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«ΤΕΧΝΟ-ΟΙΚΟΝΟΜΙΚΑ ΣΥΣΤΗΜΑΤΑ»

ΔΙΕΠΙΣΤΗΜΟΝΙΚΟ – ΔΙΑΠΑΝΕΠΙΣΤΗΜΙΑΚΟ ΠΡΟΓΡΑΜΜΑ

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«ΤΕΧΝΟ-ΟΙΚΟΝΟΜΙΚΑ ΣΥΣΤΗΜΑΤΑ»

Ανάπτυξη έξυπνης πόλης στην πράξη. Η περίπτωση της Σιόν'Αν και οι δυνατότητες εφαρμογής στην Ελλάδα.

ΜΕΤΑΠΤΥΧΙΑΚΗ ΔΙΠΛΩΜΑΤΙΚΗ ΕΡΓΑΣΙΑ

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Αθήνα, Φεβρουάριος, 2025

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«ΤΕΧΝΟ-ΟΙΚΟΝΟΜΙΚΑ ΣΥΣΤΗΜΑΤΑ»

Development of a smart city in practice. The case of Xiong'an and the implementation feasibility in Greece.

ΜΕΤΑΠΤΥΧΙΑΚΗ ΔΙΠΛΩΜΑΤΙΚΗ ΕΡΓΑΣΙΑ

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Αθήνα Φεβρουάριος, 2025

Τσαγγάρης Δημήτριος του Ιωάννη

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Περίληψη

«Αν θες να βγάλεις ένα τόπο από την φτώχεια, άνοιξε έναν δρόμο»

Η φράση αυτή, που αποδίδεται στον Ντενγκ Σιαοπίνγκ, αντικατοπτρίζει τη φιλοσοφία του για την οικονομική ανάπτυξη και τις μεταρρυθμίσεις. Ο Ντενγκ πίστευε ότι η υποδομή και η συνδεσιμότητα, όπως οι δρόμοι, τα δίκτυα μεταφορών και οι επικοινωνίες, είναι θεμελιώδεις για την ανάπτυξη μιας περιοχής. Αυτή η στρατηγική εφαρμόστηκε ευρέως στην Κίνα, με μαζικές επενδύσεις σε υποδομές, όπως δρόμους, σιδηροδρόμους και γέφυρες, οι οποίες συνέβαλαν καθοριστικά στην οικονομική μεταμόρφωση της χώρας. Κάθε μεγάλη ηγετική φυσιογνωμία μετά τον πρόεδρο Ντενγκ παραδίδει στην επόμενη γενιά μια σειρά μεγάλων έργων (Deepak, 2023). Η Σενζέν στην οποία χτυπά σήμερα η καρδιά της παγκόσμιας τεχνολογίας ήταν το όραμα του Ντένγκ Σιαοπίνγκ. Η Πουντόνγκ έξω από την Σανγκάη ήταν το όραμα του ηγέτη Τζιανγκ Ζεμίν και αποτέλεσε το Οικονομικό και χρηματοπιστωτικό κέντρο της Κίνας έκτοτε. Η Τσονγκτσίνγκ προωθήθηκε από τον Χου Τζιντάο και τον Βεν Τζιαμπάο στις αρχές του 21ου αιώνα. Η πόλη αναδείχθηκε ως ένα νέο βιομηχανικό και εφοδιαστικό κέντρο για τη δυτική Κίνα.

Η παρούσα διπλωματική εργασία, εστιάζει σε μια νέα έξυπνη πόλη που θα παραδωθεί στους πολίτες της μέσα στην επόμενη δεκαετία. Πρόκειται για την Σιόν'Αν εκατό περίπου χιλιόμετρα νότιοδυτικά του Πεκίνου και αποτελεί το όραμα του σημερινού προέδρου Σι ζι Πινγκ. Η πόλη αυτή αποτελεί ένα εξαιρετικό παράδειγμα όπου η σύγχρονη τεχνολογία εφαρμόζεται σε όλα τα στάδια της κατασκευής της πόλης. Στόχος της παρούσας ανάλυσης είναι να μελετήσει σε επίπεδο σχεδιασμού και εφαρμογής το ενχείρημα αυτό και να προσπαθήσει να εξάγει συμπεράσματα τα οποία μπορεί να φανούν χρήσιμα στην άλλη άκρη του κόσμου, στην Ελλάδα μας και στην Αθήνα μας. Η προσέγγιση του κινεζικού κράτους να χτίσει μια νέα πόλη δίπλα στην πρωτεύουσά της προκειμένου να την αποφορτίσει ίσως δώσει λύση και στα δικά μας προβλήματα εδώ. Στο τέλος η ανάλυση θα κλείσει με μια λίστα από ενέργειες που έχουν ακολουθηθεί κατά την κατασκευή της Σιόν' Αν και ίσως εμπνεύσουν μελετητές και policy makers αστικού σχεδιασμού για την δική μας πρόοδο και ευμάρεια με άξονα τις λύσεις που μπορεί να μας δώσει η σύγχρονη τεχνολογία.

Λέξεις-κλειδιά: Ανάπτυξη Έξυπνων Πόλεων, Τεχνο-οικονομική Ανάλυση, Νέα Περιοχή Σιόν' Αν, Παραγωγή Αστικού χώρου, Κρατικός Επιχειρηματισμός, Αστική Ανάπτυξη

Abstract

"To get rich, build roads first" (要想富，先修路)

This phrase, attributed to Deng Xiaoping, reflects his philosophy of economic development and reform. Deng believed that infrastructure and connectivity, such as roads, transport networks and communications, are fundamental to the development of a region. This strategy was widely implemented in China, with massive investment in infrastructure such as roads, railways and bridges becoming instrumental in the country's economic transformation.

Every great leader after president Deng has handed down a series of great projects to the next generation (Deepak, 2023). Shenzhen, where the heart of global technology beats today, was Deng Xiaoping's vision. Pudong outside Shanghai was the vision of leader Jiang Zemin and has been China's economic and financial centre ever since. Chongqing was promoted by Hu Jintao and Wen Jiabao in the early 21st century. The city emerged as a new industrial and logistics center for western China.

This thesis focuses on a new smart city that will be delivered to its citizens within the next decade. It is the Xiong'an New Area 100 kilometres southwest of Beijing and is the vision of the current president Xi Jinping.

This city is an excellent example where modern technology is applied in all stages of the construction of the city. The aim of the present analysis is to study this project at the planning level and try to draw conclusions that may be useful on the other side of the world, in our Greece and in our Athens The approach of the Chinese State to build a new city next to its capital in order to decongest it may also provide a solution to our own problems here. At the end, the analysis will be finalized with a list of actions that have been followed during the construction of Xiong'an and may inspire scholars and policy makers of urban planning for our own progress and prosperity, driven by the solutions that modern technology can provide.

Keywords: Smart City Development, Techno-economic Analysis, Xiong'an New Area, Urban Space Production, State Entrepreneurialism, Urban Development

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1. Introduction

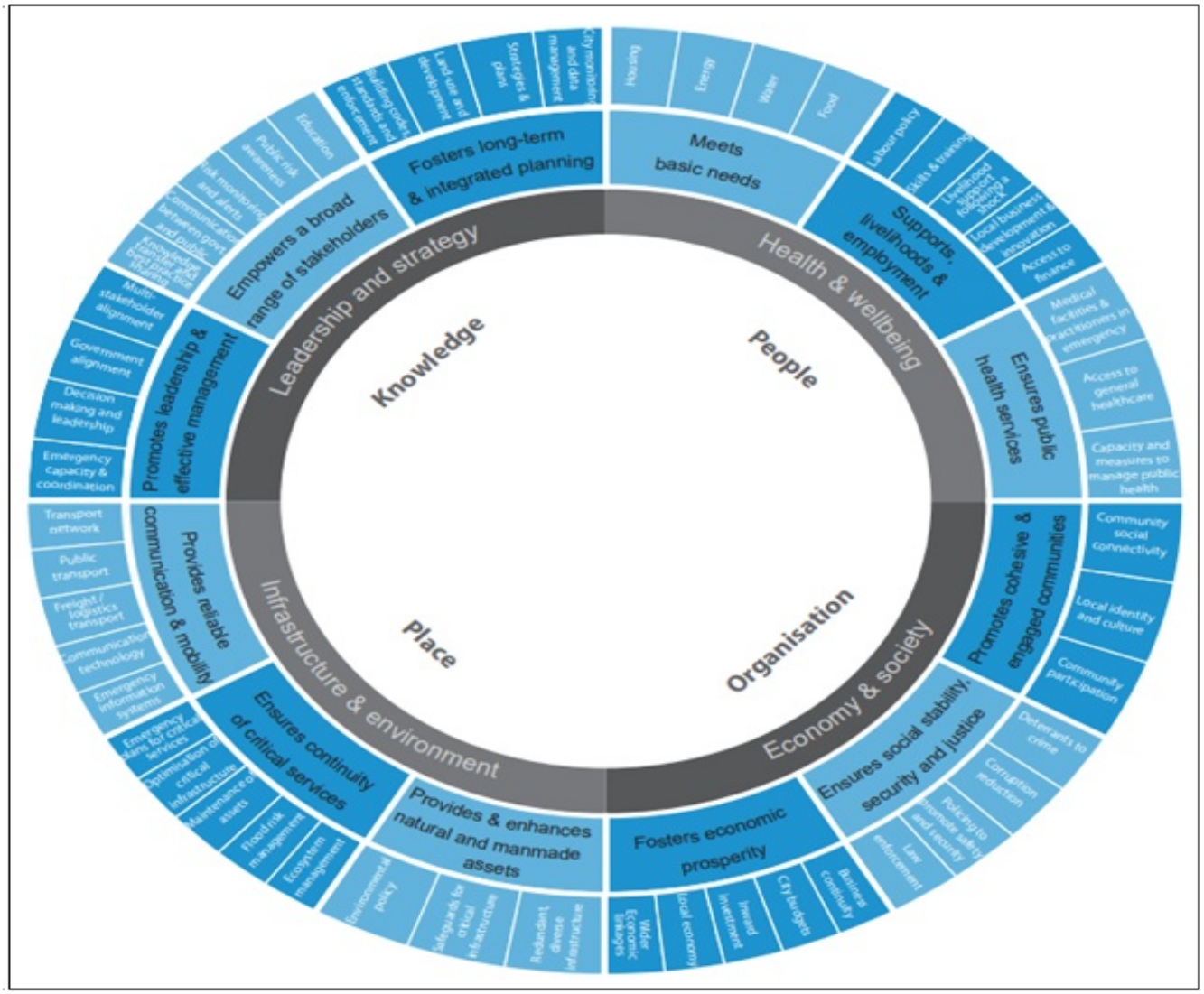
1.1 The “concept” of Smart Cities

In their work, Lai and Cole (Lai C. M. T. & Cole A., 2022) while measuring the progress of smart cities they delineate in detail the concept and its history. According to them, the concept of the "smart city" was introduced in 1992 in “The Technopolis Phenomenon: Smart cities, fast systems, global networks by Rowman & Littlefield.” (Gibson et al., 1992), evolving over time to fit various contexts and applications. It is astonishing that cities cover only 3% of the land while generating the majority of GDP and greenhouse gas emissions – 80% and 72% respectively (Patrão et al., 2020). In the beginning, the term was used in the United States to describe the growing integration of information and communication technology (ICT) within urban infrastructures during the 1990s. For some researchers, ICT serves as the cornerstone of smart city development; for others, it acts more as an enabling force to foster social capital and improve operational efficiency in urban environments (Akande et al., 2019; Albino et al., 2015; Vogl et al., 2020). Beyond technology, however, the concept of a smart city also encompasses broader aspects of urban life, including human-centered values and social well-being (Caragliu et al., 2011; Cavada et al., 2014; Lai C. M. T. & Cole A., 2022).

Diverse interpretations of "smart" have led to related terms such as "digital city," "intelligent city," "knowledge city," and "wired city," (Albino et al., 2015; Camero & Alba, 2019; Caragliu et al., Patrão et al.,). As a result, the smart city remains a multidimensional idea, lacking a universally accepted definition (Albino et al., 2015; Patrão et al., 2020; Sharifi, 2019), and it often serves as an umbrella term covering multiple urban development categories (Patrão et al., 2020). Broadly, smart cities are viewed through two domains: the "hard" domain, which includes technical infrastructures such as buildings, energy grids, transportation, and water management

systems that are enhanced by ICT[1]; and the "soft" domain, which encompasses cultural and societal factors, such as education, governance, and social inclusion, aimed at fostering the right conditions for ICT integration (Albino et al., 2015; Lai C. M. T. & Cole A., 2022).

Figure 1. The Athens Resilience Framework



Source: The Athens Resilience Guide for 2030

[1] Information and Communication Technology

Six key dimensions of the smart city concept—economy, environment, governance, living, mobility, and people—were first outlined by Giffinger et al., (2007) and have since been widely adopted by scholars and the European Union. From Greece, Athens was absent but Larissa and Patra were investigated. Patra ranked 58th and Larissa 60th in the total results and final performance out of 70 cities. The ranks included various indicators that could be aggregated into two dimensions. These dimensions employ both hard and soft domains while forming the foundational elements of a smart city. The Athens Resilience Framework[2], is based on the CRF standards developed by Arup and Rockefeller Foundation (2014). It identifies four dimensions and 12 drivers and seven qualities that pose what makes a city resilient. Compared to the existing literature, one could say that the detail of the resilience plan is higher and new aspects of a ‘smart’ city are being covered such as continuity, leadership and management, social stability and others. This concept is dynamic and important additions are being made over the years, which means that the approach changes chronologically. Moreover, smart city approaches differ globally. For instance, in China, smart city strategies emphasize big data and the Internet of Things[3], incorporating smartphones in daily transactions and widespread sensor and camera installations for surveillance (Hao et al., 2012; Hu, 2019). In contrast, Germany’s smart city initiatives prioritize sustainable development and climate neutrality, focusing on technologies to improve energy efficiency and mobility (Treude et al., 2022). This comparison illustrates the contrasting priorities of Eastern and Western approaches to smart city development (C.M.T. Lai and A. Cole, 2023).

The state of the economy plays major role also. Emerging economies face higher budget constraints and may have weaker institutions so they have to adjust their strategy accordingly (Moolngearn and Kraiwanit, 2024).

[2] CRFstands for City Resilience Framework

[3] Hereafter called IOT

Desdemoustier *et.al.* (2018) point out that the size of a city defines the understanding of the smart city concept, with a clear dichotomy of the understanding and acceptance of a straightforward concept among medium municipalities versus larger ones. Thus, city size also shapes smart city strategies. Larger cities generally implement more policies to improve environmental and living conditions due to higher population densities and associated challenges. Smaller cities, however, often focus more on economic development and may adopt a less technology-centric interpretation of the smart city. (C.M.T. Lai and A. Cole, 2023).

To conclude, this thesis will not focus on highlighting what a smart city is. On the contrary, it will employ a simple – broader definition of a smart city as one that leverages various ICT tools—including digital devices, data-collecting sensors, and I.O.T. technologies—not only to enhance promote itself digitally but also to improve six core dimensions: economy, mobility, environment, people, living, and governance. More importantly, the core of this meta- analysis **will be a study of a city while it's built from the ground up to the sky**.

1.2 The Neoliberal agenda

Over the past two decades, new city developments have proliferated across many developing countries, bringing significant socio-economic, environmental, and political-institutional effects. Xing Su (2023) explores the role of neoliberal planning in driving these projects in the Global South, highlighting three core mechanisms: **deregulation, authoritarian state intervention, and public-private partnerships (PPPs)**. These mechanisms collectively advance new city initiatives, though they often result in adverse impacts, such as heightened social exclusion, inequality, spatial fragmentation, and environmental degradation.

That analysis reveals that neoliberal planning is extensively used in developing new cities, where deregulation, state intervention, and PPPs frequently interact in complex

ways to shape urban landscapes. It is described as a 'controlled deregulation' of state institutions for the private sector to jump in and thrive.

This concept, aims to transform urban areas by attracting foreign investment, creating technological hubs, and enhancing global competitiveness (Watson, 2014).

On the first lines of Watson's work one may read

> *Neoliberal Planning can be understood "as a restructuring of the relationship between private capital owners and the state, which rationalises and promotes a growth-first approach to urban development".*

The rationale driving these projects is rooted in the desire to modernize infrastructure and promote economic growth through private sector involvement. However, critics argue that neoliberal urban development often yields negative consequences, including intensified social inequalities, environmental degradation, and unsustainable urban growth while discussing the urban patterns in Africa by foreign investors (Sassen 2014; Roy, 2021).

Moreover, these projects are designed to function as high-tech, high-investment urban centres, frequently catering to foreign investors, multinational corporations, and wealthy elites, while sidelining local communities (Xing Su, 2023). This planning model prioritizes profit over social welfare, focusing on **upscale residential and commercial developments** rather than **affordable housing or public services**. Thus, the neoliberal approach to city-building in the Global South is increasingly scrutinized for its **failure** to address the basic needs of local populations, **exacerbating inequality and social exclusion** (Xing Su, 2023).

1.3 The Neoliberal Planning Principles

Neoliberal urban planning emphasizes deregulation, privatization, and reduced government intervention in favour of market-led development. Proponents of this model argue that it accelerates economic growth by creating "investment-friendly" environments with lower taxes, relaxed regulations, and attractive conditions for foreign direct investment (FDI) (Peck & Tickell, 2002). New cities constructed under these principles, like King Abdullah Economic City in Saudi Arabia, are often branded as "smart cities" or "innovation hubs," equipped with advanced infrastructure, high-end real estate, and smart technology (Moser, 2021; Xing Su 2023).

While these developments aim to modernize urban spaces, they are criticized for focusing on high-income elites and multinational corporations, creating segregated, exclusive zones within the larger urban landscape, literally bringing the laws from the jungle to the market (Xing Su 2023; Peck & Tickel 2002). Public welfare is often sidelined, as resources are funnelled towards luxurious housing, technology-driven infrastructure, and commercial spaces, leaving affordable housing and public services underfunded. Critics argue that this model disregards the needs of local communities, creating urban areas that prioritize economic gain over social equity and local engagement (Brenner & Theodore, 2002).

1.4 The emergence of “dual cities”

A significant critique of neoliberal city-building is its tendency to heighten social inequality. These new urban centres are frequently inaccessible to the majority of local populations due to high costs of living, making them havens for wealthy elites and expatriates (Xing Su 2023). As a result, these cities often exclude low-income residents and working-class communities, exacerbating social stratification. For example, the development of Eko Atlantic City in Nigeria has led to the displacement of coastal communities, with limited provisions for their relocation or inclusion in the new city’s framework (Ajibade, I. 2017).

This exclusionary urban model has created what scholars describe as "dual cities," where affluent, high-tech areas contrast starkly with nearby informal settlements. As neoliberal projects expand, displacement becomes common, resulting in the disruption of long-standing communities and loss of social cohesion. Residents who cannot afford to live in or benefit from these high-tech developments are pushed to the urban periphery or forced into informal housing arrangements, further entrenching socioeconomic divisions (Xing Su 2023; Ajibade, I. 2017).

1.5 The Environmental Implications

Neoliberal urban projects prioritize rapid development at the expense of environmental sustainability. Large-scale city-building often disrupts natural ecosystems, leading to biodiversity loss, pollution, and increased carbon emissions. These developments typically encroach on agricultural land or ecologically sensitive zones, leading to deforestation and depletion of natural resources. For instance, rapid urbanization in cities like Eko Atlantic has resulted in the degradation of coastal ecosystems, which in turn impacts local fishing communities and biodiversity (Ajibade, I. 2017).

Furthermore, new cities often emulate Western architectural designs and high-density urban layouts, which are sometimes **unsuitable for the local climate and environmental conditions** (Watson, 2014). High energy consumption, dependency on imported building materials, and an extensive carbon footprint characterize these developments, undermining their sustainability. Critics argue that these urban projects prioritize immediate financial returns over environmental considerations, failing to incorporate green spaces, energy-efficient building designs, or long-term environmental planning (Campbell, 2016).

1.6 The role of the State

Governance in neoliberal new cities is frequently skewed **towards private sector interests.** Many of these projects are established under special economic zones (SEZs) with specific regulatory and tax policies that prioritize corporate benefits over civic rights and responsibilities (Sassen, 2018). Governance structures often rely on public-private partnerships (PPPs), where private developers wield substantial influence over urban planning and policy, resulting in minimal accountability and limited transparency (Brenner & Theodore, 2002).

This governance model restricts local communities' participation in planning decisions, leading to an erosion of democratic rights and local agency. Local governments are often sidelined, diminishing their capacity to oversee these developments effectively. This dynamic fosters regulatory arbitrage, where corporations exploit gaps in local regulations, resulting in lax environmental standards and inadequate labour protections (Shatkin, 2007). By limiting public input, these projects create urban environments that do not reflect local needs or values, leading to a sense of disempowerment among residents (Roy & AlSayyad, 2004).

Additionally, there is extensive research (Rwelamila, Fewings & Henjewele, 2014) that indicates that within the concept of P.P.P.[4] the interests of the public agents are different than the communities they represent. This constitutes a huge blow not only to the reliability of the P.P.P. model but also to its utility as a tool for building cities, thus communal, infrastructures.

Interestingly, the same phenomenon is broader outside the PPP scheme. Charalabidis *et.al. (*2020) pose that such divergence of interests is also taking place in Greece within the actions and priorities of the smart city concept.

[4] Public Sector. Private Sector. Partnership.

1.7 The role of the FDI[5]

While neoliberal cities are marketed as engines of economic growth, their reliance on foreign investment[6] creates inherent economic fragility. Many projects depend heavily on international capital flows, which are subject to volatility and market fluctuations. When investment interest decreases, these cities face financial instability and potential abandonment, as evidenced by partially completed or underutilized developments in regions like Sub-Saharan Africa (Goldman, 2011). This dependency undermines the long-term sustainability of neoliberal city models and raises concerns about their resilience during economic downturns (Harvey, 2005).

Moreover, the focus on high-end residential and commercial spaces distorts local economies, driving up property values and making housing unaffordable for the majority. This trend exacerbates economic inequality, as local populations are priced out of the new city while elites capture the benefits (Graham & Marvin, 2001). This model, critics argue, is unsustainable in the long term, as it fails to generate inclusive economic opportunities or improve the socioeconomic conditions of the broader population (Smith, 2002).

[5] Foreign Direct Investment

Table 1. Summary of the critique over the Neoliberal Approach

Category	Disadvantages and Critiques
Social Inequality	- Widen the gap between rich and poor by prioritizing wealthy elites and foreign investors (Watson, 2017). - Exclude local residents due to high living costs, increasing inequality (Bhan, 2019).
Urban Division	- Create divided spaces, with luxury zones for the wealthy and neglected areas for the poor (Roy & Ong, 2011). - Displace communities, leading to loss of homes and social networks (Lees et al., 2008).
Environmental Impact	- Harm ecosystems, increase pollution, and consume natural resources (Miraftab & Kudva, 2015). - Focus on aesthetics and technology rather than sustainability, straining the environment (Watson, 2014).
Governance Issues	- Decision-making is dominated by private companies, sidelining local communities (Sassen, 2018). - Weaken democratic processes and reduce transparency, prioritizing profits over people's needs (Brenner & Theodore, 2002).
Economic Risks	- Depend heavily on foreign investment, making cities vulnerable to economic instability (Goldman, 2011). - Raise property prices, pushing local residents out and concentrating wealth among a few (Graham & Marvin, 2001).
Neglect of Public Welfare	- Focus on luxury developments instead of addressing essential

Category	Disadvantages and Critiques
	needs like affordable housing and public services (Simone, 2004). - Leave ordinary residents underserved, exacerbating social exclusion (Watson, 2013).
Lack of Sustainability	- Overlook environmental planning, with little attention to green spaces or energy efficiency (Campbell, 2016). - Prioritize short-term financial gains over long-term ecological balance and resilience (Miraftab & Kudva, 2015).

1.8 A New Model for Space Production & the Birth of Xiong'an

The prior contemporary and evidence based framework to building new cities globally has underscored the need for alternative urban development models that are inclusive, sustainable, and locally adapted (Chen X. *et.al.,* 2018; Liu *et.al.,* 2020). The adverse consequences of these projects—ranging from social exclusion to environmental degradation **demonstrate the limitations of market-driven urbanization.** Scholars and urban planners advocate for participatory planning that includes community engagement, sustainable infrastructure, and affordable housing (Xing Su 2023).

In 2017 China responded to the challenge with a straightforward vision. That of a new millennium city that will foster economic development, ensure environmental sustainability, nurture institutional reform, and attract foreign and domestic investment (Chen, J., 2017).

Xiong'an New Area, established in 2017, is one such project in the Beijing-Tianjin-Hebei region and aims to relieve Beijing of non-essential functions, reduce urban congestion, and foster balanced development in Northern China. The "big city disease"

of Beijing together with the ambitious vision of president Xi to develop a transformative model of balanced city-regional development that will guide china into the years to come, Xiong'an was officially designated as the 19th National New Area (NNA) in 2017 (Kim & Chung 2023; Ni P., 2017)).

Some describe this project as a blend of neoliberal urban governance and state-led development that promotes economic growth by attracting investment and supporting market-oriented projects (Kim & Chung 2023). That model, established in the 1980s in cities like Shenzhen and Pudong, empowers local governments to act as "growth machines" and coordinate with business elites. Unlike Western examples of entrepreneurialism, China's state-led version (or "state entrepreneurialism") relies on the state's central role in orchestrating urban development. Under China's model, urban projects align with central government objectives, particularly the need to address unbalanced development, environmental pollution, and social inequalities (Kim & Chung 2023; Song *et.al.,* 2023).

Xiong'an **builds on the previous framework** but with unique "Chinese" aspects. As an NNA with provincial-level administrative authority, Xiong'an's NAAC is empowered directly by the central government. **This administrative structure is designed to allow Xiong'an to bypass the provincial government in decision-making, reflecting a shift toward recentralization of control in urban regions.** By creating this "hierarchical upgrading", China's leadership intends to not only support Xiong'an's goals but also **ensure stronger central oversight over key urban projects in the region**. Xiong'an is the absolute example of vertical intervention to get the job done, terrifying state power and state led business development**.** It is described as a **New Area** and not just a city a fact that implies its significance as a new model for urban land space production, regional development and special economic zone (Song *et.al.,* 2023).

Table 2. Timeline of Events

Date	Event
April 1, 2017	The State Council and the Central Committee of the Communist Party of China (CCCP) officially announce the establishment of **Xiongan New Area** as a major national project, following Shenzhen and Shanghai Pudong.
April 2, 2017	Real estate prices in Xiongan **skyrocket**, rising to 11,000 yuan per square meter from a previous range of 4,000–8,000 yuan. Crowds from Beijing rush to buy properties in anticipation of future growth.
April 3-4, 2017	Within **48 hours**, the central government **freezes the property exchange market**, halting speculative purchases. A local county official is **arrested** for insider trading related to land speculation.
April 21, 2018	The official planning guidelines for Xiongan are released, setting long-term goals for sustainable development, regional integration, and innovative urbanization.
	The **"no land finance"** policy is formally introduced, **banning large-scale real estate development** in Xiongan to prevent reliance on land sales for municipal revenue.
November 2020	**29 land deals** have been completed, covering **25.07 km²** of residential and commercial land. However, **only one** deal was made via auction; the rest were direct transfers to the **City Development and Investment Corporation of Xiongan**, a state-owned entity.
2020-Present	Xiongan's land market remains **closed to private developers**, relying entirely on **public funding and state-owned enterprises (SOEs)** for urban infrastructure and growth.

Source: Song, Y., de Jong, M., Stead, D., & Liu, Z. (2023)

Evidently, China has a long history with special economic zones, autonomous regions and high tech zones. Xiong'an's model builds on these experiences and makes the new

evolutionary step. It this fresh and innovative **framework of urban space production** where urban planning & development, high end technology, industrial evolution, environmental sustainability and preservation, as well as institutional reformation all together take place leading to a brand **new breed of NHTIDZs**[7] that will lead China to the new millennia (Song et.al, 2023; Qianji Investment Bank, 2024).

Table 3. The New Breed of NHTIDZs

Aspect	Traditional NHTIDZs	New Model (Xiong'an)	Key Implications of the New Model
Land Development	• Property-led development • Land finance model • Market-driven land prices • Private sector involvement	• State-controlled land development • Public ownership and rental system • Controlled property market • Prohibition of real estate speculation	Stronger state control over development
Financing Model	• Land-leasing revenues • Local government debt • Private investment • Market-driven development	• Direct central government investment • State development finance • Public-private partnerships • State credit-backed development	Converged urban-industrial planning
Technology	• Separate technology	• Citywide technology	Technology-driven

[7] National High Technology Industrial Development Zones

Aspect	Traditional NHTIDZs	New Model (Xiong'an)	Key Implications of the New Model
Integration	parks • Industry-focused development • Limited urban integration • Company-driven innovation	integration • Smart city infrastructure • AI-driven urban management • State-coordinated innovation platforms	social management
Urban Planning	• Isolated industrial islands • Disconnected from urban context • Focus on industrial space • Limited social infrastructure	• Integrated urban-industrial planning • Smart city from ground up • Mixed-use development • Comprehensive social facilities	Higher emphasis on domestic innovation
Governance	• Local government management • Market-oriented approach • Limited central oversight • Development zone committees	• Direct central government control • Strong state involvement • Digital governance systems • Social credit integration	More controlled business environment
Business Environment	• Open market competition • Mixed ownership	• State-owned enterprise dominance • National technology	Greater focus on sustainability

Aspect	Traditional NHTIDZs	New Model (Xiong'an)	Key Implications of the New Model
	structure • SME participation • International investment focus	champions • Strategic industry focus • Domestic innovation emphasis	
Social Management	• Traditional household registration • Basic public services • Limited social integration • Market-driven housing	• Advanced social credit system • Smart public services • Technology-driven monitoring • State-controlled housing access	More comprehensive urban services
Regional Role	• Local economic growth • Industry clustering • Export orientation • Local talent attraction	• Regional development pole • Capital function absorption • National strategic significance • High-end talent focus	Higher political significance

Source: Song, Y., de Jong, M., Stead, D., & Liu, Z. (2023); Various Notes

1.9 Objective of the Study

The purpose of this thesis is to conduct a comprehensive and in depth analysis of the Xiong'an New Area's smart infrastructure and sustainability initiatives, focusing on their innovative practices and methodologies. By examining the integration of advanced technologies such as AI, I.O.T., green urban building and Planning within Xiong'an, this research aims **to identify key insights that can be applied to urban development in Greek cities, particularly Athens**.

Athens faces numerous urban challenges, including congestion, pollution, and resource management issues (Dimitriou & Michalopoulos, 2024) similar to Beijing as the capital city of China (Cao et.al 2013). Xiong'an serves as a pioneering model for addressing these challenges through its commitment to creating a balanced urban ecosystem that prioritizes both technological advancement and environmental sustainability while it aims to relieve its capital city from its "disease" (Ni P., 2017). **The findings of this thesis will delineate a comparative framework for assessing urban development initiatives and result in a handful of useful strategic lessons both in macro, micro and counterfactual level.**

This thesis will place a significant emphasis on the interplay of technology, infrastructure, and sustainability within the Xiong'an New Area, positioning it as a benchmark for urban development in Athens. By analysing the innovative approaches employed in Xiong'an, including its smart city technologies and comprehensive sustainability initiatives, this research will highlight the importance of a holistic urban strategy and a plan that incorporates cutting-edge infrastructure while prioritizing environmental sustainability in water and energy. Subsequently, **the goal is to illustrate how Xiong'an's model can inspire and inform Athens' urban planning efforts, paving the way for a more sustainable and resilient future.**

To guide this analysis, this thesis will explore three primary research questions that aim to bridge the insights gained from Xiong'an with the urban challenges faced by Athens.

First, the question, **"What did the Chinese do?"** will delve into the specific strategies and high level concepts that will contribute to Xiong'an's success. At this part special attention will be given to the strategy and the design.

The second question, **"How did the Chinese did it?"** will focus on identifying practical solutions derived from Xiong'an's masterplans that are being implemented right now in order to deliver this megacity to its citizens. This part will investigate the plans and the actions taken in order to build the city.

The third question, **"What can we learn and what can we apply here?"** aims to evaluate the actions taken and the strategy behind them in order to deliver a comprehensive list of steps or lessons that can be adopted in a Greek Context. "Can Athens learn?" and / or "Can Athens mimic?" is the subtle hypothesis in this case.

By addressing these questions, the thesis seeks to provide a clear pathway for benchmarking Xiong'an's innovative practices to enhance urban living in Greek cities mainly Athens. In its essence this thesis makes a Talanoa Dialogue[8] with Athens. In the end, the question of "how" explains the journey (Fa'avae *et al.,* 2016).

1.10 Structure of the study

The remainder of this thesis proceeds as follows. Section two will analyse Xiong'an's high level concepts. The vision will be translated to the strategy behind the city while providing a detailed analysis of what was the case before it. This part will highlight the

8 Where are we? → Assessing the current state and challenges.
Where do we want to go? → Defining the collective goals.
How do we get there? → Identifying solutions and pathways for stronger action.

location, the resources and the strategy rational of the city. Section three will review city blueprints and detailed guidelines during the construction. Through a magnifying glass, special attention will be brought to the detailed city blueprints and guidelines and will try to answer how the Chinese State is implementing the vision. Section four will discuss the situation in Athens and Beijing. Consequently, it will delineate the similar challenges between the two cities as well as the current Athenian response. Last but not least, section 5, will deliver the analysis of the lessons learned, in macro, micro and counterfactual level and conclude with some thoughts for potential future research.

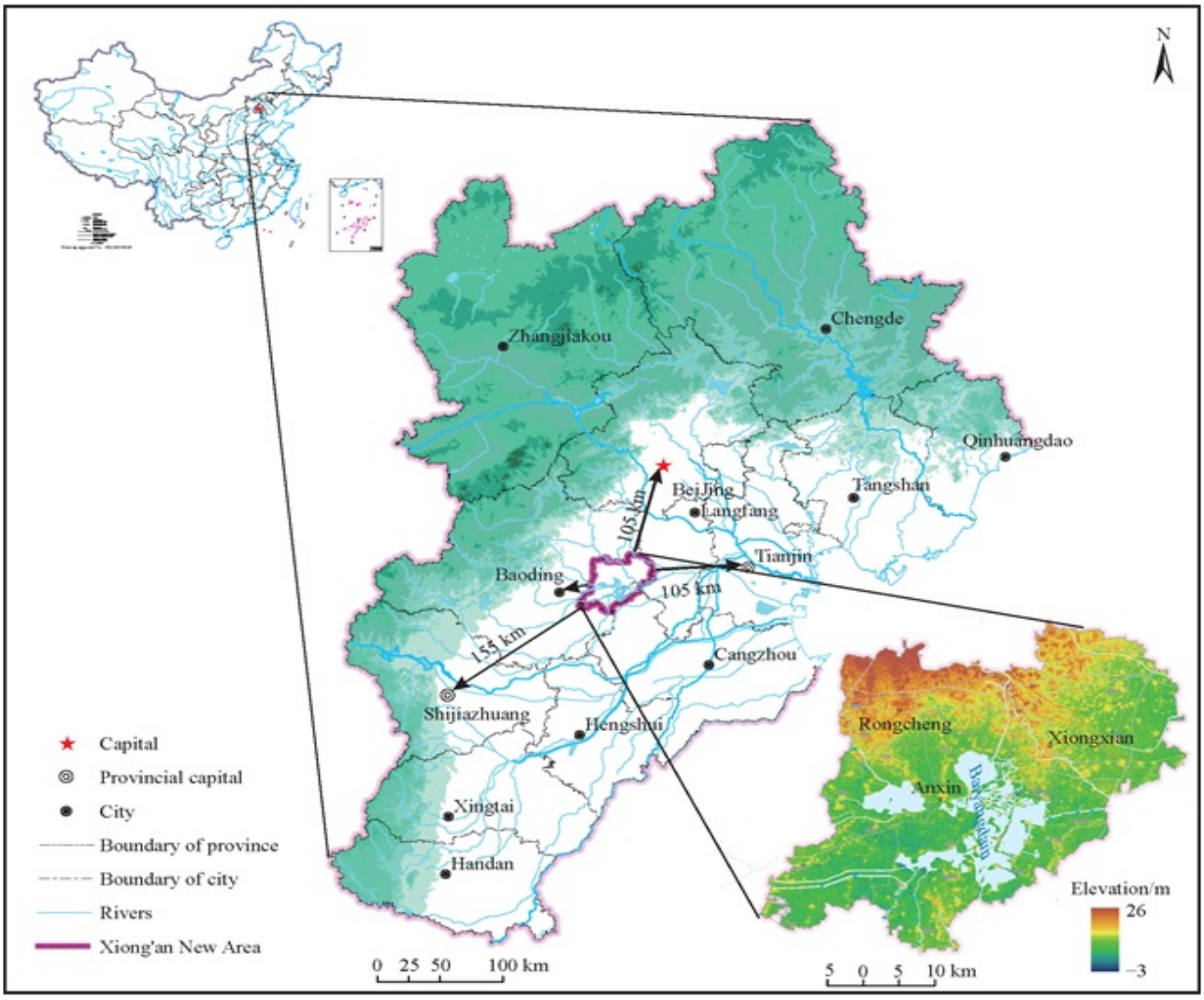
2. Xiong’an as a Model Smart City

In this section of the study, we will focus on Xiong’an's development as a smart city, employing a deductive approach to analyse its transformation by dissecting broader concepts into specific components. Firstly, we will examine the geographical and strategic factors influencing the location choice for the city. The next step will be to take a look into the design of the New Area. By design, this new city comes with a ground-breaking sponge and 3 layered city. The first layer is below the ground (utility tunnels and geothermal energy), the second is on the ground (the city itself, the buildings, the roads and the facilities) and the third is above the ground – on the cloud (the digital twin of the city). Furthermore, a digital forest is being at the heart of it and utility tunnels seem to be its foundation. This structured analysis is intended to yield a comprehensive blueprint skeleton of Xiong’an’s ongoing development and aims to provide an answer to the first research question, “what”, discussing the high level design of the city strategy.

2.1 The Location

Xiong’an New Area is strategically situated with proximity to both the Taihang Mountains and North China's vast plain regions. This area’s favourable geography makes it suitable for extensive urban development. Nonetheless, the region faced significant environmental constraints, primarily due to its location near Baiyangdian Lake, a critical wetland that has experienced periods of drying, pollution, and flood-related damage. As we will see, the state addressed the concerns (Jiang Z., *et.al.,* 2017) for the area by improving all its environmental aspects.

Figure 2. Geographic location of Xiong'an New Area.



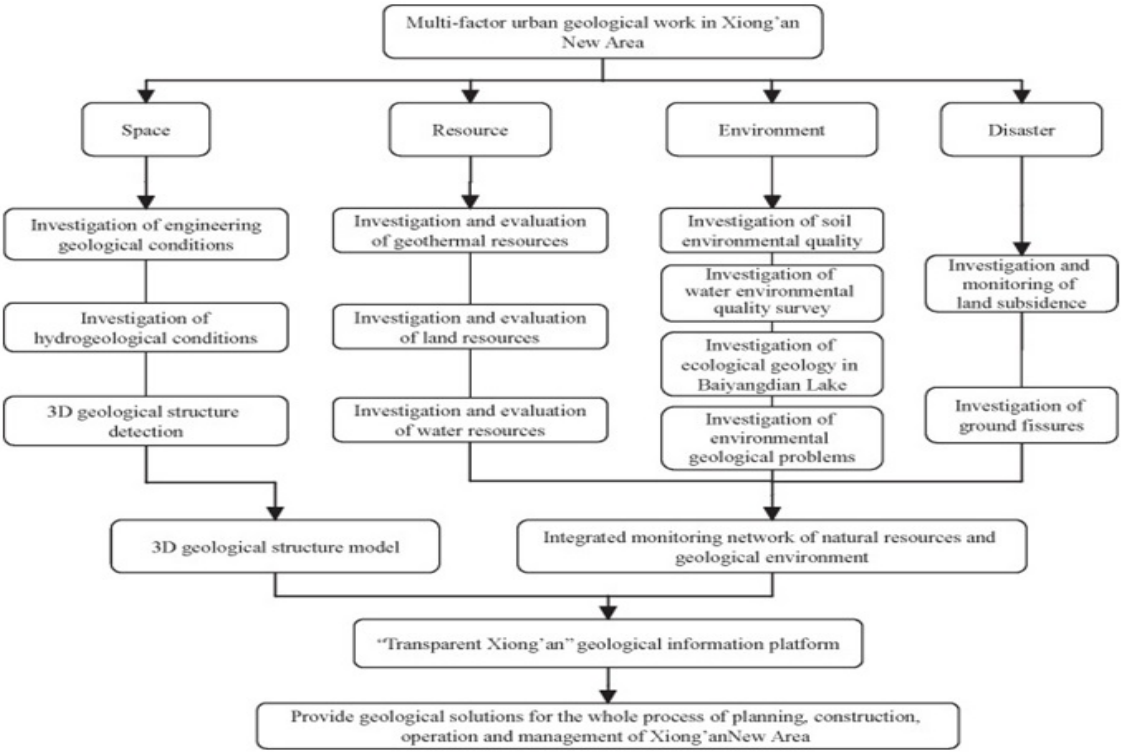
Source: Planning and construction of Xiong'an New Area: Contributions of China's geologists and urban geology (Han et al., 2024).

2.2 The Environment

For several years the Chinese Geological Survey Institute, hereafter called CGS (https://en.cgs.gov.cn/), facilitated and organized Chinese geologists into conducting systematic multi-factor geological surveys of the region. The benefits of their involvement can be categorized into 3 different segments. Firstly these surveys generated data useful for all the stages of the construction of the city. Secondly,

innovation spurred and new knowledge was generated into the aspects of working philosophy, methods and results presentation. Thirdly and most importantly CGS and the scientists involved committed on the continuous involvement into the city project development and expansion, meaning that their knowledge will continue to affect the decisions made throughout the lifespan of the city. The process that was followed by them, focused on four different pillars which are necessary for the city to thrive in the future. These pillars are the space, the resources, the environment and the disaster profile of the area (Han et.al, 2024).

Figure 3. Technical route of multi-factor urban geological surveys in Xiong'an New Area.



Source: Planning and construction of Xiong'an New Area: Contributions of China's geologists and urban geology (Han et al., 2024).

Some notable results of this detailed survey of the region can be found on the following table. To the authors eyes there are a couple of ultra-fascinating findings. Firstly the survey conducted and the process followed lead to the development of a 3D online platform that integrates both surface and subsurface structures, and the creation of the "Transparent Xiong'an" geological information platform. Among these, the monitoring network stands out for its use of space-based and ground-based integration, stereoscopic monitoring, and automated sensing. This system is playing a crucial role in managing and overseeing the natural resources and spatial development of the Xiong'an New Area. **The digital twin of the city is not only on the buildings and the roads but on the resources and the foundation of the city itself.**

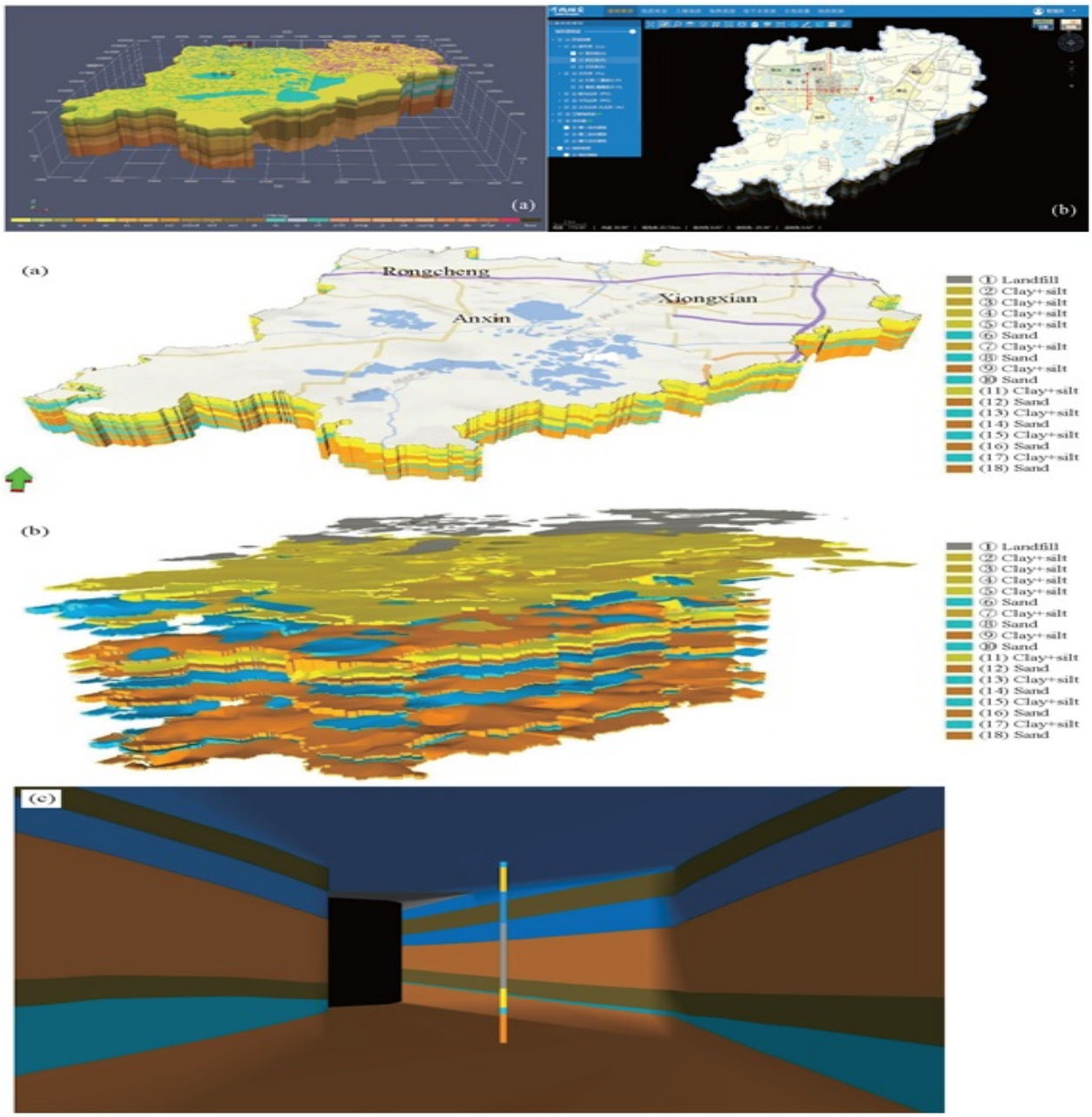
Table 4. List of findings from the geological surveys in Xiong'an New Area

No.	Findings	Description
1	Identification of Weak Soils and Loose Sands	Detected weak soils and loose sands requiring specific foundation treatments.
2	Assessment of Groundwater Resources	Mapped and quantified groundwater reserves, including quality and recharge capacity.
3	Evaluation of Geothermal Resources	Identified geothermal energy potential for sustainable energy solutions.
4	Detection of Land Subsidence Areas	Pinpointed regions prone to land subsidence to mitigate risks.
5	Monitoring of Ground Cracks	Located ground cracks to prevent structural damage and ensure urban safety.
6	Analysis of Seismic Activity	Conducted detailed analysis of seismic risks to guide earthquake-resistant construction (Gao et.al, 2023).
7	Mapping of Soil and Groundwater Contamination	Identified sources and areas of contamination, supporting environmental protection.

No.	Findings	Description
8	3D Geological Modelling	Created a three-dimensional geological model for comprehensive understanding of subsurface conditions.
9	Study of Biodiversity and Wetland Ecology	Catalogued wetland biodiversity and its relationship with geological and hydrological conditions for ecological preservation.
10	Identification of Geohazards	Located geohazards, such as karst formations and unstable slopes, to aid in land-use planning.
11	Analysis of Airborne and Soil Dust	Examined geological factors contributing to dust pollution, helping mitigate environmental and health issues.
12	Infrastructure Suitability Mapping	Conducted detailed assessments to ensure land suitability for urban construction, including transportation networks and large-scale infrastructure development.

Source: Planning and construction of Xiong'an New Area: Contributions of China's geologists and urban geology (Han et al., 2024).

Figure 4. Engineering geological structure model of Xiong'an New Area.



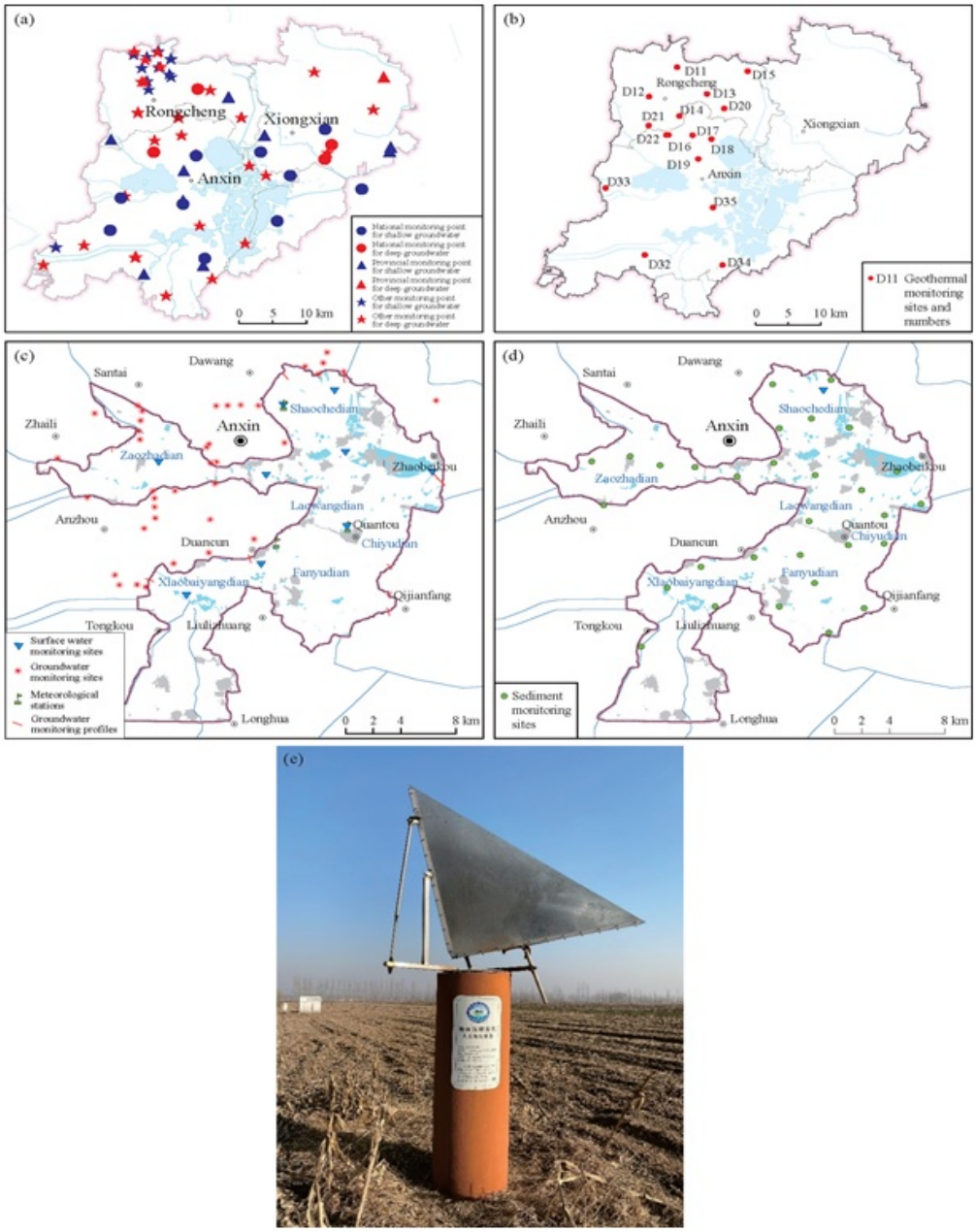
Source: Planning and construction of Xiong'an New Area: Contributions of China's geologists and urban geology (Han et al., 2024).

(a) geobody; (b) stratigraphic exploded view; (c) tunnel roaming

Secondly, the carrying capacity of Xiong’an's resources, particularly water, was at a critical threshold. Water scarcity is a longstanding problem in North China, exacerbated by high demands from agricultural, residential, and industrial sectors. Surface water pollution is also prevalent due to industrial effluents and agricultural runoff. Additionally, the Xiong’an region is vulnerable to flood risks, with heavy rainfall events threatening any infrastructure and urban planning efforts.

Using data from remote sensing, fixed observations, and historical records, Jun and Zhang (2017) evaluate the resource limits of Xiong’an's environment. Key findings suggest that maintaining current population and production levels could strain local resources beyond sustainable limits. A population increase to 5 million as it is planned to happen would demand substantial urban land (670 km^2 for built-up areas and industrial zones), pushing water consumption to over 1 billion cubic meters per year. This increase would necessitate robust flood management, pollution control, and resource planning to support both ecological and urban sustainability (Jun and Zhang, 2017; Fang C. *et.al.,* 2017; Feng Z. *et.al.,* 2017). **The overall findings and recommendations dictated that the city to be built should be a sponge city otherwise it would fail (**Yu, K., 2018; Yin *et.al.,* 2022).

Figure 5. Comprehensive monitoring network of natural resources and environments in Xiong'an New Area.



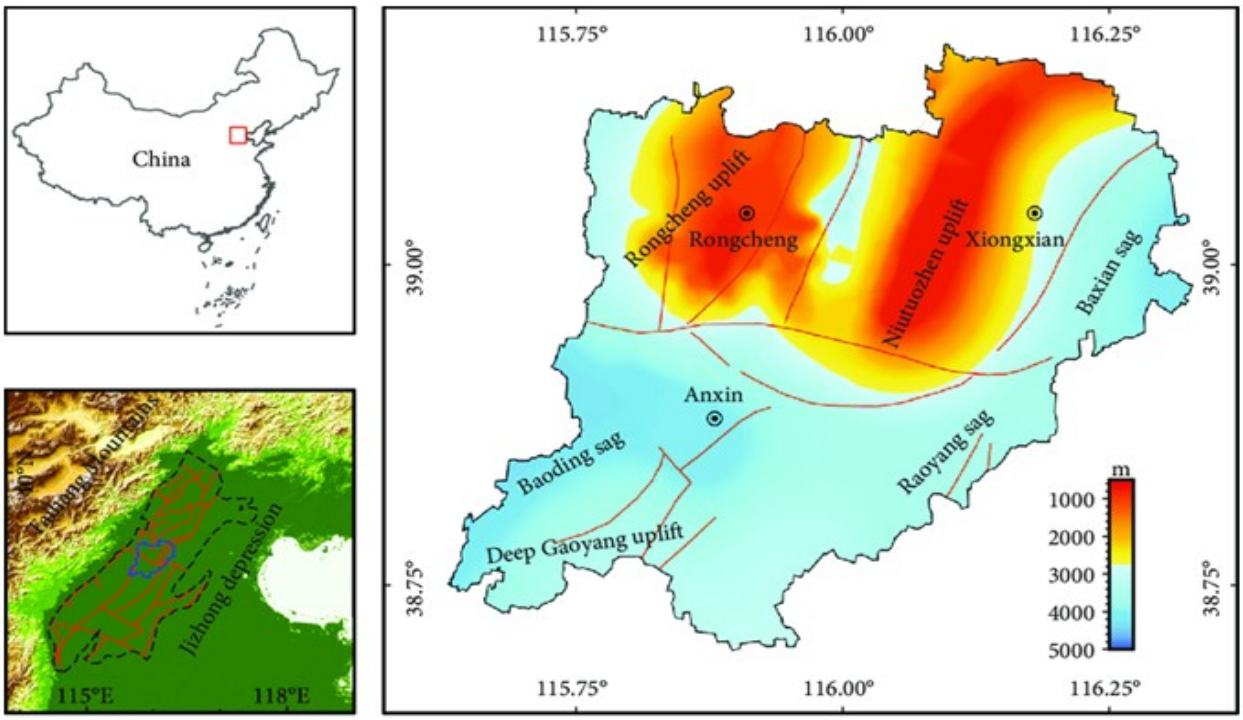
Source: Planning and construction of Xiong'an New Area: Contributions of China's geologists and urban geology (Han et al., 2024).

Additionally For the reason above, (Jun and Zhang, 2017; Yin et. al., 2022) recommended several measures to enhance Xiong'an's carrying capacity sustainably:

→ **Population and Urban Growth Control**: Limiting the population to 5 million and strategically planning urban and industrial expansion zones are essential to maintaining ecological balance.
→ **Water Resource Management**: Diversifying water sources, including the South-to-North Water Diversion project, is vital to meet the demands of a growing population. Additionally, reducing groundwater extraction and promoting water recycling are crucial for long-term sustainability.
→ **Pollution Control**: To improve environmental quality, the study suggests strict regulation on pollutant discharge, particularly from industries. This includes incentivizing eco-friendly practices and technologies that reduce emissions and water contamination.
→ **Flood Control Measures**: The study advocates for enhanced flood control through upgraded infrastructure, dike construction, and drainage systems. Creating "sponge city" designs, which enhance flood absorption, is also proposed to mitigate flood impacts and improve resilience.

Thirdly but equally important, is the local energy development strategy (Li *et.al.,* 2024). A detailed assessment of geothermal reserves in the Rongdong zone, with precise accuracy, made it possible to grant the first large-scale geothermal exploitation rights in the area (Han *et.al.,* 2024). To support this, a series of technical guidelines have been created, covering everything from early exploration to monitoring geothermal wells and managing dynamic systems. These steps ensure that geothermal resources are managed in a scientific, organized, and sustainable way in the long term (Pang Z., *et.al.,* 2017).

Figure 6. Regional geological tectonic map of the Xiong'an geothermal area.



Source: Zhu et.al., 2022

2.3 The City Design

The city design prioritizes environmental sustainability, with significant green areas, efficient waste and energy management, and "sponge city" features, focusing on storm-water management systems to replenish local water resources.

This concept of intelligent harmony is introduced which encompasses the integration of advanced technologies with natural systems to create a balanced urban environment (Hitachi, 2021; Yu, 2018; Yin *et.al.,* 2022). Such approach, seeks to harmonize human activity with ecological sustainability, ensuring efficient resource use, effective waste management, and a high quality of life for residents. Also the plan emphasizes walkable neighbourhoods where essentials are within a 15-minute reach, improving quality of

life and fostering a community-oriented culture. Overall, it aims to foster community engagement while promoting smart infrastructure that adapts to social and environmental changes.

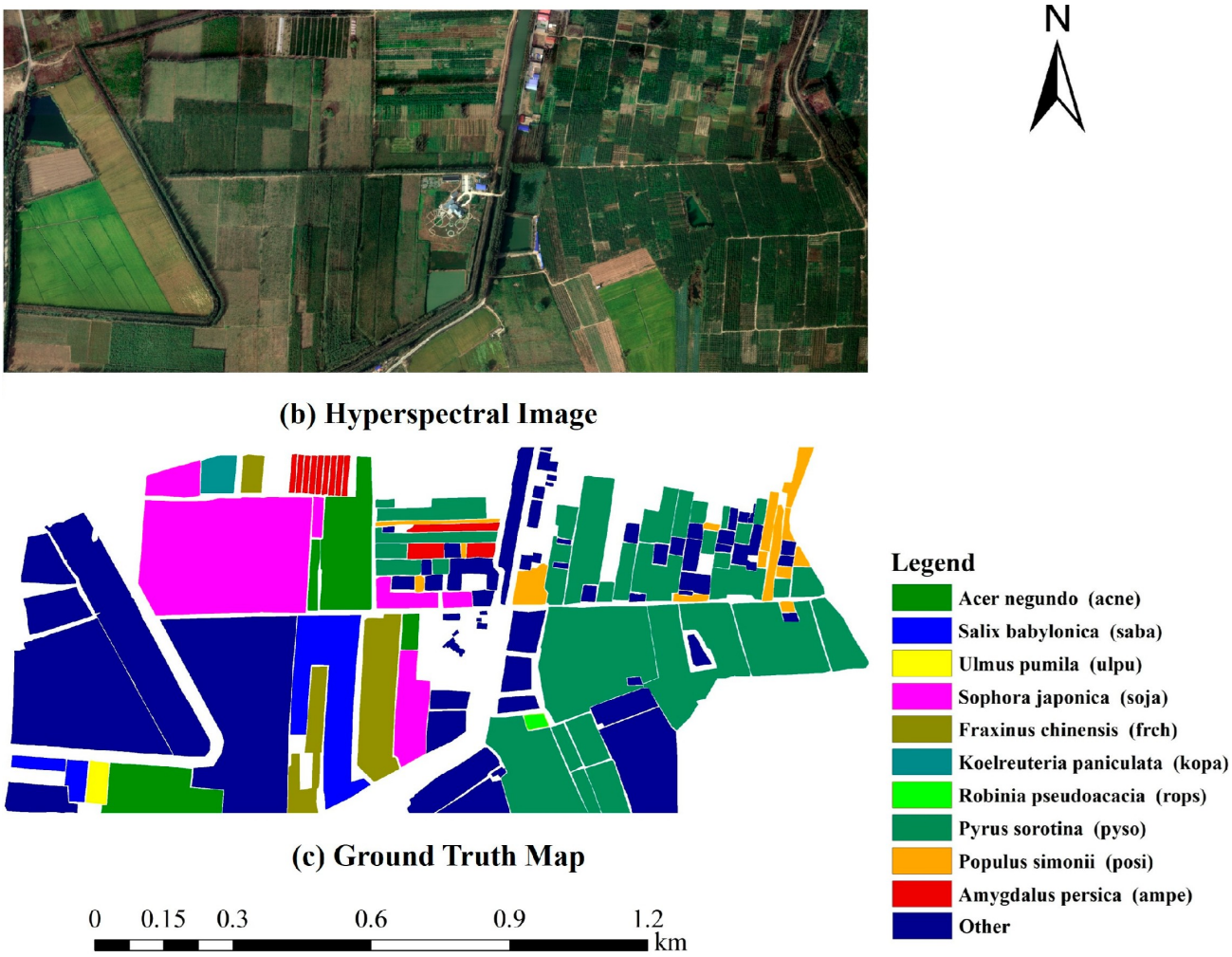
2.3.1 The Digital Forest

The **Millennium Show Forest**, part of Xiong'an New Area's sustainable development agenda, is an ambitious ecological and urban forestry initiative designed to establish a near-natural forest ecosystem covering over 600 km² by 2030, representing 30% of the area's planned 2000 km². This project incorporates principles of natural forest succession, creating multi-layered, mixed-species forests on previously undeveloped land to enhance ecological resilience, support water and nutrient cycles, and offer recreational and spiritual benefits to residents. The forest design mimics natural ecosystems with canopy, mid-story, and understory layers formed by 174 species from 37 plant families, prioritizing local species to ensure compatibility with North China's abiotic conditions, such as soil pH and precipitation (Li *et.al.,* 2020). Scattered planting techniques simulate natural distributions, avoiding traditional grid patterns, while advanced technologies such as **miniature meteorological monitoring systems and intelligent irrigation optimize forest management.** A "digital forest" system integrates big data for each tree through QR codes, tracking species, life cycle, planting history, and maintenance, supported by strict protocols outlined in the "Afforestation Manual" to ensure quality planting, irrigation, and ongoing care. Since its launch in November 2017, the initiative has achieved significant progress, with 113 km² afforested and 12 million seedlings planted. By serving as an ecological buffer zone, promoting biodiversity, and fostering ecosystem services, the forest aligns with Xiong'an's goals for landscape preservation and provides opportunities for scientific research and enhanced urban quality of life. The project exemplifies a forward-thinking approach to sustainable urban afforestation, integrating ecological restoration, technological innovation, and urban planning to address environmental challenges and improve human well-being (Li *et.al.,* 2020).

The **Millennium Show Forest** in Xiong'an New Area incorporates innovative strategies for managing invasive pests, benefiting from **centralized government control and advanced data collection systems.** Unlike standard urban forests, this project minimizes socio-political challenges by integrating decision-making protocols from the outset. A comprehensive framework addresses invasive species management through four key strategies: prevention of new introductions, early detection and monitoring, local eradication, and long-term containment. The project leverages "big data," with each tree tagged with a QR code providing real-time data on provenance, health, and pest status. This data is integrated into risk maps showing pest distribution, host suitability, and current management actions, enabling precise and timely interventions (Li *et.al.,* 2020).

To enhance public engagement, citizen scientists can contribute **through smartphone apps like the Xiong'an Forest APP and report sightings.** Advanced tools such as, hyperspectral imaging, DNA metabarcoding, remote sensing, and "sentinel trees" are employed for early detection. For local eradication, methods include removing infested trees, physical controls, and pesticide treatments, while balancing environmental safety. Long-term strategies involve biological control using natural predators, semiochemicals like pheromones for mating disruption, and landscape management to reduce pest habitat. By combining ecological planning with technological innovation, this integrated system ensures sustainable pest management and resilience against invasive species, creating a model for future urban forestry projects (Li *et.al.,* 2020; Hou C. *et.al.,* 2020).

Figure 7. Hyperspectral Imaging Xiong'An



Source: Hou C. et.al., 2020.

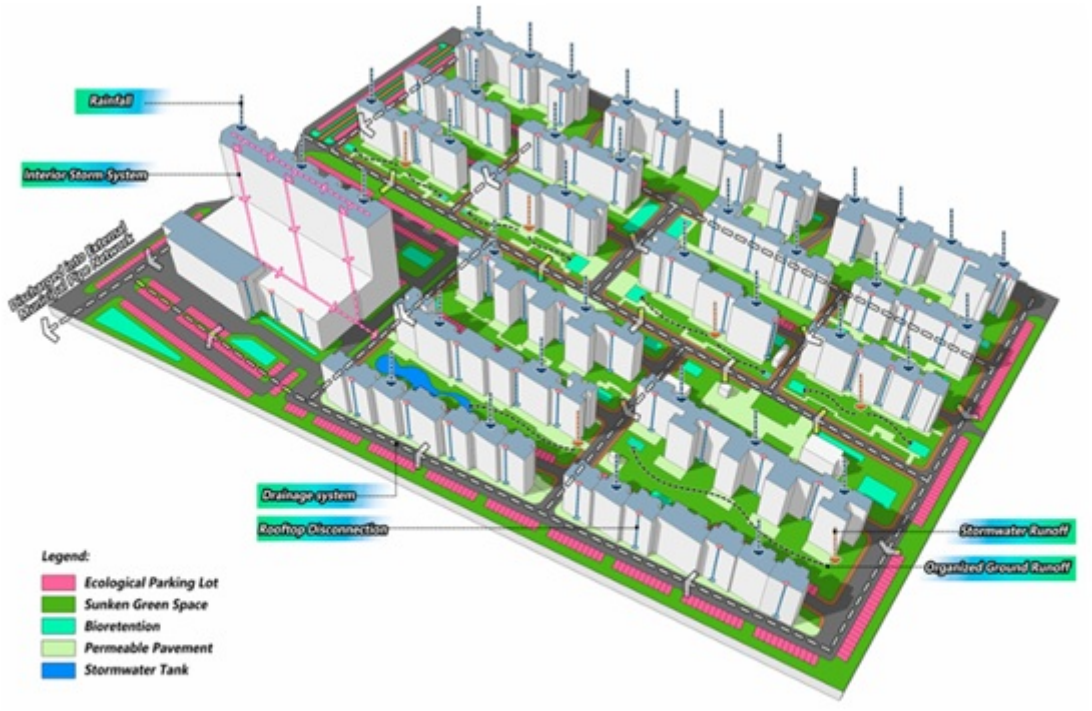
Figure 8. Snapshots of the Millenium Forest in Xiong'an New Area

Source: Li, H.-P., Wickham, J. D., Bushley, K., Wang, Z.-G., Zhang, B., & Sun, J.-H. (2020). New approaches in urban forestry to minimize invasive species impacts: The case of Xiong'an New Area in China. *Insects, 11*(5), 300. https://doi.org/10.3390/insects11050300

2.3.2 The Sponge City

In recent years, China has pursued innovative urban water management strategies to address mounting environmental challenges from rapid urbanization, particularly issues of urban flooding, water pollution, and ecological degradation. The concept of the "Sponge City" has emerged as a cornerstone of this strategy, integrating natural and engineered systems to manage storm water sustainably (Hitachi, 2021; Yu, 2018; Yin *et.al.,* 2022, Jun and Zhang, 2017; Nazarpour *et.al.,* 2023).

Figure 9. The Sponge City Design- Beijing



Source (Yin et.al., 2022)

Introduced formally in 2013, the Sponge City model was designed to leverage nature-based stormwater management techniques inspired by foreign methods, including Low Impact Development (LID) and Sustainable Urban Drainage Systems (SUDS) from the United States and United Kingdom, respectively (Yin et al., 2022). China's approach

aims to retain and purify stormwater through techniques such as green roofs, rain gardens, and permeable pavements, which mimic natural hydrological cycles to reduce surface runoff and alleviate the urban heat island effect (Yin et al., 2022).

China's initial rollout included 30 pilot cities, each with a designated area of at least 15 km², to test the effectiveness of these techniques under varied regional conditions (Yin et al., 2022). The central government closely monitored these pilots from 2015 to 2019, evaluating their impact on water quality, urban flooding, and ecological restoration. Early findings demonstrated significant benefits, such as reduced flood frequency and improved water quality, though the study noted substantial gaps in region-specific guidelines and technical expertise (Yin et al., 2022). **Public-Private Partnerships (PPP) have been instrumental** in the large-scale implementation of Sponge Cities, with private enterprises responsible for the design, construction, and maintenance of stormwater infrastructure in partnership with municipal governments (Yin et al., 2022). This collaborative approach has been financially and logistically advantageous, encouraging broader stakeholder involvement.

Expanding upon these pilots, China's 14th Five-Year Plan (2021-2025) supports a systematic demonstration phase in selected cities, aimed at refining techniques across various spatial scales, from neighbourhood-level interventions to watershed-scale projects. Furthermore, the plan prioritizes public education, integrating Sponge City concepts into school curricula and community outreach to foster environmental awareness and public support (Yin et al., 2022).

2.3.3 The Design Principles

The Sponge City design in China integrates several principles from global stormwater management practices, as well as traditional Chinese water control strategies. Modern inspirations include Low Impact Development (LID) from the U.S., Sustainable Urban Drainage Systems (SUDS) from the U.K., and Water-Sensitive Urban Design (WSUD) from Australia. These practices emphasize reducing runoff through permeable surfaces,

green infrastructure, and localized water retention. Traditional Chinese practices, such as the terraced fields and drainage systems used in ancient village layouts, serve as additional inspiration. These historical systems managed water effectively without heavy infrastructure, preserving natural water flow and storage capacity. Sponge City designs adopt a similar philosophy, focusing on "natural storage, infiltration, and purification" as key mechanisms (Yin et al., 2022; Yu et al., 2018).

2.3.3 A. Green Infrastructure

Green infrastructure is a primary element of the Sponge City, focusing on decentralized systems that absorb and filter stormwater at the source. Examples include green roofs, permeable pavements, bioretention areas, and rain gardens. These features allow water to infiltrate where it falls, reducing surface runoff and mitigating urban flooding risks. Each component is designed to perform multiple functions, such as cooling urban temperatures, enhancing biodiversity, and improving aesthetics.

Green roofs, for example, help absorb rainwater and delay peak flow rates, while bioretention areas, which consist of soil, plants, and drainage materials, filter pollutants and recharge groundwater. Permeable pavements facilitate water infiltration and are particularly effective in managing runoff in urban areas with high impermeable surfaces. In designing these infrastructures, each Sponge City pilot was encouraged to adapt to local climate conditions, such as higher rainfall intensities in southern China and more arid conditions in the north (Yin et al., 2022).

2.3.3 B. Gray Infrastructure

Gray infrastructure is integrated with green components to manage water when natural systems alone are insufficient. This includes traditional drainage pipes, detention tanks, and pumps. These elements serve as conduits for excess water that green infrastructure cannot absorb, allowing cities to handle large rainfall events or severe flooding more effectively. The design integrates gray infrastructure with green systems, using them as complementary mechanisms to manage water across different scales.

2.3.3 C. Blue Infrastructure

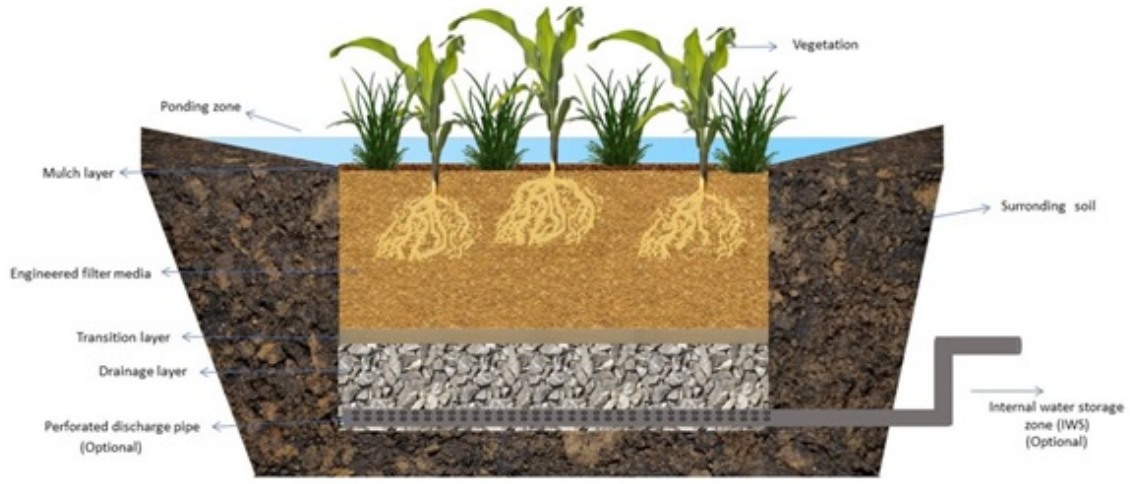
"Blue" infrastructures, such as lakes, rivers, ponds, and artificial wetlands, play a central role in the Sponge City’s design, particularly at larger scales. Baiyangdian Lake in Xiong’an New District, for instance, functions as a core retention area in the "One Heart" model, retaining floodwaters and serving as a productive wetland that supports biodiversity (Yu et al., 2018). By using natural or artificial wetlands to store stormwater, Sponge City designs aim to improve water quality, create ecological habitats, and support natural water cycles. Blue spaces also help cool urban areas and provide recreational areas, which are important for residents' quality of life.

2.3.4 The Design Framework

2.3.4 A. Facility Scale

At the facility level, designs focus on specific green infrastructure installations, such as individual bioretention cells, rain gardens, or permeable pavements, with precise sizing and layouts that correspond to the site’s rainfall intensity and hydrological characteristics. Rain barrels and rooftop gardens are used on small plots to harvest rainwater, providing supplementary water sources and reducing demand on municipal water supplies. This facility-level focus maximizes immediate water absorption, filtration, and storage (Yin et al., 2022).

Figure 10. Schemantic representation of a bioretention cell (Micro-Level)



Source: (Nazarpour et.al., 2023)

2.3.4 B. Neighbourhood Scale

At the neighbourhood or district scale, Sponge City designs incorporate green corridors and networks of ponds to manage water at a community level. This scale integrates green, gray, and blue infrastructure, creating cohesive networks that allow water to flow between elements. For instance, in Xiong'an, the "Nine Corridors" are designed to carry water from surrounding rivers into the city, flowing through levee-free corridors that provide productive wetland spaces while mitigating flood risks. This meso-scale integration allows for both functional water management and the creation of accessible green spaces for residents (Yu et al., 2018).

Figure 11. A ditch that can collect rainwater at a park in Xiong'an New Area (03/ 30/ 2022)

Source: http://en.people.cn/n3/2022/0401/c90000-10078515.html

2.3.4 C. Urban and Watershed Scale

At the urban and watershed scale, Sponge City designs focus on large retention areas, such as lakes and floodplain parks that serve as natural flood control zones. Baiyangdian Lake in Xiong'an New District exemplifies this macro-scale approach, acting as a natural retention basin within the larger urban ecosystem. Large urban retention zones, such as those designed for Xiong'an, support aquifer recharge, improve water quality through sedimentation and natural filtration, and reduce the velocity and volume of downstream floodwaters. Additionally, wetland restoration within these larger scales contributes to biodiversity conservation, creating natural habitats that support various species and contribute to ecosystem stability (Yu et al., 2018).

Figure 12. High level –Sponge city design of Xiong'an New Area

Source: https://www.chapmantaylor.com/news/conserving-water-and-preventing-flooding-with-sponge-city-design-principles-across-china

2.3.5 The Implementation Strategies

2.3.5 A. Public-Private Partnership (PPP) Model

China's Sponge City initiatives encourage Public-Private Partnerships (PPP) to finance, construct, and maintain Sponge City infrastructure. In this model, municipal governments create agreements with private companies, bundling related projects under unified contracts that ensure consistent design, construction, and operational standards. This model not only reduces the financial burden on municipal governments but also introduces private-sector expertise and innovation in water management, furthering the effectiveness and reach of Sponge City practices (Yin et al., 2022).

2.3.5 B. Interdisciplinary Collaboration and Public Engagement

Successful Sponge City design requires collaboration across multiple disciplines, including urban planning, hydrology, environmental engineering, and landscape architecture. In addition, public awareness and education have been emphasized, with educational programs in schools to foster understanding and support for Sponge City practices among younger generations. Engaging the public in local Sponge City projects, such as community rain gardens and green roofs, fosters a culture of environmental responsibility and enhances the social acceptability of these initiatives (Yin et al., 2022).

2.3.5 C. Adaptive Policy and Technical Guidance

Both national and local policies guide the design and implementation of Sponge Cities, with adaptation for regional hydrological and environmental conditions. Technical guidelines address aspects like pollutant removal efficiency, optimal retention capacity, and regional rainfall intensity, although the articles note that localized technical standards are still under development. Monitoring and feedback mechanisms have been established in pilot cities to refine these guidelines continuously, ensuring that future Sponge City projects are informed by empirical data on performance (Yin et al., 2022).

2.3.6 A Transformative approach: Xiong'an

China's Sponge City concept represents a transformative approach to urban water management, combining nature-based solutions with traditional infrastructure. Through its integration of green, gray, and blue infrastructures across different spatial scales, the Sponge City design enables effective stormwater management that aligns with ecological restoration and urban resilience. The systematic demonstration phase, supported by national policies and PPP financing, aims to optimize this model for broad, sustainable adoption. This framework not only addresses immediate water challenges but also promotes long-term urban sustainability, fostering resilient communities that are better equipped to handle climate-induced water challenges. The

Xiong'an New District and other cities advance this concept while China's Sponge City framework serves as a potential global model for sustainable urban water management.

Figure 13. Design aspects of a sponge city.

Source: https://www.chapmantaylor.com/insights/what-are-sponge-cities-and-why-are-they-the-future-of-urban-design

2.3.7 The Underground Utility Tunnels

Zhang's *et.al.,* (2021) work, titled "External Benefit Assessment of Urban Utility Tunnels Based on Sustainable Development," establishes a technical framework for evaluating the long-term societal, environmental, and economic benefits of Urban Utility Tunnels (UUTs), with an emphasis on their application in urban sustainability. UUTs integrate multiple utility pipelines within a shared subterranean tunnel, offering a consolidated solution to the issues presented by traditional open-cut trench systems. This structure provides accessible space for municipal services—such as water, gas, electricity, and telecommunications—enabling streamlined maintenance while reducing ground-level disruptions. Despite their sustainability benefits, high initial costs have limited the widespread adoption of UUTs, particularly in densely built environments (Zhang *et.al.,* 2021). The technical advantages of UUTs span several dimensions. First, UUTs optimize the use of both aboveground and underground spaces. By housing utilities within a single tunnel, UUTs avoid the "spaghetti subsurface problem"—the chaotic intermingling of buried utilities—freeing underground space for future urban needs (Zhang, T., 2023). Furthermore, by consolidating these utilities, UUTs minimize the maintenance disruptions typically caused by surface-level excavation, reducing the risk of accidental damage to other subsurface structures. Their enclosed design also protects pipelines from external hazards and improves inspection, significantly enhancing the reliability of municipal services and extending the operational lifespan of roadways and other public infrastructure. Additionally, UUTs are designed with resilience against environmental risks, shielding critical services from impacts related to seismic activity, extreme weather, and soil erosion (Zhang *et.al.,* 2021).In their analysis the "composite market price method," is developed to capture UUTs' broad non-market benefits by using available market prices to estimate avoided costs, such as infrastructure repair or land use costs. This method diverges from traditional subjective or survey-based approaches by providing more concrete valuations, which may be more persuasive to both public and private stakeholders. This market-based approach also avoids issues of valuation overlap, ensuring that each external benefit is clearly defined

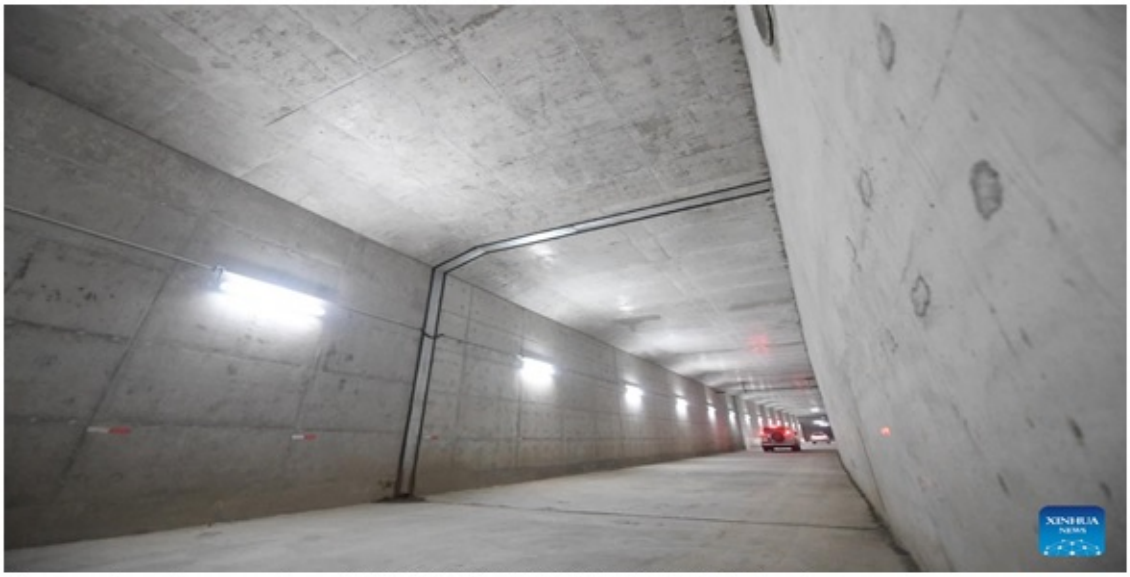
and distinct. The assessment compares UUTs directly with traditional buried pipelines, which would otherwise serve as the default urban utility infrastructure. By evaluating damage avoidance, resource conservation, and other avoided costs, the methodology offers a comprehensive framework for understanding UUTs' long-term financial and social returns (Zhang *et.al.,* 2021).

Figure 14. Layout of Road network in Xiong'an New Area

Source: Xiongan.gov.cn

By eliminating aboveground utility lines and reducing the dust, noise, and pollution associated with maintenance work, UUTs enhance the urban environment and visual landscape. Public willingness-to-pay (WTP) for these aesthetic improvements is determined through a stated preference method, which surveys residents' financial valuation of cleaner, quieter neighbourhoods (Zhang *et.al.,* 2021). Xiong'an New Area, is committed to a high-density urban plan and sustainable infrastructure. The planned UUT network, covering 90 km of mainlines and 100 km of branch lines, is designed to serve a target population density of 10,000 residents per square kilometer. Municipal pipelines for water, gas, electricity, and telecommunications will be consolidated in this network, which is projected to last for a 100-year service lifecycle.

Figure 15. An underground logistics channel in Rongdong District of Xiong'an New Area (03/ 30/ 2022)



Source: http://en.people.cn/n3/2022/0401/c90000-10078515.html

Figure 16. Staff members inspect an underground pipeline system in Rongdong District of Xiong'an New Area (03/ 30/ 2022)

Source: http://en.people.cn/n3/2022/0401/c90000-10078515.html

3. The New Area Masterplans

3.1 The 5G Network

Xiong'an's ambitious smart city vision represents a remarkable blueprint for the future of urban development, with its 5G network infrastructure serving as the beating heart of this technological marvel. Picture a city where connectivity isn't just an afterthought, but rather woven into its very fabric - from the towering skyscrapers to the underground tunnels, and even extending into the serene countryside. At the core of this vision lies a sophisticated 5G network that promises lightning-fast speeds of at least 100 Mbps for downloads and 4 Mbps for uploads, though these are just the minimum benchmarks. The city planners have opted for a Standalone (SA) architecture, essentially building a pure 5G network from the ground up rather than piggybacking on existing 4G infrastructure. This bold choice reflects their commitment to future-proofing the city, even as they maintain 4G networks during the transition period. Think of it as constructing a modern superhighway while keeping the old roads operational until everyone has vehicles capable of handling the new infrastructure (Xiong'an New Area Development and Construction Administration, 2017).

The physical implementation of this network is the perfect balance between form and function. Imagine a three-tiered system of base stations: powerful macro stations perched atop buildings and poles, providing broad coverage; smaller micro stations cleverly disguised within everyday urban features like mailboxes and light poles; and indoor distribution systems ensuring seamless connectivity even in the deepest underground spaces. These aren't just utilitarian installations - the city has mandated that they blend seamlessly into the urban landscape. Picture antenna boxes camouflaged as architectural features, base stations masquerading as decorative pavilions, and equipment hidden behind specially designed facades that appear solid but are actually transparent to radio waves. This attention to aesthetics extends from the bustling city center to the tranquil parks and scenic areas, where the technology must remain

invisible to preserve the natural beauty (Xiong'an New Area Development and Construction Administration, 2017).

The infrastructure supporting this network is equally impressive in its scope. New buildings are being designed with dedicated platforms on all four sides to host 5G equipment, while existing structures are being thoughtfully retrofitted. The city has established detailed specifications for everything from machine rooms (spanning 20 to 30 square meters depending on location) to power requirements (40 kVA for macro stations and 10 kVA for micro stations). Underground spaces haven't been forgotten either - for every 100,000 square meters of underground commercial space, 50 square meters are reserved for communication equipment, with similar provisions made for subway systems and other subterranean infrastructure. It's a bit like ensuring every neighbourhood has its own power substation, but in this case, it's for maintaining the invisible web of connectivity that will power the smart city (Xiong'an New Area Development and Construction Administration, 2017).

Environmental consciousness is woven throughout these plans. The network is designed to be energy-efficient, with equipment that can adjust its power consumption based on usage patterns - think of it as having a smart thermostat for your entire communication network. The materials used must be both durable and environmentally friendly, capable of maintaining their performance for at least a decade while meeting strict environmental standards. Signal filtering materials must achieve the delicate balance of being strong enough to last (with specific strength requirements of 69.9 MPa for tensile yield and 142 MPa for bending yield) while being transparent enough to radio waves to keep signal loss under 1 dB across all frequency bands (Xiong'an New Area Development and Construction Administration, 2017).

The underground aspect of Xiong'an's infrastructure is particularly fascinating, with provisions made for everything from shopping malls to subway systems. Every three kilometers of underground traffic space gets its own dedicated machine room, ensuring that whether you're shopping in a subterranean mall or commuting on the subway,

you'll stay connected. This comprehensive underground network extends to municipal facilities like transformer stations and water plants, creating a truly three-dimensional web of connectivity that spans the entire city. It's as if the planners have created an invisible nervous system for the city, with signals flowing seamlessly between the surface world and the underground realm (Xiong'an New Area Development and Construction Administration, 2017).

Looking at the technical standards, one can appreciate the meticulous attention to detail in the network design. Base station spacing and antenna heights have been carefully calculated based on China's frequency allocations and Xiong'an's unique urban planning needs. Macro station antennas are positioned between 15 and 35 meters high, while micro stations operate at 3 to 15 meters, each carefully placed to provide optimal coverage without creating interference. Indoor systems are even more precisely calibrated, with each remote radio unit covering 15 to 20 meters inside buildings and up to 50 meters in tunnels. This precision extends to the aesthetic integration requirements, where every visible piece of equipment must contribute to, rather than detract from, the city's visual harmony (Xiong'an New Area Development and Construction Administration, 2017).

The result is a masterpiece of urban planning that manages to balance cutting-edge technology with environmental responsibility and aesthetic beauty. Xiong'an's approach demonstrates that smart cities don't have to choose between function and form - they can achieve both through careful planning and innovative design. As cities worldwide grapple with the challenges of modernization, Xiong'an's comprehensive blueprint offers valuable lessons in how to build a truly integrated smart city where technology enhances rather than dominates the urban landscape. It's a vision of a future where infrastructure isn't just smart, but also sustainable, beautiful, and seamlessly integrated into the fabric of daily life (Xiong'an New Area Development and Construction Administration, 2017).

3.2 The Data Centers

Within Xiong'an's bustling streets lies an invisible nervous system that keeps the city's digital pulse beating strong. The city's data centers aren't just cold, technical spaces – they're the living, breathing hearts of a digital ecosystem that touches every aspect of daily life. From the towering core data centers that process millions of calculations per second to the smallest community centers that keep neighbourhoods connected, each facility plays its part in an intricate dance of data.

There are several different layers of this digital ecosystem, starting with what you might call the city's digital castles – the core data centers. These fortresses of technology are marvels of modern engineering, carefully positioned to tap into the city's arteries of power, water, and fiber optics. Massive halls with rows upon rows of humming servers, each rack occupying as much space as a small office and consuming enough power to run several homes. These buildings are crafted with almost obsessive attention to detail. No windows pierce their walls, protecting the sensitive equipment within, there is not even a single expansion joint that could compromise their structural integrity. Moreover, the building's footprint is carefully considered, with perfect squares or rectangles chosen to maximize every inch of space (Xiong'an New Area Development and Construction Administration, 2017).

Advanced cooling systems keep everything running smoothly. These centers use a mix of traditional and natural cooling methods to stay efficient. Some even tap into nature itself, using cool air when available to reduce their energy footprint. Every rack, every cable, every power supply is planned with precision, ensuring that these facilities will remain future-proof in the long term (Xiong'an New Area Development and Construction Administration, 2017).

Moving down the hierarchy, we find the aggregation data centers –the city's digital substations. While smaller than their core counterparts, these facilities are no less critical. They're the meeting points where data from countless sources comes together,

like tributaries flowing into a digital river stream. These centers strike a perfect balance between power and efficiency, with each rack taking up less space but still packing a significant punch. Some can handle power loads ranging from enough to run a small business to enough for a small factory, all while maintaining the same high standards of reliability and security as their larger siblings (Xiong'an New Area Development and Construction Administration, 2017).

At the neighbourhood level, community data centers bring technology closer to home. These local hubs, typically no larger than a small apartment, serve as digital community centers where various service providers share space and resources. These centers are built smart – avoiding any water pipes or fire hydrants inside that could pose a risk to the equipment. Instead, they're designed with careful consideration for safety and efficiency, using innovative power solutions and shared infrastructure to keep costs down while maintaining reliability (Xiong'an New Area Development and Construction Administration, 2017).

The smallest but equally crucial components are the indoor distribution rooms –the capillaries of the digital circulatory system. These rooms ensure that every corner of every building maintains a strong connection to the network. They're strategically placed throughout structures, with careful calculations determining their placement – one room for every hundred thousand square meters of building space, or every few kilometers in underground transport systems. It's like having a miniature data center on every few floors, ensuring that whether you're in the basement or the top floor, you're always connected (Xiong'an New Area Development and Construction Administration, 2017).

What's particularly fascinating is how Xiong'an has reimagined the traditional approach to cellular infrastructure through its innovative "sky feed system.[9]" Instead of dotting the landscape with conventional cell towers, the city has pioneered a towerless concept

[9] Translation from Chinese may not be accurate. Could be translated into towerless system

that integrates communication equipment seamlessly into the urban fabric. Antennas and base stations are artfully concealed within building features, transforming ordinary structures into silent enablers of connectivity. It's like giving buildings a second job – during the day they might be offices or apartments, but they're always working to keep the city connected (Xiong'an New Area Development and Construction Administration, 2017).

The technical specifications that underpin this entire infrastructure are precise yet flexible. Take the library system, for instance, where signal distribution points are spaced like a carefully arranged bookshelf, maintaining exact distances to ensure optimal coverage. Or consider healthcare facilities, where the infrastructure must perform an intricate ballet around sensitive medical equipment, maintaining crucial separation distances while ensuring uninterrupted connectivity [54].In sports venues and exhibition centers, the system adapts to handle massive crowds, with signal strength carefully calibrated to maintain connectivity even when thousands of people are sharing the same space. Educational institutions get their own specialized treatment, with infrastructure designed to support dense concentrations of tech-savvy users while maintaining the flexibility to grow with future needs (Xiong'an New Area Development and Construction Administration, 2017). What makes this all work together is the attention to future-proofing. Every duct, every cable path, every power system is built with tomorrow in mind, maintaining generous reserves for expansion. It's like building a highway with extra lanes that aren't needed yet but will be crucial in the future. The power systems are designed to keep running even when the main grid falters, with backup systems that can maintain operations for days if needed.

This intricate web of technology, hidden behind walls and beneath streets, forms the foundation of Xiong'an's smart city ambitions. It's a testament to human ingenuity – how we can take something as complex as data infrastructure and weave it so seamlessly into the urban landscape that most people never even notice it's there. Yet this invisible system touches every aspect of city life, from the smartphone in your

pocket to the traffic lights at the intersection, working tirelessly to keep the digital heart of the city beating strong.

3.3 The Construction Sites

In Xiong'an, construction sites have evolved into living, breathing digital ecosystems where every grain of dust, every movement, and every decision is carefully monitored and optimized. These aren't just places where buildings rise from the ground – **they're sophisticated operations where artificial intelligence, Internet of Things sensors, and cloud computing come together to create something extraordinary.**

Figure 17. A carbon emission supervision platform in Xiong'an New Area (03/ 18/ 2022)

Source: http://en.people.cn/n3/2022/0401/c90000-10078515.html

Walking onto one of these sites feels like stepping into the future. Scattered throughout the area, nearly invisible sensors keep a constant watch on everything from dust levels to noise pollution. These sensors are constantly measuring temperature, humidity, and water quality with remarkable precision. When dust levels climb too high, they don't just record the data – they spring into action, triggering automated systems to dampen the area. This happens in real time, around the clock to protect both workers and the

surrounding community (Xiong'an New Area Development and Construction Administration, 2017). The communication network binding these sites together is impressively robust. Whether through traditional wired connections or cutting-edge wireless technologies, data flows continuously from every corner of the site. These systems don't just work in perfect conditions – they're built to handle whatever nature throws at them, maintaining their vigilance through dust storms and downpours alike. This network can be described as a digital nervous system that extends throughout the entire construction site, with each sensor acting as a nerve ending feeding information back to the brain.

Figure 18. An engineer expounds on the building information modelling (BIM) technology in Xiong'an New Area (03/ 29/ 2022)

Source: http://en.people.cn/n3/2022/0401/c90000-10078515.html

Security at these smart construction sites goes far beyond traditional fences and guards. Every piece of information is encrypted, verified, and protected by multiple layers of security protocols. A digital vault is in place where every piece of data is carefully

catalogued and protected, accessible only to those with proper authorization. The system even segments different types of information, creating separate secure channels for various kinds of data, different secure tunnels for different types of information, each with its own unique key (Xiong'an New Area Development and Construction Administration, 2017).

The video surveillance system deployed across these sites is nothing short of remarkable. These aren't your typical security cameras – they're more like digital observers equipped with night vision, thermal imaging, and the ability to analyse behaviour patterns in real-time. Using artificial intelligence, these systems can distinguish between normal construction activities and potential safety risks, automatically alerting site managers when something seems amiss. They can even work with drones and augmented reality glasses, creating a comprehensive view of the site that can be accessed from anywhere in the world (Xiong'an New Area Development and Construction Administration, 2017).

Managing the flow of people and vehicles through these sites is a task fully automated and completed by sophisticated digital systems. Workers are identified and tracked through real-name authentication, ensuring that everyone on site is authorized and properly trained for their role. It's like having a virtual site manager who never sleeps, constantly monitoring who is where and making sure everyone is where they should be. For vehicles, smart systems recognize license plates automatically, track movement patterns, and even ensure that trucks are properly cleaned before leaving the site to minimize dust spread into surrounding areas (Xiong'an New Area Development and Construction Administration, 2017). Quality control and safety compliance take on new meaning in these smart construction sites. Imagine a system that can predict potential safety issues before they become problems, automatically triggering alarms and mitigation measures when needed. Environmental monitoring is particularly sophisticated – sensors continuously check for dust, noise, and pollutants, automatically activating suppression systems when levels exceed acceptable thresholds. It's like having an environmental control room that never sleeps, constantly adjusting

and fine-tuning to maintain perfect conditions (Xiong'an New Area Development and Construction Administration, 2017).

Behind all of this activity lies a powerful cloud computing infrastructure that serves as the site's brain. This digital command center processes vast amounts of data in real-time, enabling managers to make informed decisions based on actual conditions rather than guesswork. The cloud architecture allows for seamless scaling as project needs change, ensuring that computing resources are always available when and where they're needed originated from a supercomputer that grows and shrinks with the project's needs, always maintaining peak efficiency (Xiong'an New Area Development and Construction Administration, 2017).

What makes Xiong'an's approach truly revolutionary is how all these elements work together in perfect harmony. Each sensor, camera, and system is part of a larger whole, creating a construction environment that's not just smart, but truly intelligent. The result is construction sites that are safer, more efficient, and more environmentally friendly than ever before. Workers benefit from enhanced safety measures, managers have unprecedented control and visibility over operations, and the surrounding community is protected from traditional construction impacts like dust and noise.

Xiong'an's smart construction sites represent a fundamental shift in how we approach urban development, setting new standards for efficiency, safety, and environmental responsibility. As cities worldwide grapple with the challenges of rapid urbanization, these smart construction sites offer a glimpse of how technology can help us build better, smarter, and more sustainably (Xiong'an New Area Development and Construction Administration, 2017).

Figure 19. Various Stages from Xiong'an Construction

Source: Planning and construction of Xiong'an New Area: Contributions of China's geologists and urban geology (Han et al., 2024).

3.4 The city

3.4.1 The Buildings

Xiong'an is undertaking an impressive transformation to become a truly "smart" city, where buildings don't just stand still – they think, communicate, and adapt. At the foundation of this vision is a sophisticated network system that combines both public and private networks. While everyday residents will use standard 4G/5G networks like we're all familiar with, critical services like hospitals and emergency response teams will have their own secure, private networks – ensuring they can always communicate when needed (Xiong'an New Area Development and Construction Administration, 2017). The buildings themselves are getting a complete technological overhaul. Each structure will be equipped with crystal-clear intercom systems and public announcement capabilities, along with perfect cellular coverage that extends even underground. It's essentially giving each building its own nervous system, allowing it to sense and respond to what's happening inside and around it (Xiong'an New Area Development and Construction Administration, 2017).

Safety is a primary focus in this smart city design. The buildings will be equipped with high-definition cameras featuring night vision capabilities, intelligent fire detection systems, and smart parking solutions that can guide drivers to empty spots. These systems work together like an invisible, tireless security team that's always on duty, monitoring and protecting the people inside (Xiong'an New Area Development and Construction Administration, 2017). The city planners haven't forgotten about structural health either. Each building will have sophisticated sensors that can detect even minimal tilting or vibration, while environmental monitors keep track of air quality. Energy meters will constantly monitor power usage, making it similar to having a fitness tracker for buildings – always keeping an eye on their structural and operational health (Xiong'an New Area Development and Construction Administration, 2017). Environmental control takes a major leap forward in this system. The buildings will feature intelligent temperature and humidity controls that can automatically

balance energy use with comfort levels. These systems track water and power consumption in real time, making adjustments as needed to maintain optimal conditions while minimizing waste (Xiong'an New Area Development and Construction Administration, 2017). Perhaps most impressively, all these systems are interconnected through a secure cloud network, creating what amounts to a "building brain" that can make intelligent decisions about safety, comfort, and energy use. This comprehensive approach transforms ordinary buildings into smart, responsive environments that contribute to a more efficient and comfortable urban space, all while maintaining a strong focus on environmental responsibility and energy conservation (Xiong'an New Area Development and Construction Administration, 2017).This massive undertaking in Xiong'an represents more than just technological advancement – it's a glimpse into the future of urban living, where every building plays an active role in creating a safer, more comfortable, and more sustainable city environment. It's like upgrading from a collection of individual buildings to a living, breathing ecosystem where everything works together in harmony (Xiong'an New Area Development and Construction Administration, 2017).

Figure 20. A view of Rongdong District in Xiong'an New Area (03/ 31/ 2022)

Source: http://en.people.cn/n3/2022/0401/c90000-10078515.html

3.4.2 The Roads

The roads in Xiong'an are not just pathways, but intelligent networks that can think, communicate, and adapt to everything happening on them. The IoT (Internet of Things) road system is designed on the principles of "human-vehicle-road" collaboration, where every element of traffic works together seamlessly. These smart roads will be equipped with an impressive array of sensors and monitoring systems. They'll be able to detect everything from the weight of vehicles passing over them to the moisture in the road

bed that might cause problems later. The roads will even monitor their own health, sensing if they're developing structural issues or if ice is forming on the surface. Traffic management takes on a whole new meaning within this ecosystem. Advanced cameras and sensors will watch traffic flow, count vehicles, measure speeds, and even keep an eye on pedestrians. These aren't just ordinary cameras – they're sophisticated devices that can see in the dark, identify license plates, and detect traffic violations automatically. The weather plays a crucial role in road safety, so Xiong'an isn't leaving anything to chance. Their roads will be equipped with various weather monitoring systems – from rain gauges to air quality sensors. When bad weather approaches, the system can **immediately alert drivers and dynamically suggest safer routes or speeds.** This proactive approach to safety could potentially prevent accidents before they happen (Xiong'an New Area Development and Construction Administration, 2017).

Figure 21. An intelligent vendor vehicle in Xiong'an New Area (03/ 31/ 2022)

Source: http://en.people.cn/n3/2022/0401/c90000-10078515.html

One of the most visible elements of this system will be the multifunctional poles placed along the roads. These aren't ordinary street lights, but smart towers that combine traffic lights, cameras, sensors, and information displays all in one. They'll serve as the backbone of this intelligent road network, collecting data and communicating important information to drivers in real-time (Xiong'an New Area Development and Construction Administration, 2017)

Figure 22. The intelligent lampposts in Rongdong District of Xiong'an New Area (03/ 31/ 2022)

Source: http://en.people.cn/n3/2022/0401/c90000-10078515.html

All of this technology, yet again, works together through a sophisticated communication network that ensures every piece of information is secure and gets to where it needs to go. When an incident occurs – whether it's an accident, a traffic jam, or dangerous weather conditions – the system can immediately adapt. Traffic lights can

adjust their timing, drivers can be alerted through digital displays, and emergency services can be dispatched more efficiently.

This comprehensive approach to road infrastructure represents a fundamental shift in how we think about transportation. Xiong'an isn't just building roads; they're creating an intelligent transportation ecosystem that can think for itself, adapt to changing conditions, and actively work to keep everyone safer and moving more efficiently. It's a glimpse into the future of urban transportation, where every journey is safer, smoother, and more predictable thanks to the power of connected technology (Xiong'an New Area Management Comitee, 2020; Xiong'an New Area Development and Construction Administration, 2017).

3.4.3. Infrastructure Sharing

Imagine building a city where every piece of infrastructure works together like a well-orchestrated team. This is exactly what Xiong'an is doing with their smart city plan. Instead of different departments building their own separate networks – which would be like everyone digging up the streets to lay their own pipes – they're taking a "share and share alike" approach. Phone companies, transport authorities, and utility providers all use the same infrastructure, making the **city both more efficient and less cluttered.** Rather than installing new poles just for smart city equipment, they're making existing structures pull double duty. Street lights and road signs become high-tech multitaskers, hosting everything from internet equipment to environmental sensors.

Underground, there's an equally impressive system taking shape. Think of it as the city's nervous system – a network of fiber-optic cables and junction boxes that carry data instead of electrical impulses. These aren't just any cables and boxes though. They're built to be tough, protecting against everything from lightning strikes to flooding, and they're designed with growth in mind. It's like building a highway with extra lanes that you might not need today but will be grateful for tomorrow. The way these cables are laid out is carefully planned too. They follow what engineers call a

"star-tree" pattern – imagine a tree where the trunk splits into branches, and those branches split into smaller ones. This makes the network easier to manage and fix if something goes wrong, just like how it's easier to find a problem branch on a well-organized tree (Xiong'an New Area Development and Construction Administration, 2017).

Perhaps most importantly, Xiong'an is thinking ahead. They know technology moves fast, so they're building their network with room to grow. They're leaving extra space – about 10-15% more than they need right now – for future technologies we might not even have yet. They're also putting small computing centers called "edge nodes" throughout the city. Think of these as mini-brain centers that can process information quickly right where it's needed, rather than sending everything to one central location.

Figure 23. A wireless charging pile at a charging station in Xiong'an New Area (03/ 18/ 2022)

Source: http://en.people.cn/n3/2022/0401/c90000-10078515.html

This forward-thinking approach means Xiong'an isn't just building for today – they're building a city that can grow and adapt as technology evolves, ensuring their smart city stays smart well into the future.

3.5 The Data Structure

The Xiong'an New Area's data resource catalogue specification embodies an ambitious vision for establishing world-class digital infrastructure. At its core, this specification provides the foundational framework for creating a sophisticated big data asset management system, with the ultimate goal of transforming Xiong'an into a world-leading digital city equipped with deep learning capabilities. The framework has been carefully designed to facilitate the seamless integration of diverse data types, encompassing **government data, location-based information, and urban operational data,** while maintaining robust protocols for authorized sharing and secure access (Xiong'an New Area Development and Construction Administration, 2017).

3.5.1 Resource Directory Structure

The specification implements a sophisticated multi-tiered directory system that efficiently organizes data resources through three distinct classification approaches. The primary classification encompasses departmental, subject-specific, and basic directories, creating a structure that enables both broad organizational oversight and granular data management while maintaining flexibility for future expansion. Departmental directories function as the organizational backbone of the system, managing resources based on provider responsibilities and institutional hierarchies. Subject directories focus on specific business domains or objects, enabling targeted access to specialized data sets and facilitating domain-specific applications. The basic directory layer serves as the foundation, housing fundamental government data that underpins broader data services and applications (Xiong'an New Area Development and Construction Administration, 2017).

Additionally, it introduces an intricate coding system that uniquely identifies each data resource through a three-part identifier structure. The front-end code, designated as 330003 for Xiong'an, establishes regional identity and administrative context. The middle code combines administrative division information (139900) with departmental categorization, providing a clear organizational structure. This is complemented by a unique back-end identifier that ensures individual resource tracking. This hierarchical coding structure ensures systematic organization while maintaining the flexibility necessary for cross-departmental data sharing and integration (Xiong'an New Area Development and Construction Administration, 2017).

Figure 24. A Xiong'an Data Frame

Format: [Front-end Code]/[Middle Code]/[Back Code]

1. Front-end Code (6 digits)
   - Xiongan New Area: 330003
2. Middle Code (10 digits)
   - Administrative division code (6 digits): 139900
   - Department category code (1 letter)
   - Department code (3 digits)
3. Back Code (5 digits)
   - Unique numerical identifier

Source: Xiong'an New Area Development and Construction Administration, 2017.

3.5.2 The Metadata Architecture

Xiong'an's data system can be described as a vast digital library, but instead of just books, it's managing every piece of digital information in the city. Just as a library needs a way to organize its books so people can find them, Xiong'an has created a sophisticated system to organize its massive amount of digital information (Xiong'an New Area Development and Construction Administration, 2017). At its heart, this

system is having a super-detailed label on everything. Each piece of data is having its own "ID card" that tells you exactly what it is, who created it, who can use it, and how to access it. These labels are written in both Chinese and English, making sure everyone who needs to use the system can understand it. It's similar to how a library book has a card telling you its title, author, and where to find it on the shelves (Xiong'an New Area Development and Construction Administration, 2017).

The system is particularly clever about how it handles different types of data. Whether it is information stored in databases, files like documents and spreadsheets, or even multimedia content like videos and images, everything has its own place and description (Xiong'an New Area Development and Construction Administration, 2017).

Security is a major priority in this digital library. Not everyone can access everything – there's a careful system of permissions and access controls in place. One can think of it like having different library cards that give different levels of access, from basic browsing to full administrative privileges. Every time someone accesses the data, it's tracked and recorded, ensuring everything remains secure and properly used.

Behind the scenes, there's a whole team of people making sure this system runs smoothly. You have data providers who are like the publishers, making sure their information is up-to-date and accurate. System operators are like librarians, keeping everything organized and running smoothly. Users are like library patrons, accessing the information they need through proper channels. And there are supervisors who make sure everything follows the rules and regulations (Xiong'an New Area Development and Construction Administration, 2017). The system is built to grow and adapt over time. Just as libraries had to adapt from card catalogs to computer systems, Xiong'an's data system is designed to incorporate new technologies as they emerge. It can handle real-time data sharing, batch processing of large amounts of information, and even integrate with other systems across different platforms.

What makes this system particularly impressive is its attention to detail while remaining practical and usable. It's like having the organization of a major research

library combined with the user-friendliness of your local public library. Everything is carefully labelled, tracked, and secured, but still accessible to those who need it.

This complete, innovative and comprehensive approach to managing city data is crucial for Xiong'an's development as a smart city. It ensures that all the digital information flowing through the city – from traffic data to utility usage to public services – is properly organized, secured, and accessible to those who need it, creating a foundation for a truly modern, digital city.

3.5.3 The Data Security Infrastructure

Figure 25. The intelligent operations center in Rongdong District of Xiong'an New Area (03/ 29/ 2022)

Source: http://en.people.cn/n3/2022/0401/c90000-10078515.html

As previously described, Xiong'an is a city where almost everything is connected and digital. While this creates amazing possibilities, it also means that extremely strict security system to be in place in order to protect that treasure trove of digital

information. This is exactly what Xiong'an is doing with their comprehensive data security system.

This security system is having multiple layers, like an onion. At its core, it's designed to make sure all the city's data is manageable, controllable, and trustworthy. Every piece of information, from the moment it's collected to the moment it's deleted, is protected by sophisticated security measures. It's like having a security escort that follows each piece of data throughout its entire journey.

The first line of defence starts right at the point where data is collected. Whether it's a traffic camera, a smart meter, or any other device collecting information, there are strict security protocols in place. It's similar to having a highly secure entrance gate where everyone's identity must be verified multiple times before they're allowed in. The system uses powerful encryption – think of it as a super-complicated secret code that would take thousands of years for computers to crack.

When data needs to move from one place to another, it travels through what you might think of as **secure underground tunnels**. These digital pathways are heavily protected and monitored constantly for any signs of suspicious activity. The system is designed to move data quickly and securely, with strict rules about how fast it should travel and how it should be protected during its journey (Xiong'an New Area Development and Construction Administration, 2017).

Storage of data is handled with equal care. The data is encrypted multiple times, stored in multiple secure locations (so if one location has a problem, the data is safe elsewhere), and protected by both digital and physical security measures. Only people with the right clearance can access specific types of information, and every access attempt is recorded When it comes to sharing data between different organizations or systems, there are strict rules and procedures in place. A "diplomatic" protocol for information exchange is in place, where every transfer must follow specific security guidelines and leave a clear trail of who accessed what and when (Xiong'an New Area Development and Construction Administration, 2017).

Even when data needs to be deleted, there's a careful process to ensure it's completely and irreversibly removed, a digital “paper shredder” that doesn't just cut the paper into strips, but completely disintegrates it so it can never be reconstructed.

The human element isn't forgotten either. Everyone who works with the system must undergo specific training and follow strict security protocols. There are clear procedures for what to do if something goes wrong. To make the system even more secure, Xiong’an is using cutting-edge technologies like blockchain – among others accommodating the digital yuan, which is being used to pay construction workers’ wages (Rogers, 2023, Xiong’an New Area Development and Construction Administration, 2017; Song *et.al.,* 2023).

To conclude, this approach to security shows how seriously Xiong’an takes the protection of its digital assets. It's not just about building a smart city; it's about building a safe smart city where people can trust that their information is protected at every step of the way.

4. Urban Challenges: Athens *vs* Beijing

During the previous parts of this study we had the chance to review the actions of the Chinese state towards the problems that its capital city was facing. At this part, we will become more creative. At the first part of the section, we will highlight some of the main problems that Athens is currently facing, we will draw a small parallel line with the problems of Beijing as a capital city and then we will attempt to benchmark Athens with Beijing and as a result Xiong'an. It is important to note here, that this paper maintains that Xiong'an was created as a result of Beijing's sickness. Additionally, this benchmark comes with a lot of challenges. Firstly and most importantly, Xiong'an in being developed right now and Athens has already thousands of years of history. Secondly among others, China has a lot of money to spend, since it's a robust economy, while Greece is far behind in terms of economic prosperity. Thirdly, Chinese bureaucracy is more mature and effective than the Greek one. Moreover Greece is a part of the European Union and certain policies are being directed[10][11]. Without criticizing these directives, Greece does not have the same autonomy as China, since it's a part of a greater union of countries. There are a dozen more differences between the two cases in economic, political and institutional levels, but the objective here is simply to learn from the best. In order to do so, one must first look himself in the mirror, identify the issues and then look at the best practices and the most effective solutions. China half a century ago was a totally different country. Today it is leading the global innovation race and has achieved astonishing results in each and every field of global competition, including smart city development- in a nutshell -actions speak louder than words (Siemens, 2019; Wainwright, 2014).

[10] E.g. New European Bauhaus (European Commission, 2024) or BIM for the European Public Sector (EU BIM TASK GROUP, 2017).

Having raised that concern, Athens is a city of nearly 700,000 people at its heart, surrounded by a broader metropolitan area of 3.75 million residents. “The birthplace of democracy” as it is many times called, is facing a complex web of challenges that touch every aspect of urban life. On the same par, Beijing is the Capital city of China with equivalent historic value and roughly 21 million residents. Additionally, there are estimates from 2013 that more than 5.000.000 migrants had moved to Beijing till 2013, 67% of them living mainly in Suburban areas and within 5.6 m2 floor space (Yu and Cai, 2013).

Both cities are facing a rapid urbanization surge. This rapid urbanization has generated significant challenges across environmental, social, economic, and cultural dimensions. This analysis examines these interconnected issues and their implications for sustainable development.

4.1 Rapid Population Surge

In china the rate of urbanization from west to east is described as the new great leap forward with the similar potential for disaster (Cao S., et.al., 2014). Too many people are moving to the coastal east to find jobs and make a living. Similarly in Athens the job opportunities and the chances of a better life lead to the concentration of almost half the Greek population within Attica region. On top of that Athens has two additional issues to manage. The first is tourism and the second is immigration from warzones. During 2015-2016, the city received an influx of refugees that exceeded its own population. While this strained city services, Athens chose to see this as an opportunity rather than just a challenge. A lot of effort is put to integrate newcomers into the fabric of the city, recognizing that new residents can bring fresh ideas, skills, and energy to help revitalize the community (Dalakoglou, 2014). Yet this is a struggle that technology and smartness could help, but no significant actions were made on that front. Tourism on the other hand, somehow is self-explained. Approximately more than 30 million passengers travel through Athens Airport every year, with a huge proportion of them coming through Athens (GTP Headlines, 2025). The challenge of balancing

tourism development with heritage conservation increases the complexity of cultural preservation in an urbanizing context. Moreover, the rural-urban cultural disconnect continues to widen, threatening the intergenerational transmission of cultural knowledge and practices, in simple words, people forget their roots and their heritage.

The challenges of urbanization in both China and Greece require a sophisticated, multi-sectorial approach encompassing urban planning, infrastructure development, and environmental management. The complexity of these issues demands coordination across multiple governance levels, from national to county administration. Success in addressing these challenges will depend on developing integrated solutions that balance economic development with environmental protection, social equity, and cultural preservation (Dodman *et.al.,* 2017)

4.2 Access to Housing

Access to housing in both Athens and Beijing is a hot topic. Rising property prices, urban density, and limited land availability are shared obstacles (Karadimitriou *et.al.,* 2021; Nickayin *et.al.,* 2020). The rate of homelessness is increasing in the case of Athens and young couples find it difficult to find a place to start a family. Housing is the core of the family and Greece is facing another issue that isn't present in China at that magnitude. It is the rapidly declining and aging population. The perfect storm is gathering when everyone is moving to Athens, abandoning rural Greece, and then realizing that housing is simply not there for them. With prices through the roof and wages being lower than most European countries a social bomb is ticking faster and faster. It will not be unreal for the years to come, for Athenians to live in 6 square meters of floor space.

4.3 Scarcity of Resources

Climate change-induced reduced rainfall in Greece has led Athens authorities to urge residents to conserve water as the capital faces increasing water scarcity. The Athens

Water Supply and Sewerage Company (EYDAP) has activated reservoirs to bolster supply but warned that declining water levels could worsen without sufficient rain or snowfall this winter -2025. EYDAP's Managing Director highlighted the urgency of the issue, while the Environment and Energy Ministry is exploring environmentally friendly solutions, including constructing new reservoirs, to address potential future droughts. The €5.9 billion initiative, presented by Environment and Energy Minister, focuses on sustainable water management, infrastructure improvements, and climate resilience. Greece ranks 19th globally in water stress, with irrigation accounting for over 80% of water use and significant losses due to outdated infrastructure. Athens' water utility, reported that water reserves have dropped dramatically, prompting €400 million in planned investments to improve network efficiency. Additionally, €200 million will be allocated for wastewater management and desalination, with €80 million earmarked for urgent repairs (EIB, 2024; AMNA, 2023; Sachinis, 2024).

Athens is an example of a very large city; indicatively, it hosts the 30% of the population of Greece and generates 47.3% of the GDP of Greece. However, the catchment area contributing to the water supply system is about 3% of Greece. -Sargentis et. al., 2019

In par, water resources face equally serious challenges in China. Assessments reveal that 19.8% of major rivers are suitable only for industrial or agricultural purposes, while approximately 60% of groundwater sources exhibited poor quality by 2013. The situation is exacerbated by the uneven distribution of water resources, particularly affecting northern regions, where increasing urban demand intensifies existing scarcity issues (World Bank, 2011; The Guardian, 2024).

For that reason China has invested heavily in artificial rain since the late 1950s. The country 10 years ago boated a battery of 7,000 cloud-seeding artillery guns, the same

number of launchers for chemical-bearing rockets, and more than 50 planes – all manned by an army of 50,000 employees, ready to launch full-scale warfare on the weather (Wainwright, 2014).

Adding insult to injury, a relatively new phenomenon in Athens is energy poverty. Especially after the Russian –Ukraine Conflict energy prices have skyrocketed increasing the problem with energy consumption. Energy consumption patterns reflect the environmental strain of urbanization in China too. The country's rapidly increasing energy demands, projected to reach 4.7 billion ton coal equivalents by 2020, coupled with regional disparities in energy efficiency, pose significant challenges for sustainable development.

Land resource management presents another critical concern (Wang X. et. al., 2024). Since 1979, China has experienced a 10% reduction in arable land, with documented losses of 12.4 million hectares between 1980 and 2008. This decline stems from inefficient land utilization and the conversion of agricultural areas to industrial and residential purposes, contributing to rural decay (Wang *et.al.,* 2024; The Project Group of "Evaluation, Regulation and Promotion of Carrying Capacity of Resource and Environment of Xiong'an New Area," 2017). Athens is not different in that respect, the study of Mela A. *et.al.,* (2024) examined the availability and accessibility of outdoor public spaces across Attica's administrative sectors. On average, only 37.25% of respondents felt their neighbourhoods provided adequate public spaces, while only 15.2% found them abundant, and 18.7% expressed dissatisfaction. Residents in the northeast of Attica reported higher satisfaction with the availability of public spaces, likely due to the suburban character and differences in city planning. Accessibility showed no stark differences across Attica; however, newly developed suburban areas in eastern Attica were less efficient in accessibility compared to metropolitan Athens and Piraeus. Overall, suburban areas in the northeast exhibit better availability, but accessibility remains a challenge in some newer developments.

> *"Rural places at the fringe of Athens were instead destroyed, fragmented, or heavily damaged, irrespective of the high landscape quality and considerable biodiversity stock, simply because of their proximity with developmental axes…A particularly important issue is that economic development and environmental protection policies were spatially delinked, not only in past planning experiences, —at least in some ways—also in current strategies, with a partial connection with social cohesion issues.*
>
> *In other words, economic development and environmental protection were (and, in some aspects) still are seen as spatially distinct priorities" - (Nickayin et.al., 2020)*

At the end, the lack of commitment on a urban sprawl strategy – a coordinated urbanism movement- for Athens remains a critical problem with inconsistency between goals and operational implementation tools acting as a hindrance to any relevant effort (Chorianopoulos *et.al.,* 2010; Skayiannis 2013; Asprogerakas 2016, 2018; Pagonis, 2019).

4.4 Environmental Challenges

Athens is also grappling with environmental challenges that would seem familiar to many modern cities, but with unique local twists. Rising temperatures turn the city into an urban heat island, while poor planning has left it vulnerable to flash floods. The city's infrastructure is showing its age in every fluctuation of the weather conditions. The Fili landfill is overflowing, water systems are leaking, and traffic congestion has become a daily headache for residents. Water supply, as discussed earlier, is poorly

managed and problematic leading to a predicted water crisis in the years to come (Dalakoglou, 2014)

The environmental impact of urbanization in China manifests primarily through severe air pollution, water degradation, land resource depletion, unsustainable energy consumption, and ecosystem disruption. Atmospheric quality has deteriorated substantially in urban areas, with data indicating that 48% of urban residents inhabited cities failing to meet basic air quality standards as of 2006. The predominance of coal, constituting 75% of energy sources, has resulted in elevated emissions of various pollutants, including PM2.5, SO2, NOx/CO, O3, and CO2. Furthermore, ecosystem degradation has reached concerning levels. The extinction of over 200 plant species since the 1950s, combined with accelerating soil erosion and increased frequency of natural disasters, indicates severe ecological disruption. Urban heat island effects and altered precipitation patterns further compound these environmental challenges (Coberlotto, 2018).

4.4.1 Health and Social Concerns

A recent study by the Institute of Demographic Research and Studies (IDEM) has shed light on a growing social divide in Athens, reflected starkly in mortality rates. The findings reveal that life expectancy differs drastically between the city's wealthier northern and southern suburbs and the working-class areas of western Athens, central Athens, and Piraeus.

In 2021, mortality rates stood at 14.9 per 1,000 in Piraeus, 14.1 in central Athens, and 13.9 in western Athens—substantially higher than the 11.8 in the southern suburbs and 10.9 in the northern districts. The financial crisis that began in 2010, coupled with the Covid-19 pandemic, marked a turning point, reversing years of progress in reducing mortality.

Experts link these disparities to economic hardships and uneven access to healthcare. High private healthcare costs have forced many lower-income residents to forgo

treatment, exacerbating health inequalities. Poorer districts also face added burdens from substandard housing, harsher working conditions, and environmental hazards such as higher pollution levels from traffic and industrial activities (Ekathimerini, 2025).

The social ramifications of urbanization are equally profound in China. Public health has emerged as a primary concern, with air pollution alone accounting for 1.6 million deaths in 2015. The incidence of lung cancer has increased dramatically, showing a 464.8% rise between 2004 and 2005. Climate change-induced health impacts and respiratory diseases further burden the population (Coberlotto, 2018).

4.5 Modernizing Old Infrastructure

The challenge of modernizing both Cities (Athens and Beijing) comes with the risk of taking away their historical beauty and that is another considerations among many others that one has to take into account. Technology modernization means new infrastructure that has to be installed over new buildings, or below the ground. Digging an old and overpopulated city is a hard task to do and brings certain limitations on the table that are not there when building from scratch. This is a critical consideration for both Athens and Beijing. The task of modernizing an old city comes with the same risks as modernizing an aeroplane while flying and it is totally different than landing the plane and making the changes, or even building an aeroplane from scratch. For example, we currently possess the knowledge that UAM service infrastructures cannot be installed in Athens due to Spatial Constraints (Perperidou & Balta, 2024). These critical considerations have to be put in the decision making process in order to tackle the riddle of making Athens smarter.

4.6 Financial *&* Institutional Considerations

Greece has weathered severe economic storms in recent years. The global financial crisis hit Athens particularly hard, transforming it from a growing economy into one struggling with widespread unemployment and poverty. The impact rippled through

every aspect of city life, affecting everything from housing to basic services. The wealthy moved to the suburbs, creating what is called "islands of prosperity" surrounded by areas of increasing hardship. This divided the city not just economically, but socially as well (Dalakoglou, 2014).

Moreover, from an institutional perspective the governance of Athens faces its own set of challenges. Picture trying to coordinate a massive project where different departments don't communicate effectively with each other (Asprogerakas, 2016). That's similar to Athens' situation, where overlapping jurisdictions and limited transparency make it difficult to implement city-wide improvements. The city is working to modernize its management systems, but it's like trying to update an old computer while still using it – it needs to be done carefully and systematically.

In Beijing, migration of workers presents significant social challenges by restricting access to welfare services for migrant workers. This institutional barrier has created a substantial "floating population," reaching 5 million individuals by 2012, who face limited access to essential services, housing and social inequality (South China Morning Post, n.d. ; Zhao et al., 2013; Caberlotto, 2018)

4.7 Athens “smart” Transformation

To address these challenges, Athens is embracing technology in creative and cost efficient ways. A list of the technologies used in Athens can be found on the table below.

Table 5. List of smart city implementations in Athens

Category	Factor	Implementation/Details
Traffic/Mobility	Maps and Navigation	Google Maps and Bing Maps available
	Digital Transport Applications	OASA Telematics (oasa.gr/telematics)

	Mobile Apps	OASA, Moovit
	Parking Guidance Systems	Coverage not specified
	Electric Bus Bulletin Board	Coverage not specified
Health	Hospital Location Services	Google Maps integration
	Digital Medical Appointments	FindDoctors.gov.gr
	Pharmacy Locations	Google Maps integration, fsa-efimeries.gr
	Remote Medical Care	Various platforms (e.g., drtsoukalas.com)
	Health Data Analytics	Ministry of Health (moh.gov.gr)
	Healthcare Platforms	EOPYY (eopyy.gov.gr), IDIKA (idika.gr)
Government	Digital Document Requests	KEP Services (aitiseis-kep.services.gov.gr), City of Athens Services
	Digital Banking	All Greek banks offer digital services
	Retirement Services	EFKA (efka.gov.gr)
	Digital Cadastre	Ktimatologio.gr
	E-Government Services	Gov.gr
	City Planning	GIS e-poleodomia

Education	Remote Learning	Hellenic Open University (eap.gr), IEP Platform, Ministry of Education platforms, e-class, Athena.net.gr
Recreation/Tourism/Culture	Tourism Information	TripAdvisor, Various public and private platforms
	Virtual/AR Experiences	COSMOTE Chronos Acropoli, Foundation of the Hellenic World, Google Maps Live View
	E-Commerce	Wolt, e-food, Skroutz.gr
	Internet Coverage	COSMOTE, Vodafone, Nova coverage maps
	Digital City Representations	Google Earth, Bing Maps, OpenStreetMap
	Cultural Institutions	SNFCC, National Gallery, EMST, National Museum
	Digital Ticketing	More.com
Infrastructure	Utility Management	EYDAP (water), DEI (electricity)
	Street Lighting	AI-powered adaptive lighting on motorways
	Toll Systems	Various e-pass systems, MyOdos app
	EV Charging	Chargemap
	Internet Access	WiFi Map available
	Data Sharing	City of Athens GIS,

		Statistics.gr
	Smart Home Integration	Limited implementation
Environment	Environmental Monitoring	EMY (weather), Various apps
	Environmental Applications	Blue Flag program
	Weather Forecasting	Meteo.gr
	Surveillance Systems	Skyline webcams
Security	Cybersecurity	Hellenic Police Cyber Crime Division
	Smart Police Allocation	Not specified
	Drone Patrols	Not specified

Source: Pantazis et. al. 2024

A group of researchers from University of West Attica (Pantazis et. al., 2024) made a detailed approach to the evaluation of the smartness of the city concluding that smartness can be made in relative terms by giving high bandwidth to the city from the infrastructure perspective, while the municipality or the government intertwine with the private sector interests into shaping the smartness of the city (Pantazis et. al. 2024). From the authors' perspective and by adopting a rigorous approach to the interpretation of the presented table, city of Athens **cannot be described as highly smart** at least when compared with the Chinese Standards (Janus, 2021). On the contrary, this paper maintains that these results are truly astonishing, albeit in a disheartening manner. The list consists of mainly private businesses that promote their own agenda and websites that deliver baseline or commercial information in relative real time. Smart means sensors, Smart means automations and smart means pro-activeness which is merely present in an Athenian environment. Adding insult to injury, on the indexes that were taken into consideration remote education and the e-classes of universities which is already a 20 year old innovation as well as a digital ticketing system which is a private company are present. That evaluation of how smart is Athens, can be a separate paper itself and not the objective of this research. It depends on the benchmarks that one uses and the aspirations that one possesses. Still, this thesis maintains that Athens by all respects has become ‘dumber’ in 2025 standards.

Conversely, this thesis benchmarks Athens with the best and has high ambition in motivating change towards that direction. The following sections aim to derive lessons for Athens to address these challenges. A response that shows a city determined to reinvent itself while respecting its heritage. A proposed list of strategic considerations that address everything from climate change to social inequality through perhaps mimicking best practices or leapfrogging to certain technologies. A grand reinvention – taking the wisdom from the far east and combining it with modern solutions to create a more resilient, smart and futureproof city, perhaps near Athens.

This thesis believes that the city's transformation isn't just about identifying problems and writing endless resilience guides about how things could be done in theory; it's about reimagining what a historic city can be in the modern world. Through a rigorous identification of current challenges, an objective assessment of the situation as it stands, a pragmatic acknowledgment of what is feasible, and the strategic utilization of our academic institutions and intellectual resources, combined with a commitment to prioritize collective progress over profit and personal ambition, we must embrace innovation and translate it into actionable strategies. These efforts should culminate in a realistic plan that will guide us effectively in the years to come. Beijing and Athens are both historic cities, but their histories differ significantly in terms of age, cultural influence, and global context. Nevertheless, both cities stand as testaments to their respective cultural and historical trajectories and both cities face significant challenges in terms of the ‘big city disease’ (Ni P., 2017). What we know is that the Chinese State responded to the challenge by developing a new city to relief Beijing. The Overall strategy followed can be generalized into the following lessons.

5. Counterfactual Analysis, Benchmarks & key takeaways

During the following lines, of the thesis a counterfactual analysis will be made within the concept of a techno-economic paradigm (Green *et.al.,* 1999). This analysis raises the question what if, the solution to the "big city disease" of Athens, would be the development of a new smart city in relative close proximity to Athens. Based on the findings, the Chinese State did exactly that. Instead of further bolstering Beijing with such passion, they tried to relieve it and move forward. Greece of course is different in many respects. Firstly, there are rural areas that could support decentralized regional development and that would also be a valid alternative to the problem. Moreover, the Population of Athens and Greece is much lower than this of China. If at the end of the day, the solution for Athens would be to move people out, another analysis should be made comparing these two counterfactual scenarios – build one new city and move people there vs recuperate rural villages of Greece and move people there. Given the scope of this thesis, a comprehensive analysis of this issue is not feasible. However, it is an important area that warrants further investigation in future research. Nevertheless, there was a smart city project in Athens taking place approximately at the same time when Xiong'an was being initiated. Inevitably, one cannot ignore the case of the Hellinikon project that could play the role of Xiong'an New Area within a Greek context.

5.1 Counter-factualizing the Neoliberal Concept

5.1.1 The Hellinikon Project

"Neoliberalism hinges upon the active mobilization of state power."

- Brenner & Theodore, 2005

At the outset of this thesis, we examined the neoliberal approach to smart city development and its implications for urban transformation, social equality, and institutional deregulation. The Hellinikon project serves as a compelling case study that exemplifies these theoretical insights.

Situated strategically along the southern coast of Attica, proximate to Athens, the site formerly served as the nation's primary airport, encompassing substantial acreage of both developed land and natural forest. In 2018, the property was privatized through its sale to Lamda Development, a transaction that diverged significantly from its public portrayal. According to prevalent media narratives[12], the private investor secured financing from Greek banking institutions and negotiated a decade-long payment structure valued at approximately 900 million euros (Financial Statement of Lamda Development for the fiscal year 2020, page 6 -7).

Table 6. Total Loans of the Private Investor for the Purchase and Development of Hellinikon

Financing Description	Loan Amount (€ million)	VAT Financing (€ million)	Duration	Banks Involved
Development of coastal zone,	442	100	Up to 10 years	Eurobank,

[12] There is a significant difference between paying the full price upfront and paying part of the price with the remainder deferred over a decade. Media often present the investor as having paid the full price upfront, while omitting the loans from Greek banks and the 10 year old payback period that is "subject to change" if things go wrong. This simplification may be for clearer communication, but it also obscures details with implications for the average Greek taxpayer. The same taxpayer has indirectly funded the reconstruction of Greek banks twice, during the 2012 and 2015 recapitalization programs, where taxpayer-backed funds were used to stabilize the banking system as part of broader bailout measures.

Financing Description	Loan Amount (€ million)	VAT Financing (€ million)	Duration	Banks Involved
residential and commercial infrastructure				Piraeus Bank
Development of a shopping mall on Vouliagmenis Ave.	415	86	Up to 6 years (extendable to 11 years)	Eurobank, Piraeus Bank
Development of a shopping mall in Agios Kosmas Marina	102	19	Up to 5 years (extendable to 11 years)	Eurobank, Piraeus Bank
Guarantee letter for cost overruns and reduced revenues	175	-	-	Eurobank, Piraeus Bank
Guarantee letter for the deferred payment to Hellenic Republic Asset Development Fund (HRADF)	307 - 347	-	Annual readjustment	Eurobank, Piraeus Bank

Total Loan (excluding guarantee letters): €959 million
Total VAT Financing: €205 million
Guarantee Letters: Up to €522 million

Source: Author's Notes based on the Annual Financial Report, January 1 – December 31, 2020.Pages 6 &7.

In the years following the acquisition, the developer has marketed parcels at prices reaching thousands of euros per square meter—a striking contrast to the original purchase price. Moreover, while failing to execute the complete scope of the proposed

development, the investor has begun selling portions of the property to secondary investors at premium rates (Naftemporiki, 2023; 2025).

"We want to bring life to the property earlier, and for this purpose, we are accelerating the investment plan through these sales. We cannot do everything on our own." Quote attributed to Mr. Athanasiou - CEO of Lamda Development (Roussanoglou, N., 2024)

While ethical considerations surrounding this transaction abound, legal implications fall outside this study's scope. Nevertheless, this research posits that the former airport site represented an unprecedented opportunity for the Greek state to save Athens' future—an opportunity that has been fundamentally altered by its privatization. This thesis argues that the site should have been utilized for the strategic urban decongestion of Athens for several reasons.

Firstly, the location's proximity to Athens' city center would have facilitated a natural and manageable population redistribution rather than a disruptive relocation. Secondly, such development could have assisted the systematic depopulation and subsequent restructuring of the city center. Instead, the current Hellinikon project threatens to exacerbate existing urban challenges. The development is likely to attract workers from throughout the Balkans, yet Greece's comparatively low wage structure makes it improbable that these workers could afford housing within Hellinikon area, where real estate prices are premium. Instead, they will likely seek accommodation in the urban core, where rents remain more accessible, thereby intensifying the "dual city" phenomenon.

Beyond demographic pressures, the development will strain Athens' already scarce water and energy resources. Furthermore, the Greek state has committed to implement

supporting infrastructure, compounding the public investment in this private enterprise. Moreover, Article 11 of the deal -Obligations of the Greek state - notes:

> *… the Greek State commits to compensate the Buyer and/or the Company in case of a State Liability Event, specifically: (a) State Delay Event, (b) Change of law which: (i) modifies Law 4062/2012, or (ii) increases the Company's environmental obligations (except those imposed by EU Law)*

To summarize the financial framework, the Greek state transferred 6.2 million square meters of prime coastal real estate for 915 million euros. The investor secured a 1.16 billion euro loan from Greek banks under domestic law. Following the 2021 deal closure and an initial 300 million euro payment, the remaining balance was structured over a decade. By 2024, citing implementation challenges, the primary investor began parcelling and selling portions to secondary developers for substantial premiums.

The project's 25-year development timeline (estimated delivery 2046) promises among others, a green oasis for everyone to enjoy, luxury residential units, a casino, private healthcare and educational facilities, retail complexes, and recreational spaces. Concurrently, the Greek state is implementing a 5 billion euro housing support program through 2027, focused on minor new development[13] but mainly on subsidizing the purchase of aging properties at inflated valuations—a strategy that may exacerbate rather than ameliorate housing challenges (Capital.gr, 2024).

In retrospect, this analysis suggests that an approach more aligned with China's Xiong'an New Area project might have better served Athens' needs, potentially offering superior environmental and social benefits while reducing state expenditure. Such an alternative could have addressed urban congestion while promoting sustainable development practices.

[13] 2500 houses are going to be built all over Greece.

Table 7. Snapshot of the Hellinikon Project

Aspect	Details
Location & Scale	6.2 million square meters Southern coast of Attica Former Athens International Airport site Strategic coastal position near Athens city center
Financial Structure	Total sale price: 915 million euros Initial payment: 300 million euros (2021) Payment plan: Remaining balance over 10 years Investor loan: 1.16 billion euros from Greek banks
Development Timeline	Project initiation: 2018 (sale agreement) Deal finalization: 2021 Total projected duration: 25 years Current status: Partial resale to secondary investors (2024)
Planned Facilities	Luxury residential complexes Casino Private hospital Private university Shopping mall Public park
State Involvement	Additional investment for supporting infrastructure Buyer Compensation in case of a State liability Event
Critical Concerns	Potential increase in urban center population density Strain on existing water and energy resources Housing affordability issues Workforce housing challenges

Aspect	Details
	Impact on Athens city center development
Price Dynamics	Original purchase: Less than 500 euros per square meter[14] Current resale: 2078 euros per square meter[15] Significant value appreciation within short timeframe
Socioeconomic Implications	Expected influx of Balkan workforce Potential intensification of urban inequality Housing pressure on city center Enhancement of "dual city" phenomenon

[14] Total Area is 6.2 million Sqm. 30% of that area will be built. Assuming the 915 million euros refer to that area (1,86 mil. Sqm), then the price paid per Sqm equals to 491.9355 euros.

[15] Based on Naftemporiki (2024), a total of 51.000 Sqm were sold for 106 mil euros. That equals to 2078.4314 euros per Sqm

5.1.2 The Housing Program Spiti mou 2

An “a posteriory” comparison of the Spiti mou 2 housing program and the Hellinikon Project will take place at this part of the thesis. While it was not initially the within the scope of the study, this analysis will further highlight, the inconsistency, lack of strategy and waste of resources from the Greek state. On the same time, this analysis will be factual evidence of the problems of Athens and why perhaps the former airport area can be described as a missed opportunity for the Athenians.

Table 8. Spiti mou II, High level financial framework

Field	Details
Total Budget	€2 billion (1 billion from the Recovery Fund, 1 billion from bank funds).
Loan Terms	Interest-free for 50% of the amount from the Recovery Fund, the remaining 50% at the interest rate of the respective bank. For special categories, the bank's interest rate is subsidized by 50% for the entire loan duration.
Income Limits	Minimum: €10,000. Maximum limits: Single: €20,000, Married/Civil Union: €28,000 (+€4,000/child), Single-parent families: €31,000 (+€5,000/child beyond the first).
Maximum Loan Amount	€190,000, with coverage up to 90% of the property's notarial value.
Fund Budget	€1,000,000,000.00
Application Start Date	15/01/2025
Application End Date	Until the budget is exhausted

Source: *https://greece20.gov.gr/?calls=stegastiko-programma-quot-spiti-moy-ii-quot*

By February 07 of 2025, 120.000 applications were made and 56.000 applications were approved on a national level (Dnews, 2025). Roughly 40%[16] of the Greek population resides within Attica so we can make the hypothesis that 48.000 applications could be made for Attica region and 22400 applications would be approved for Urban and Suburban Athens, Piraeus and the greater region.

With exactly the same financial framework, these 22.400 individuals that applied for the Spiti mou 2 funding, could buy the whole area[17] of the Hellinikon for a loan of 50.000 euros each[18]. With proper state management of the project, participation of national educational institutions, mimicking of best practices from a global environment, adoption of innovative technologies and state control over all the details that mater, a triple rehabilitation[19] could take place, rejuvenating not only Athens but also surrounding areas like Piraeus and the former airport. The results could be a social housing and green revolution which could alleviate the pain of the big city disease from hundreds of thousands of residents while offering a long term solution to the problem. These beneficiaries would enjoy modern houses[20] while the timeframe of actual delivery of the project could be way less than 25 years. At the current turn of events, the housing problem will not be solved, the former airport will be a construction site, hopefully, till 2046 and the Athenians will purchase houses that are in the best case already 20 years old at super inflated prices within a “diseased” urban environment. A final consideration of the turn of events is the timing. In particular, Xiong’an New Area

[16] As of the 2021 census, approximately 36.4% of Greece’s population (3.81 million out of 10.48 million) resides in Attica.

[17] The total 6.2 million Sqms while only 30% of it would be built, 1,86 mil. Sqms

[18] The sum equals to 1,12 billion Euros while the total Area of Hellinikon was sold for 915 mil. euros

[19] Athens, Piraeus and Former Airport Area

[20] With spiti mou 2 housing program beneficiaries’ can only buy houses built earlier than 31/ January/ 2007.

was initiated officially on April 1st 2017 [21] while the Hellinikon on 2020 [22]. Consequently, the lack of knowledge of the alternative, of a New Area being built to relieve a diseased urban environment, cannot be an excuse and cannot be an argument since there is a solid timeframe of 2 to 3 years in between, for a policymaker or an institution to make research and find out. Last but not least, Spiti mou 2, is budgeted at 2 billion euros out of greater 5 billion euros housing relief fund. A portion of these 3 remaining billions could be invested in numerous and creative innovations that would also further relieve Attica in so many ways for example a sponge city endeavour, UUT's, a digital forest and so on. These innovations could, furthermore, yield even more additional breakthroughs in a Greek scientific context, similar to the innovation through action and experience pattern of Xiong'an New Area.

The outcomes of the preceding analysis were somewhat distressing. Going back to the original analysis, not supposing that Greece would develop a new smart city to distress Athens, what would be the lessons to learn from Xiong'an Development?

When reflecting on these lessons, it is important to differentiate between macro-level and micro-level approaches, as each offers unique insights and opportunities for action. The macro level encompasses broad strategies and systemic frameworks that address overarching challenges and guide long-term development. In contrast, the micro level focuses on localized, context-specific actions that prioritize practical implementation and immediate results. By examining these two dimensions, it becomes possible to identify lessons that inform both strategic planning and on-the-ground execution, fostering a comprehensive approach that bridges high-level vision with actionable outcomes.

[21] Publicly announced

[22] Agreement signed between private consortium and Greek government

5.2 The Strategy on a macro level

5.2.1 Lesson 1: The State has the necessary power

Athens above all is not just a big city. It is the location where half the Greek population resides and more than half of the visitors of the country experience. As a result, a mere municipal structure cannot solve the problems. You need a state within a state to do so, you need the power of a state to do so and the resources and the capacity as well as the institutional power to make deep changes. One of the institutional innovations that China brought onto the table during the Xiong'an planning and development was the mere acknowledgement that such projects can't be solely ran by local governments but primarily by the central governmental "firepower".

5.2.2 Lesson 2: Social Benefit has to be the fundamental objective

Table 9. Sector Dynamics and Implications

Sector Dynamics	Implementation Requirements
Private sector follows profit	State Entrepreneurship may be the solution
Public sector addresses actual problems	Public institutions must be prepared for low-profit, high-impact projects
PPP models may not work for bankrupt economies	Strong public institutions are needed for mega-projects
Weak bureaucracy limits PPP effectiveness	Focus must be on public capacity building

If building a new infrastructure similar to Xiong'an near Beijing is the answer this can't happen from the private sector alone, especially when you want to make it cost effective. The lesson here has two implications. The Private sector goes where the profit sits (Peck & Tickel 2002 and others). The Public sector goes where the loss is.

State Entrepreneurialism may be the answer to that riddle. The PPP's as a model to solve problems, especially to a recovering Country and a weak bureaucracy seems not just the right choice. There is a subtle hypothesis here which needs to be tested. A problematic economy which is recuperating from a financial crisis, runs into PPP's mainly because of the lacking of capital as well as knowledge. Both these two elements[23] push the private sector to proliferate heavily on whatever project they take. There are numerous cases, not only in Greece with projects taken under the PPP scheme that were delayed, postponed or went out of budget or time. At this stage, it is essential to offer a more precise explanation that in the case of the Hellinikon project, there wasn't even a partnership between the state and the private sector, but it was a transaction of selling public real estate to private funds. It is described in the literature and the local media as the Greek mega city project but the reality is far away from that concept. A private company bought public land with its own borrowed capital as discussed earlier in the counterfactual analysis.

Thus, any state should realize that if actual mega projects must happen in order to solve the problems – contribute to the society, then the profit margins will be low and the profit capacity will be absent for a private company or fund to invest. If you want to make it cheap, reliable, fast and for the weak or the masses, you must **"repair or prepare"** a public institution to do so and that remains a challenge for the Greek State itself. In Xiong'an the national institutions were engaged in the process while the state orchestrated their involvement. BUPT University innovated on Xiong'an with its underground navigation system (Zhang, T., 2023). Tsinghua University assisted with the urban planning. The academy of social sciences of China highlighted the risks and the opportunities for the location and the resources. Alicloud and the private sector rushed to create innovation hubs and relocate R&D operations, leading to the development of a smart traffic system in collaboration with Baidu for driverless car

[23] The lack of physical capital and "know how"

development, an urban cognition and simulation system with Ali Cloud for AI public management, an AI medical imaging system developed by Tencent, and automatic speech recognition technology by iFlytek, which was applied in the local judicial system as part of a "smart courts" project. These efforts were part of the broader goal to build smart infrastructure for city simulation, risk management, and real-time monitoring. Previous experiences were used to the city's advantage while new innovations spurred through the process (Zhang, 2023; South China Morning Post, 2023; Song *et.al.,* 2023).

Xiong'an was developed somehow through experience on a state level (Wang S., 2018) and innovative knowledge sprouting during the action. This means that the digital forest project, the sponge city design as well as the three layered approach to the building of the city[24] were the next step on the value ladder, given the experiences of the past on a national level. The catastrophic floods of the past led to the sponge city design. The heavy pollution of the air led to the digital forest. The heavy traffic and congestion of Beijing led to the development of the digital twin and the virtual city utilizing the smart sensors and the road-vehicle-resident triangular cooperation framework. The importance and the power of data led to the development of multiple sensor technologies both on a construction level as well as on a daily life level. The need of security emerged, that led to a distinct process and a new frame architecture. The need of keeping everyone connected safely signified the importance of this kind of infrastructure and led to the development of a city that promises incredible smartness and the highest quality of life standards for its citizens.

5.2.3 Lesson 3: The location and the environment are significant

We are a product of our environment. If we don't take care of it, it will not take care of us. The location is crucial. Sustainability in terms of resources and longevity in the

[24] below the ground, on the ground and above the ground – on the "cloud"

sense of space is critical. China did the unimaginable, they picked a location with problems, revitalized it and then converted it into the next mega city. There are high doubts that Greece could do so. On the other hand, Greece, has the luxurious choice of less polluted areas, closer to Athens with relatively high resources in terms of water and land. Yet recent history in Athens is a tale of uneven, poorly organized and without any respect to the environment urban expansion. Environmental catastrophes hit one after the other the greater area of Attica. During the last decade, in the summer Athens is burning and in the winter Athens is flooding, with climate change being the primary force to blame.

5.2.4 Lesson 4: Timely Action is Essential to crisis prevention

If you lose control, be ready to make tough decisions. To the author's eyes, in Beijing the situation went out of control, thus radical measures had to be taken. In this case, the radical initiative was to force people out of Beijing. One of the key success factors that will shape Xiong'an is the central planning of the state to move people out of Beijing. Certainly, their quality of life will increase and definitely the incentives were there for them both financial and social, but still it remains unclarified (Zhuang, S., 2024) and I guess we will never know if they actually wanted to move out of Beijing. The plan is to move 5 million people, roughly half the size of Greece in absolute terms, out of their daily routine to an alien region. That's a bold move. For the case of Athens there is not enough evidence to support if the situation is out of control, though certainly there is enough evidence to pinpoint that life is becoming tougher every day. Housing is getting even more difficult especially for young people while the city's infrastructure has remained relative the same for the last decade mainly because of the huge financial crisis of the recent past. Additionally, public safety concerns, make it necessary to establish resilient infrastructure systems that can function under severe threats of hazards (Kapucu *et.al.,* 2023; Jabareen *et.al.,* 2023). Action must be taken as soon as possible otherwise the future seems very ominous even from the safety perspective.

Tough decisions come to a high price. The total cost of the project for the Xiong'an New Area will reach hundreds of billions of us dollars[25][26] (Liu J., 2017). This budget can be supported by an economy like China but it's highly questionable that can be supported by an economy like Greece in relative terms. Interestingly though, the absolute equivalent amount for Greece would be a budget of 2.36[27] billion dollars. However, if the situation gets out of control, the fiscal cost will be deteriorated by the necessity of immediate actions. This will create windows of opportunities for "premium - opportunistic" prices and higher potential cost for the whole endeavour. This lesson merely translates to 'pro- act' and do not 're-act' at a certain critical point, in which each additional action comes with a higher cost. Nevertheless, the problem in Greece is that there is no action at all so asking for pro-action is even a harder task to do.

Generally speaking, actions speak louder than words. The Athens resilience guide is a masterpiece of theoretical knowledge. But knowledge without action has the same worth as no knowledge at all. This means that within the resilience guide can be found numerous explanations of what is going on, how to measure it, what will be the consequences of the actions and the weights of the decisions and their impact. As a matter of fact, there are 200 hundred pages of theory and 10 pages of action. The author of this thesis -and other authors (Nickayin *et.al.,* 2020)- believe that words cost more than actions and recommend the future resilience guide to have 200 pages of actions and 10 pages of theory.

[25] Its not clarified explicitly. Xiong'an New Area has planned 240 key infrastructure and urban projects with a total expected investment of over 800 billion CNY (Chinese Yuan), of which 660 billion CNY has already been invested in the 38 km² starting area as of 2023 (Song et. al., 2023).

[26] According to Morgan Stanley, the investment in the new area will vary from 1.2 trillion yuan ($182.5 billion) to 2.4 trillion yuan ($365 billion), making it the largest construction project in China so far in terms of projected expenses.

[27] If 300 billion are spent for a nation of 1.4 billion people, approximately 2.36 billion would be available for a population of 11 million people.

Contemporary technology offers a lot of options. Global knowledge offers a lot of best practices and Greek universities offer a lot of great brains. Actions should be taken into actually combining these elements rather than theorizing what would happen if, while at the end of the day time flied and the Athenian situation marginally deteriorated. A few projects are highlighted and nothing more. A revision plan for every one year is also posed without specific metrics of what happened for the previous years of implementation. Namely within the first pages of the report **a kind of disclaimer** is written:

"…According to a 2015 OECD report, despite efforts to guide urban growth, a series of structural challenges have remained:

• a gap between planning and implementation;

• a gap between spatial planning and socio-economic planning;

• the incomplete development of basic land management tools;

• and the lack of participatory planning.

In order to further Resilience in Athens, metropolitan governance reforms and a carefully designed financial scheme, must be implemented. Stakeholder mobilization has to focus on a shared set of policy priorities for a more Open, Green, Proactive and Vibrant City of Athens." - Source: Athens Resilience Strategy page 31

The participation of the local population must be complementing the strategy and making them a pillar of it is crucial. Though, people have also to make a living and apparently that's their first priority. Engaging in the city affairs is of course welcomed but the policy makers should not and **must not count on it**. In this resilience guide, it seems that too much responsibility is passed to the citizens, rather than the authorities, perhaps to close the gap of action or to justify why things are not done when compared with the best and not with the worst.

5.2.5 Lesson 5: Political Vision is needed

From the perspective of Xiong'an, President Xi's vision served as a powerful catalyst for the project's development. In the case of Greece, however, it's difficult to pinpoint a leader with a comparable vision or set of incentives. Nevertheless, one of the key lessons learned is that, above all, a strong and compelling driving force—perhaps in the form of a unified vision—is essential for spearheading mega projects that can significantly shape and improve people's lives. It is sad, in a sense, that in a thesis that aimed to tell a technical story and highlight the role of technology in order to advance peoples livelihood, we end up discussing about politics. But politics matter. Especially in the contexts of cities that are managed by political formations within a democratic context. A true challenge for an individual with a vision, at the end of the day, is to find a way to prevail within that context and to an extent, inspire for the necessary changes to happen.

From the perspective of Athens though, in the recent elections there was a promising change in leadership. The new mayor[28] – a man who came out of nowhere- with a strong academic background and a fresh vision for an eco-friendly urban revolution inspired Athenians towards a sustainable, green and cyclical agenda (Stamouli, 2024).

The city has witnessed a remarkable transformation in its approach to urban challenges. Walking through Athens today, you might notice thousands of newly planted trees dotting the streets and squares – part of an ambitious 5,000-tree initiative to cool the city's neighbourhoods and clean its air[29]. Last summer's intense heat waves (2024) prompted the new Municipal leadership to take swift action, turning the city into a

[28] Mr. Chrysostomos Doukas

[29] Covering rooftops entirely with grass can reduce temperatures by approximately 0.7 °C in the central areas of Athens, including the city center, with reductions reaching 1 °C and higher depending on the area and prevailing wind conditions (Spyrou *et.al.,* 2024).

network of refuge spots with cooling centers and water stations where residents could find relief from the scorching temperatures. What stands out most is the attention to the city's most vulnerable – elderly Athenians now wear biometric watches that help monitor their wellbeing, while reinforced medical teams and expanded home care services ensure no one is left behind during extreme weather events. That was a part of a fresh pilot program orchestrated by the new authorities to tackle the problems that lied within Athens for years (Smith, 2024).

Moreover, there are efforts to rebuilt the municipal administrative framework from the ground up, emphasizing towards clarity and accountability. The mayor's office has become a place where citizens' voices matter, with Athenians actively participating in shaping their neighbourhoods' futures. It's this blend of practical environmental action and community engagement that seems to be writing a new chapter in Athens' long history. It is referred as the "Doukas Model" and brings onto the table new aspirations for the city of Athens (Stamouli, 2024)

Additionally, an honourable mention is the new regional governor of Attica[30] who is a successful politician and a fierce supporter of transparency. His cooperation with the new mayor of Athens is promising towards positive advancements.

Nevertheless, the past mismanagement of Regional resources and the vindictive policy of the central government against a mayor who does not belong to their faction, raises huge concerns on if there will be the opportunity for a better future for Athens. Recent investigations have revealed significant irregularities in the allocation of municipal - regional funds designated for Athens' recycling initiatives. Roughly, 34.7 million euros were missing an amount that had been collected by the municipalities of Attica in the years 2022 and 2023 to be allocated in favour of recycling through the "burial fee".

[30] Mr. Nikolaos Chardalias

EDSNA[31][32] kept most of it because, according to the EAD[33] investigation, it had no other way to finance the €334 million contracts it had signed, assuming that the government would include it in NSRF[34] programs (Aftodioikisi.gr, 2025). These financial discrepancies have raised concerns about the oversight of environmental programs and fiscal accountability within the regional administration. Simultaneously, a notable institutional restructuring is taking place, wherein the central government is reasserting control over previously decentralized municipal agencies[35] like Anaplassis S.A. (Kede, 2023). This agency was originally established to provide technical expertise and operational support for complex urban development projects that exceed typical municipal capacity[36]. The prior mayor had control over that institution as well as the management of its funds, thus could make an impact to the local society[37]. The newest mayor was stripped out of it and it came back to the central government authority. This allocation of authority poses significant challenges for local governance, particularly in the implementation of large-scale urban initiatives that require specialized knowledge and experience such as the new Panathinaikos FC stadium in Elaionas region and the conversion of its previous Stadium into a park within the center of Athens (Alexandras Avenue) often referred as double rehabilitation or Double Anaplassis or Dipli Anaplassi. The timing of this institutional reorganization has sparked debate about the implications for municipal autonomy and the effective

[31] Ειδικός Διαβαθμιδικός Σύνδεσμος Νομού Αττικής

[32] Translation to English is an endeavour by itself but can be explained as - Special Municipal - Regional (Intergrade) Association of the Prefecture of Attica

[33] National Authority for Transparency - Εθνική Αρχή Διαφάνειας

[34] National Strategic Reference Framework - ESPA

[35] https://anaplassis.gr/

[36] The objective of the institution is "the planning and implementation of regeneration throughout the Greek territory in order to improve the quality of life, social cohesion and economic development."

[37] The previous mayor also belonged to the same political faction - party with the government.

execution of ongoing metropolitan projects (Kathimerini, Various Articles on Dipli Anaplassi, 2021-2024)

5.3 The Strategy on a micro level

In this section of the thesis we will focus on specific lessons that can be learned on a micro level. We will move away from the strategy of the state and we will delve into the strategy on a city level.

5.3.1 Lesson 1 - Communication (ICT) Infrastructure as the Foundation of everything

Table 10. Key points at a micro level I

Key Points	Description
Infrastructure Deployment	Initial focus on high bandwidth networks to support digital communications in Xiong'an's New Area.
Sensor Integration	Networks served as the base for the deployment of environmental sensors (air quality, pollution, noise) on both construction and city levels.
BIM Systems	Building Information Modelling (BIM) played a key role in supporting a zero-accident policy and efficient output monitoring.
Scalable Results	The importance of having measurable results from day one with scalable infrastructure.

Even in Xiong'an New Area the first deployment of infrastructure was directed towards building networks with high bandwidth in order to support digital communications effectively. These networks were the foundation. Later on the sensors were deployed into the different facilities on a construction level that was later upgraded into the city level. Environmental sensors about the quality of the air, the pollution to the

environment and even the noise were firstly implemented. Then on a construction level, BIM systems played fundamental role into a zero accident policy as well as an effective and measurable output monitoring. If you want to have measurable results you need the 'scale' from day one. And if the scale are the sensors, then its foundation is the communication infrastructure.

5.3.2 Lesson 2 - Centralized Management of Data adds Value

Table 11. Key points at a micro level II

Key Points	Description
Unified Data Management	Centralized management of real-time data collected from IoT sensors and cameras across the city, instead of separate jurisdictions processing data independently.
City Brain	The unified "City Brain" allows for cross-processing of data, leading to improved management, risk mitigation, and overall city functionality.
Smart Pole Innovation	The development of the smart pole as an innovation, incorporating multiple sensors and connected to the City Brain.
Digital Twin of the City	A digital twin of the city as a revolutionary concept, facilitating better city planning and decision-making.

One of the innovations that are astonishing in Xiong'an New Area is the unified management of the information. Extensive IOT sensors and cameras were deployed collecting real time information about different aspects of the city and its construction. All this information was processed by one brain and not multiple sub nerves. This means that instead of each different jurisdiction processing its own data, a central management could cross process these data to yield outstanding managerial information. This development resulted in the implementation of the smart pole, an innovation that, in my view, should be widely adopted. Additionally, the viability of

the city's digital twin represents another remarkable innovation. The city brain is a global innovation that hasn't been seen in any other country in such depth and can mitigate so many risks, improve so many lives and bring on to the table so many advantages and possibilities. It is described, within the Xiong'an development context as a sci-tech revolution that must spread throughout China (Pan J., 2017).

Figure 26. Staff members work at the intelligent operations center in Rongdong District of Xiong'an New Area

Source: http://en.people.cn/n3/2022/0401/c90000-10078515.html

5.3.3 Lesson 3 – The details matter

Table 12. Key points at a micro level Ill

Key Points	Description
State Planning in Detail	The state should impose micro-level planning, ensuring that small but important details are considered in urban development (e.g., antenna aesthetics, data room requirements in buildings).
Standardized Guidelines	Centralized state guidelines, such as camouflage for antennas and specific data room requirements, ensure uniformity across all facilities and buildings.
Implementation by Local Authorities	Local authorities focus on implementation, while the state provides the overall planning and structure, ensuring consistency.
Smart Pole Standardization	The state's imposition of the smart pole standard, capable of accommodating 33 different sensors, facilitates centralized data collection and management across multiple agencies.

This lesson has to do with the small details that no one would think of at a provincial level but make a difference when imposed by the state on a high level. What does this mean though? For example, the antennas that are going to be used in Xiong'an on the buildings and in the facilities are obliged to follow a certain camouflage to match the aesthetics of the local architecture. This is a central guideline that no specific provincial authority may think of or even try to implement. Another similar approach is the obligation for each building depending on its orientation to have its own data room. That guideline came from the state with very specific parameters on the size and utilities that will offer to the data center. To add insult to injury, there are specific guidelines about the ducts that are going to be used and all these small details that matter in the greater picture. The question here is simple. Would anyone on a provincial level think about it or delineate it? Here comes a state with its brain capacity to highlight and impose these details and these details matter today. A state that plans

everything and a province that implements it is the subtle prevailing pattern in this case. The smart pole of Xiong'an New Area can accommodate 33 different sensors. It's imposed by the state and all the different state and municipal agencies just connect to it. What could anyone else ask? In the case of Athens there is a totally different story. Every national or provincial agency has its own sensors, its own infrastructure and its own management. There should be additional research towards the cost and the benefits of such a reality. A fun fact that highlights the difference between China and Greece is the case of the new police – traffic cameras implemented in Athens in 2024. These new cameras do not transfer the data of the traffic violations over internet to the central agency. A police officer should go to the actual camera location, use a ladder to reach it, via an usb factor withdraw the data, physically carry them to the agency and then process them (Caranddriver.gr, 2024). Retrospectively, it has to be mentioned that, most new technologies used for policing[38] are still at a research level in both EU and Greek context (Gkougkoudis *et.al.,* 2022).

[38] Often referred as smart policing or e-policing

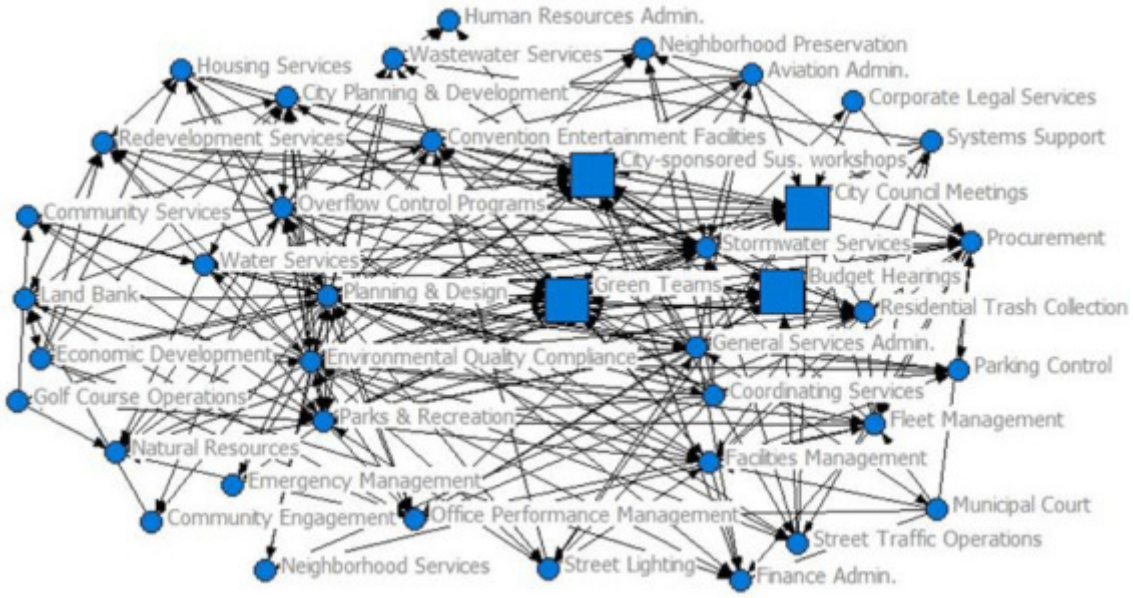
Table 13. Key points at a micro level IV

Key Points	Description
State vs. Provincial Approaches	In Xiong'an, the state imposes guidelines that affect aesthetics, data infrastructure, and sensor management, which would not be thought of at a provincial level. In contrast, Greece has a more fragmented approach with separate infrastructure for each agency.
Smart Pole in Xiong'an	The smart pole in Xiong'an is centrally managed, connecting various state and municipal agencies seamlessly.
Athens Traffic Camera	In Athens, separate agencies manage their own sensors and infrastructure, highlighting inefficiencies in data transfer (e.g., new police traffic cameras require physical data retrieval rather than centralized online transmission).

5.4 Concluding Thoughts

Depending on the view of Xiong'an there is a million other things that one could focus on. A city is a complex structure of complex structures. Building them and maintaining them is a chain of projects that like an endless cycle never ends. On top of that we have the constant change of human needs that makes the imperative rule for the city and its utilities to adapt, paired with the evolution of technology and the dynamics of innovation in every aspect of human life, the complexity of this ecosystem just further increases (Przybysz, A *et.al.,* 2024).

Figure 27. Example of Functional Units & Venues (City of Kansas)



Source: Hawkins and Krause (2023)

During the execution of this piece of work the following questions emerged. Some of them subtle and others more profound, somehow direct the future research that can take place in order to better describe the phenomenon or the question **to build or not to build**[39]?.

First and above everything is the institutional level and managerial jurisdiction of big cities. The way local and state institutions intertwine, especially in the cases of heavily populated areas, is a research domain by its own (Hawkins and Krause, 2023). As a result another question that follows is[40] how can the processes be streamlined when

[39] An ambiguous expression that refers to a new city. To build a new city to distress an existing one or not?

[40] if the case is a big megacity

these institutions collide? Endless research needs to be done, is done and can be done on that front (Hawkins and Krause 2023).

On the other hand, another tough question is to build from scratch or to modernize? Some cities –well most cities that come to mind- have hundreds or even thousands of years of history. A policy maker or an institution of local or state dynamic, has to make the decision to modernize the infrastructure or build it from scratch. This topic becomes particularly hot, when someone takes into consideration the fact that this modernization has to be carried out, with minimal disruption, in other words, the city is a living organism. Then if one decides to build from scratch and try to distress the "congested" city by moving away the population residing there, another huge concern is how to do it. How can someone force people out, when the sheer amount of people is the root cause of all the problems that the city faces? Can one force people out or incentivize them? And when the incentives are monetary, then the cost advantage of building from scratch is being diminished since the assumed reduced cost of building from scratch a brand new and futureproof infrastructure, is being inflated by the monetary incentives given to people to actually use it- migrate from their current residential areas-. In this case, the cost effectiveness can be described in other words as capital efficiency. What is the best way to efficiently use your capital as a state or as a local municipal authority to maximize its value? That question is one of the most complex ones, since one must calculate the returns of leapfrogging technologies on an already as described complicated function.

Another issue is that as we move up on the value chain towards a smarter city, a lot of sensors and data gathering and management systems must be installed. Consequently, one may wonder what are the legal and institutional countermeasures that have to be in place, in order to secure a robust respect for personal freedom and human life? The legal implications are countless and the complexity further increases.

Nevertheless, this study concludes that miracles can happen and that Xiong'an New Area looks like a great one. Xiong'an's story is still being written, but its approach to building resilience from scratch while facing multiple challenges offers valuable lessons for the cities around the world.

This thesis begun with a famous quote of Deng Xiaoping, inevitably it ends with another quote from him. At the end of the day, this thesis maintains that all the concerns can be answered by the improvement of human life and the increase of living standards. Xiong'an aims to fulfil this commitment and for the residents that have already moved there it does.

As Deng Xiaoping once said:

"It doesn't matter if a cat is black or white, so long as it catches mice." 不管黑猫白猫，能捉到老鼠就是好猫 – Deng Xiaoping

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