and safety for pedestrians to walk through.

### Disconnecting Spaces

This section sheds light on the elements of disconnection, highlighting the difference between streetscape and roadscape and underline the negative impact of the technical properties of roads.

The superblock grid (see section on technical design) facilitated a major scale transition from the organic pre-oil settlement to the 1991 Atkins Comprehensive Plan that streamlined growth along the four intercity highways to Dubai, Sweihan, Al Ain and Al Gharbia. The spaces in between these urban areas became testbeds for neighbourhood design. The combination of infrastructure growth, ethnically segregated sprawl, strict zoning and low-density urban fabric in Emirati housing areas led to a predominantly road-centred urban form.

Despite having been designed on a 'tabula rasa', urban highways disrupt the urban continuous and prevent transverse movement.<sup>57</sup> This applies to both city-to-waterfront connections<sup>58</sup> and neighbourhood-to-neighbourhood disruptions both for walking and driving – a fact that is evident through the high DRI metrics for the focus areas 5 (Al Qana) and 7 (ADU)<sup>59</sup> discussed in section on the social use of roads.

<sup>54</sup> Nada Al Taher, 'Background on Mawaqif', *Gulf News*, 2014. Available at: <https://gulfnews.com/uae/transport/background-on-mawaqif-1.1401180> (accessed 14 November 2022).

<sup>55</sup> Kyriazis et al., 'Behavioral Mapping of Abu Dhabi's Public Spaces', p. 82. For other visual references see the Abu Dhabi exhibition website.

<sup>56</sup> Urban acupuncture is a term coined by Manuel de Solà-Morales in 1999 and refers to focused, small-scale interventions of public space and building regeneration and (whenever possible) community involvement.

<sup>57</sup> 'Tabula rasa' is a vision of renewal that ignores the existing urban structure. See also Elsheshtawy, 'Informal Encounters', p. 92.

<sup>58</sup> The two highways running on the two longitudinal waterfronts of the Abu Dhabi island (the Khaleej Al Arabi Road and the Sheikh Zayed Bin Sultan Road – also known as Salam Street). Both linear parks were redesigned to accommodate one-lane widening of the highways, but vehicles remain the primary means with minimum options for pedestrians. There are only two crossing points for pedestrians for 9km of waterfront.

<sup>59</sup> In area 7, a pedestrian bridge (the only one for 17km) was positioned in front of Abu Dhabi University without connecting to any pedestrian networks on either side. In area 5, a new multi-use, leisure development (Al Qana) was constructed, bridging a water channel on a privatised public space. However, the

While highways create a direct impact in connecting and disconnecting areas of the city, the impact of urban arteries and local roads create an indirect impact, mostly relating to the wide right of ways (ROW), parking and plot access, lack of investment in streetscape, land thresholds and over-supply of capacity. While downtown morphologies scale down the ROWs, the suburbs leave the corridors, creating barriers for pedestrians to cross and increase the city's asphalt-generated heat.<sup>60</sup> Overprovision of wide ROWs originated from the technical inability of local authorities to integrate utility corridors.<sup>61</sup>

In some cases, ROWs are filled with service roads for parking and plot access, significantly reducing pedestrian space and increasing risk of accidents. This mostly applies to residential suburbs as the once single-building land plots were subdivided into rentals, causing an influx in automobiles that exceeds the maximum design capacities and forces informal parking solutions.<sup>62</sup> Furthermore, many of the one-direction lanes are poorly designed, adding unnecessary distances to routes.<sup>63</sup>

An equally important factor of disconnection is the streetscapes in terms of design options and implemented quality. Many areas, mostly suburban, still lack formal streetscaping. The lack of universal design (e.g. ramps and signage), discontinuous corridors for pedestrians and bicycles, narrow pedestrian bays on traffic light medians, lack of resting places and shade, materials that are dangerous to walk on and inaccessible bus stations are some of the most common findings across the city. All are products of a design approach prioritising cars over pedestrians. Notably, less affluent urban areas still lack streetscaping (Musaffah, Shabiya, Shakhbout and Baniyas) in comparison to wealthier areas (Saadiyat, Yas and Raha Beach).

Finally, disconnections occur due to street design inconsistencies that usually take place along neighbourhood boundaries. The most common cases are gated communities like Saadiyat. Within these communities, the streetscape is often overdesigned. However, the design approach, materiality and even design principles may be completely different just outside their gates. The limited number of access points into these communities and the presence of non-porous landscaping (walls or dense greenery) entails a lack of pedestrian accessibility. It deteriorates both walking and driving DRIs and divides urban space, promoting isolated islands of social and ethnical segregation.<sup>64</sup> The application of different design guidelines within a few meters of space – inside and outside of gated communities – is indicative of the presence of distinctly separate governance systems, both in terms of the principles and manuals applied as well as the approval processes. This lack of provision for transitional areas and of control highlights one of the major shortcomings of the otherwise detailed design manuals for Abu Dhabi.

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obstacle of the adjacent highway has proven itself stronger than the water channel. Access from/to the opposing 'Officers' City' development and the bus stations on the highway are not safe as pedestrians must walk on narrow sidewalks along the road underpasses.

<sup>60</sup> This difference is exemplified when comparing area 3 (Tourist Club) against areas 4, 5, 6, 7 and 9 (Khalidya, Al Qana, Mezyad Mall, ADU and Al Shamkha respectively). Especially for areas 7 and 9, residual space exceeds 50 percent of the total (see section 3.4)

<sup>61</sup> Until very recently, the smaller ROW set for local roads on any Emirati National Housing Project set by the (former) UPC and the DOT was 18m. Only the latest master plans were able to decrease this to a 12m (partially showing on area 7 – ADU).

<sup>62</sup> See for example areas 6, 7 and 9.

<sup>63</sup> Such as the driving DRI for area 6 – Mezyad Mall.

<sup>64</sup> Kanna, *The Superlative City*.

## The Social Use of Roads

The previous sections demonstrate from a technical and functional perspective how roads in Abu Dhabi provide connectivity but equally form barriers to movements. This section explores the social dimension of road use and how roads create both connectivity and barriers for people. Arguing that the city's planning system, focused on zoning and iconic buildings along with its efficient road network, lacks care for a diverse population. Emphasising people's movement, temporality and liveliness is fundamental to improve the city's liveability and sense of place.

### Connecting People

In Abu Dhabi, the dominance of roads transformed from merely a tool for movement into spaces for socialising, resting or even looking for work.

The suburban development of the city is reflected in the distances between neighbourhoods that are covered by an extended network of roads. While travelling along these primary roads (highways, motorways), elements such as the petrol stations become not only a space for drivers to stop for petrol, but also a place of socialisation due to its geographically central location on the road network along with the fact that these are food and drink areas too.<sup>65</sup> Similarly, new sociability pockets have emerged closer to low-density, detached house neighbourhoods. Vacant land on the sides of major crossroads is also used as a parking space for food trucks.<sup>66</sup> Another example is the empty, unscaped ROWs transforming into play and sports areas like badminton, football, volleyball and cricket.<sup>67</sup> At the same time, as roads are the support infrastructure for daily life, they also have a fundamental social function for those who work along them. Construction workers are often seen on the side of the roads, under the shade – if existent – resting or waiting to be picked up for work. Roads become transitional spaces that emerge as an opportunity for those who need to be seen.

While during the day many residential streets are often empty or semi-empty, at night, with more comfortable temperatures, residents come out into the streets to walk their dogs, go for a stroll and talk on their phones. Public spaces awaken to a liveliness that often does not exist during the day. The nocturnal landscapes are a fundamental topic when exploring the role of streets in most cities of the Middle East.<sup>68</sup> Though few surveys were done

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<sup>65</sup> An interviewee that had to attend weekend family functions and travel back and forth 400 km between Abu Dhabi and Fujairah mentioned: 'It was very common to meet groups of Nationals having lunches in the petrol pumps restaurants and cafeterias. Sometimes as it happened, I recognized former high school, university, or work colleagues' (Interviewee M).

<sup>66</sup> 'These spaces have occurred as surprising not only for their locations in the bare landscapes where the first supermarket would be 10 to 20 km away but also they ended up being busy mostly after sundown' (Interviewee R).

<sup>67</sup> These commonly take place downtown or on street corners in low-income, working-class areas or roadsides. See Yasser Elsheshtawy, 'Urban Enclaves and Transient Cosmopolitanism: Scenes from Abu Dhabi and Dubia', *City* 24/5–6 (2020), pp. 805–17. Available at: <https://doi.org/10.1080/13604813.2020.1843279> (accessed 25 August 2023); Khaled Alawadi, Shefa Hashem and Praveen Maghelal, 'Perspectives on Everyday Urbanism: Evidence from an Abu Dhabi Neighborhood', *Journal of Planning Education and Research* 3 (2022), pp. 1–24.

<sup>68</sup> 'After Dark: Nocturnal Landscapes and Public Spaces in the Arabian Peninsula, Panel I', *Harvard Grad-*

in the suburbs to demonstrate these observations, studies undertaken on the CBD show that in contrast with the daytime and peak hours, pedestrian movement increases with families walking with children in the late afternoon.<sup>69</sup> After sunset, although streets might see a reduction of people, the perimeters remain very active. Those studies also observe that the most common times for walking were from 6pm to 9am and that destinations only 15 minutes away are considered too difficult to walk in the summer temperatures – a distance that in many other cities of the world is not a challenge.<sup>70</sup> If, during the summer, working times and climate conditions are important dimensions constraining walkability, the poor walking infrastructure including lack of shade, wide roads and road barriers are permanent challenges to walkability.

In contrast with the wider roads supporting vehicular movement, the *sikka* (see section on functional use of roads), emerges as an extension of the home, becoming spaces for residents to stay and socialise. These semi-private spaces are some of the few places where objects such as chairs, sofas, fake grass or even children’s toys are found and demonstrate the existing or potential liveability of a neighbourhood.<sup>71</sup> They are the most democratic of the urban spaces, as they exist in many of the neighbourhoods and provide for the many demographics in the city, whether Emirati or non-Emirati. The role of the *sikka* as a pedestrian route is vital in Abu Dhabi’s street network, providing high levels of pedestrian connectivity and access to basic neighbourhood services. The presence of a *sikka* and other opportunity areas (e.g. empty plots) offer a localised solution for mobility and socialisation in Abu Dhabi, with a more limited impact on the metropolitan scale. However, their role in both connecting the city and as public space is not evident in the literature. These left-over, in-between spaces are often forgotten in street network analysis and lack investment as pathways.<sup>72</sup> However, this invisibility also allows them the informality and seclusion that promotes higher levels of informal use as spaces to stay and socialise.<sup>73</sup>

The comparison between residential neighbourhoods and gated communities and the impact on residents’ life is highlighted in some of the interviews undertaken during this project.<sup>74</sup> When compared to traditional Emirati neighbourhoods, gated communities bring more life to the streets and a sense of community through their higher densities, narrower roads, smaller houses, green areas and proximity between the buildings.<sup>75</sup> However,

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*uate School of Design* (2017). Available at: <https://www.youtube.com/watch?v=fpvT-cEfQSA> (accessed 4 July 2022).

<sup>69</sup> Kyriazis et al., ‘Behavioral Mapping of Abu Dhabi’s Public Spaces’; Khaled Alawadi, et al., ‘Assessing Walkability in Hot Arid Regions: The Case of Downtown Abu Dhabi’, *Urban Design International* 27 (2021). Available at: <https://doi.org/10.1057/s41289-021-00150-0> (accessed 4 July 2022).

<sup>70</sup> Alawadi et al., ‘Assessing Walkability in Hot Arid Regions’.

<sup>71</sup> Scoppa, Bawazir, and Alawadi, ‘Walking the Superblocks’, pp. 359–69.

<sup>72</sup> Khaled Alawadi et al., ‘Revisiting Transit-Oriented Development: Alleys as Critical Walking Infrastructure’, *Transport Policy* 100 (2021), pp. 187–202. Available at: <https://doi.org/10.1016/j.tranpol.2020.11.007> (accessed 4 July 2022).

<sup>73</sup> Elsheshtawy, ‘Informal Encounters’, pp. 92–113.

<sup>74</sup> ‘Three years ago, I lived in an area where the roads were too wide. The houses were too big. So, nothing was close to me. So, if I want to run some errands, if I want to go to the grocery, I cannot walk to the nearest grocery shop because they have to cross an avenue. So back then, yes, I dependent that also on roads, I couldn’t do any basic daily routine or take any baby’ (Interviewee HAH).

<sup>75</sup> In compounds ‘unlike my previous neighbourhood [suburban villa type neighbourhood], you can see everyone walking. In the streets, all the men and woman are walking to the nearest grocery shop [...] The

these areas only provide for those who can afford to live there and drive, as these gated communities are often inaccessible to those who walk or take public transport, including the people who service these communities such as nannies, gardeners and cleaning staff.

Figure 11: (a) Street Appropriation; (b) Sikka



Photo by Alexandra Gomes (a) and Apostolos Kyriazis (b)

### Disconnecting people

High levels of motorisation together with low-density development led Abu Dhabi, as many Gulf cities, to rely on buses as the only means of public transport.<sup>76</sup> In Abu Dhabi the bus network coverage is below the needs of its population. The bus network is scarce in lower density suburban areas and is difficult for pedestrian to access the bus stops.<sup>77</sup> Those who depend on buses often need to adjust their timetables or wait a long time for a bus, even in the cases of company buses provided by employers.<sup>78</sup> The only alternative to the bus is the taxi that, although cheaper than in other countries, is still unaffordable to most low-income workers.<sup>79</sup>

street within the compound becomes a social experience' (Interviewee HAH).

<sup>76</sup> Rode et al., 'Resource Urbanisms'.

<sup>77</sup> Clémence Montagne, 'Voices of Expatriate and Bus User Women in Abu Dhabi (UAE). Constraints and Detour Strategies', *Women's Issues on transportation 'Bridging the Gap' 5th International* (2014). Available at: <http://hdl.handle.net/20.500.12458/157> (accessed 4 July 2022).

<sup>78</sup> Philippe Fargues, Nasra M. Shah and Imco Brouwer, 'Working and Living Conditions of Low-Income Migrant Workers in the Hospitality and Construction Sectors in the United Arab Emirates: A Survey among Migrant Workers through Focus Group Discussions', *Technical Report, Migration Policy Center; GLMM; GRC 2019/02* (2019). Available at: <https://cadmus.eui.eu/handle/1814/65986> (accessed 4 July 2022).

<sup>79</sup> Abdellatif Qamhaieh and Surajit Chakravarty, 'Global Cities, Public Transportation, and Social Exclusion: A Study of the Bus System in Abu Dhabi', *Mobilities* 12/3 (2017), pp. 462–78.

Transport and mobility in Abu Dhabi, as other cities in the region, are intimately related to equity and social exclusion.<sup>80</sup> Emiratis and most high-income expats drive and have negative attitudes towards buses, while migrant workers become captive riders – public transport users without a modal choice.<sup>81</sup> The fact that migrant workers often live in working compounds in Abu Dhabi's far suburbs add to this challenge. It excludes them from certain areas of the city and easy access to spaces and facilities, demonstrating that investment in the improvement of public transport systems that cater for both demographic groups is fundamental.<sup>82</sup> If using public transport might be a challenge, the pedestrian infrastructure is also not fully prepared for walking. Barriers created by road design and layout, including protective measures to avoid car accidents such as road barriers, put pedestrian lives in danger while crossing the roads.

Planning in Abu Dhabi continues to have a strong desire for control, with a focus on the efficiency of movement and segregation of uses. Street life, as found in organic and historical cities, is not present. The lack of an historic centre, the fact that streets are not considered or designed to be public space and the destruction of heritage buildings indicates the need to control informal development having a direct impact on street life.<sup>83</sup>

Unlike in more compact urban forms, roads in Abu Dhabi are mostly transitional places. They are places to pick up work, park the car or shop. Most residential neighbourhoods have minimal or no urban design investment for people to stay and linger. The interior of the blocks is secluded from the major arteries where roads and parking spaces dominate. There is no space for activity or encouragement for this area to be used as a social space by residents and visitors.<sup>84</sup> Furthermore, streets lack basic elements such as seating areas, shade and kiosks that could attract informality and socialisation. This is particularly relevant for low-income workers who cannot afford to use private and commercial areas. Without formalised infrastructure, these workers use all available spaces, such as leftover spaces often close to work or transport nodes, to rest and meet with others.<sup>85</sup>

Streets are also a barrier for children. Apart from non-Emirati areas with some higher densities (e.g. Al Reef) where a playground with fake green grass exists, no children are seen playing outdoors in residential neighbourhoods. Proximity to traffic, poor pedestrian infrastructure and no playgrounds, seating, water fountains or shaded areas prevent families and children from using the public spaces. In the CBD, children play on the sidewalks or between buildings (inappropriate locations to play).<sup>86</sup> In the suburbs, even with lower traffic levels, issues of safety emerge in relation to kids playing in the street seeing many high-income residents moving to gated communities to feel safer.<sup>87</sup>

<sup>80</sup> Mayada Adnan, Almarood and Praveen Maghelal, 'Enhancing the Use of Transit in Arid Regions: Case of Abu Dhabi', *International Journal of Sustainable Transportation* 14/5 (2020), pp. 375–88.

<sup>81</sup> Qamhaieh and Chakravarty, 'Global Cities, Public Transportation, and Social Exclusion', pp. 462–78.

<sup>82</sup> Ibid p. 473; Almarood and Maghelal, 'Enhancing the Use of Transit in Arid Regions', pp. 375–88.

<sup>83</sup> Elsheshtawy, 'Informal Encounters', pp. 92–113.

<sup>84</sup> Ibid.

<sup>85</sup> Ibid.

<sup>86</sup> Alwadi, et al., 'Revisiting Transit-Oriented Development', pp. 187–202.

<sup>87</sup> '[In gated communities] you feel more comfortable for your kids to be walking in the streets, walking to the park, walking to the grocery. I see kids walking from the compound five minutes to the grocery and back. I would never see this in other parts of the city' (Interviewee HAH).

The issue of disconnectivity is most pronounced in the suburbs, notably the Emirati neighbourhoods on the mainland. Although walkability has recently improved, most improvements are linked to exercising and some daily needs, not functional walking or cycling to work. Suburban landscape covers over 70 percent of the developed land in Abu Dhabi and walkability in these areas, though improving, is still limited due to cultural trends (preference for car, gender, etc.), design, climate and psychological reasons.<sup>88 89</sup>

**Figure 12: (a) Bus Stop Isolation; (b) Walled Compounds**



*Photo by Peter Schwinger (a) and Alexandra Gomes (b)*

## The Future of Roads

This section introduces a discussion about the future of roads and suggests reformulating current policies and planning practices to address some of the disconnections created by roads in Abu Dhabi.

There are four main parameters to discuss when exploring this topic: citizenship, location, technology and governance. Citizenship in the Gulf often influences elements such as housing typologies and car use affordability. Location relates directly to the quality of the space, proximity to main amenities, the central nodes of public transport and the potential for the use of sustainable modes of transport (walking and cycling). Technology is fundamental when discussing roads, from car technology to traffic control or even online commerce and its impact on movement. Finally, governance, as strategy and policies are shaping the present and can be fundamental in determining the future.

While roads are the basic infrastructure to go from A to B in Abu Dhabi, these are mostly designed under a segregating bias of ethnicity and financial status. Coverage, connectivity and frequency of buses in low-density suburbs should be improved and roads planned for all, including the ‘temporary’ residents such as non-citizen workers.

<sup>88</sup> Rode et al., ‘Resource Urbanisms’; Alawadi et al., ‘Assessing Walkability in Hot Arid Regions’.

<sup>89</sup> ‘The way you use the road also depends a lot on the land use. What are these roads connecting? If I have to walk with my daughter, who is 3 years old for 20 minutes, in a street it would be impossible for me. With kids is very difficult’ (Interview HAH).

Location and the geography of the city is also important, as urban development in Abu Dhabi island is different from the mainland. The impact of roads might change with a coordinated (re)investment in the infrastructure that supports and creates the incentives for car use. This includes:

- shifting from highways to alternative transport modes and relevant infrastructure as well as better road design guidelines that increase connectivity for public transport, pedestrians and cyclist;
- shifts on urban form and housing typologies with infills rather than ‘leapfrog’ development;
- a better relation between public transport-densification and changes on the land use system;
- changes in the street layout.

Desire lines are a design condition that impacts those who use the streets and reduces transport equity and inequalities in the use of space. Urban reactivation of empty plots, the *sikka* and informal areas for play, sports and socialising are an opportunity to activate urban space. Current investment in pavement and cycle lanes in many Emirati neighbourhoods seems fragmented. The changes need to focus more on the functional use of the infrastructure, such as commuting to work or shopping. Superblocks’ permeability, malls, parking along with the demolition of walled boundaries around gated communities would improve space connectivity and the visual landscape, impacting the footfall and density of street use. Direct access and connectivity between entrances/gates/streets and public space with public transport is also fundamental in the support of socialisation, social cohesion and reducing inequalities while also improving walkability and the environment.

Digital work and online commerce, which have seen an increased demand in recent years, already impacts the use of roads. Driving less for commuting due to more permanent online shifts can affect the use of neighbourhood-scale provision for leisure and social activities. Accommodating this new focus will be fundamental for the future of Abu Dhabi.

On the other hand, online commerce company drivers need better conditions to safely travel and work, as they currently risk their lives on the highways. The recently implemented highway tolls negatively impact those who cannot afford them and therefore less of an impact on those who drive the most, leading to increased inequalities in mobility. Electric vehicles, while improving local emissions and the environment, are still dependent on electricity generation and occupy the same (land) space as the current petrol vehicles. On demand transport and shared mobility could be considered for those who mostly work from home and do not need a car to commute. This could be used by expats and Emiratis, as an efficient, and comfortable alternative to car and public transport as well as encouraging walking for short trips and the use of information technology to improve walkability. Urban governance and policies should improve its consideration of the social fabric. Guidelines are too technical and often disregard the social dimension. A change of perception of what a city means is essential. The lack of accessibility to amenities and



facilities, the acceptance of distant suburban areas by Emiratis and the implications from a distinct governance system for the gated communities are issues to consider. The dynamics of urban regeneration on both the downtown superblocks and the old industrial zones of Mina Zayed and Musaffah are also absent. Finally, decentralisation and polycentrism – can the creation of different centres, and self-contained neighbourhoods help change mobility and liveability? All these are elements to consider in the future of strategic planning and local governance.

## Conclusion

This paper employs a socio-spatial approach to examine the physical and social effects of road investment and the car-centric development in Abu Dhabi. It explores how road design can either include or exclude people and neighbourhoods, acknowledging the importance of not only altering the functional aspects of roads but also incorporating recreational, social and aesthetic elements into the design. This study illustrates that merely providing social spaces will not address the inherent problems within road infrastructure, including mobility barriers, sustainability challenges and the exacerbation of inequalities. It emphasises the need for a more holistic approach to urban planning aimed at improving liveability.

The study concludes that roads are designed in a dysfunctional manner, affecting both Emiratis and non-Emiratis, drivers and non-drivers in distinct ways. It suggests that roads are a fundamental tool for challenging and changing the current urban dynamics of the city. The aim is to provide policymakers and institutions with a better understanding of local perspectives and policy recommendations to work towards a more equitable and sustainable future.



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