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CRITERIA FOR CITY NEIGHBOURHOODS' PLANNING AND DESIGNING IN THE CONTEXT OF THE SMART CITY PLATFORM

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KRITERIJI ZA PLANIRANJE I PROJEKTIRANJE GRADSKIH SUSJEDSTVA U KONTEKSTU SMART CITY PLATFORME

DOKTORSKI RAD
Knjiga I

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Supervisor CV

Prof. Ph.D. Bojan Baletić, graduate in architectural engineering, is a full professor at the Faculty of Architecture University of Zagreb. Since 2006, he has held the position of Vice Chancellor for Development and Spatial Planning of the University of Zagreb for the mandate period 2006. 2010. in the administration of the rector prof. Ph.D. Alekse Bjeliš. He has been a member since 1997 Croatian Academy of Technical Sciences.

Born on November 17, 1957 in Šibenik, Croatia. He attended primary and secondary school in Zagreb and London. Graduated from VII. grammar school in Zagreb in 1976. He entered the Faculty of Architecture at the University of Zagreb in 1976. where in 1981 he obtained the title of graduate engineer of architecture. From 1984 to 1986, he attended postgraduate studies master's degree in "Architecture in Tourism and Leisure" at the Faculty of Architecture in Zagreb. In 1996, he defended his doctoral dissertation at the Faculty of Architecture of the University of Zagreb on the topic applications of neural networks in architectural design (mentor Prof. G. Knežević, Ph.D. and commentator Prof. Ph.D. sc. Z. Žagar). Training and research stay at ILAUD Urbino (1981), University of Strathclyde in Glasgow (1986, 1988), University of California at Berkeley (1989), University of Georgia in Athens (2003).

In 1981 and 1982, he was employed part-time at the Urban Institute of Croatia. From 1983 to 1991, scientific intern on scientific topics at the Faculty of Architecture. Since 1992, he has been an assistant in the course "Application of computers in architecture" (teacher under the formal patronage of Prof. Knežević). Years In 1995, he established a computer classroom at the Faculty of Architecture, and in the same year by decision of the Faculty Council becomes the subject holder. In 1996, he was elected to the scientific teaching position of assistant professor, in 2002, title of associate professor. In 2006, he was in the process of being elected as a full professor. As vice dean for teaching at the Faculty of Architecture from 1997 to 2001 and from 2003 to 2007, he worked on the creation of a new research program undergraduate and graduate studies in architecture and urbanism, and on the future organization of postgraduate studies research. He is the mentor of two doctoral theses and one master's thesis. Since 2005, he has been a representative of the Faculty of Architecture in the Council of Technical Sciences and a member of the Commission of the Council of Technical Sciences for determination of criteria and confirmation of election to positions.

Bojan Baletić has published over 60 scientific and professional papers, 21 of which at international scientific conferences gatherings. In total, he participated in 47 international and domestic meetings. In the period from 1990 to 2005, he was leader or member of the scientific committee in 14 scientific and professional meetings. He was the editor of 6 collections of works scientific gatherings. He was the manager of four international projects within TEMPUS, ALIS link and USAID ALO program, and

manager of seven domestic scientific research projects. It was reviewed by experts' publications, proceedings of international meetings and professional teaching program. He gave 25 invited lectures at international and domestic gatherings and tribunes. Among the professional works, 22 professional articles were published in a book, magazine or collection of papers. He is the author of 15 architectural and urban competition works (two I. awards, two II. awards and one placement), and 14 architectural and urban projects (8 realizations). He is the author
software packages for the computer with which he improved his professional work (it should be highlighted the website of the exhibition "Science in Croatia", CDROM "RH Alan", CDROM "Swatch Virtual Catalogue", studies of the visual impact of construction
expansion of the Plomin TPP in the Plomin Bay). He is the editor of the university edition of the book "University and the City".

He is the founder and president of the CAD section of the UHA (1989-1996) and international CAD scientific meetings. Forum (1989, 1996) and MediaScape (1993, 1995). In 1995, he was appointed by the Minister of Science and Technology Republic of Croatia as a member of the board of directors of the CARNet agency for a term of four years. From 2002 to 2005, the manager was S the Croatian side of the joint scientific research project "A Partnership for Sustainable Rural Economic Revitalization in Croatia" University of Zagreb, University of Georgia and ICAM. In 2003, he was elected to the president of the University Council for the support of regional development and the local community. In 2005, appointed is the head of the Expert Commission for the renovation of the French Pavilion and the Student Center in Zagreb. Years In 2005, he received recognition from the Committee for International Cooperation of the University of Zagreb for promoting international cooperation in scientific, artistic and professional fields. Since 2006, he has been a member of the Committee for continuous professional development of the HKAIG Class of Architects and chairman of the Education Committee. Since 2006 is the HKAIG representative in the Architectural Council of Europe (ACE) for education issues. He has been a member of the Administrative Board since 2007 council of the Varaždin Student Center and president of the supervisory board of the University Press, and since 2010 he has been a member of Administrative Council of SRCE. He is (or was) a member of many associations (DAZ, UHA, Ecovast, ZUIK HGK, NGO Korablja, ECAADE, CROSS, DSE).

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Abstract

The rapid advancement of digital technology has accelerated the evolution of urban planning, notably the creation of smart cities. This research seeks to investigate and rethink the criteria for planning and designing of city neighbourhoods within the smart city framework, as it examines existing international standards and smart neighbourhood projects to identify major areas where current planning criteria might be improved.

The objectives are as follows: (1) examining established guidelines used by international organizations; (2) assessing neighbourhood projects based on long-term architectural principles; (3) developing new criteria through comparative analysis of emerging technologies and their integration into urban planning; and (4) evaluating the smart city concept with a focus on sustainability, inclusivity, and human-centered design.

The hypotheses propose that existing criteria to be restructured to meet a variety of urban demands and lifestyles, with the potential to establish new standards for smart neighbourhood development. Finally, the research aims to provide new guidelines for improving the quality of life through innovative, sustainable, and inclusive urban design.

Key words: Smart Cities, Smart Neighbourhoods, Smart City Criteria, Smart Environment, Smart People, Smart Living.

Sažetak

Brzi napredak digitalne tehnologije ubrzao je evoluciju urbanog planiranja, posebice stvaranje pametnih gradova. Ovo istraživanje nastoji istražiti i preispitati kriterije za planiranje i projektiranje gradskih četvrti unutar okvira pametnog grada, budući da ispituje postojeće međunarodne standarde i projekte pametnih susjedstava kako bi identificirala glavna područja u kojima bi se sadašnji kriteriji planiranja mogli poboljšati.

Ciljevi su sljedeći: (1) ispitivanje utvrđenih smjernica koje koriste međunarodne organizacije; (2) procjena projekata susjedstva na temelju dugoročnih arhitektonskih načela; (3) razvijanje novih kriterija kroz komparativnu analizu novih tehnologija i njihovu integraciju u urbanističko planiranje; i (4) procjena koncepta pametnog grada s fokusom na održivost, inkluzivnost i dizajn usmjeren na čovjeka.

Hipoteze predlažu da se postojeći kriteriji restrukturiraju kako bi se zadovoljili različiti urbani zahtjevi i stilovi života, s potencijalom za uspostavljanje novih standarda za razvoj pametnog susjedstva. Konačno, istraživanje ima za cilj dati nove smjernice za poboljšanje kvalitete života kroz inovativan, održiv i inkluzivan urbani dizajn.

Ključne riječi: Pametni gradovi, Pametna susjedstva, Kriteriji pametnog grada, Pametno okruženje, Pametni ljudi, Pametno življenje.

Extended (structured) summary

CRITERIA FOR CITY NEIGHBOURHOODS' PLANNING AND DESIGNING IN THE CONTEXT OF THE SMART CITY PLATFORM

The research investigates the concept of smart cities and emphasizes the ways in which the incorporation of digital technology has led to a significant increase in urban planning throughout the world. The findings of this research highlight the significance of technology in assisting with the resolution of urban issues such as resource management and sustainability, as well as in enhancing energy efficiency and reducing traffic congestion. However, there are currently concerns regarding the long-term viability of the environment, public inclusion, and personal privacy. As a result, the research advocates for a human - centered design methodology that achieves a balance between the well-being of residents and the improvements in technology.

This research systematically examines the deficiencies in planning and design standards already evident in smart city contexts, a vital subject in urban development discussions. This research provides a robust basis for re-evaluating smart community design through the examination of established global standards, the analysis of practical implementations, and the proposal of innovative alternatives. The primary objectives of this research are to identify and assess existing guidelines and their deficiencies, critique the implementation of smart neighbourhoods from an inclusive and sustainable perspective, develop revised criteria that balance technological innovation with human - centered values, and underscore the importance of equitable access to urban resources and services.

The initial purpose is to identify the deficiencies and omissions in the existing guidelines, particularly their dependence on technological measures rather than social, psychological, and cultural aspects of urban living. The research seeks to build a basis for developing more inclusive and equitable planning guidelines through a thorough assessment of these requirements. The research assesses existing frameworks, including the EU and the European Investment Bank, with an emphasis on individuals, the environment, and quality of life to attain this objective. Moreover, it underscores the absence of human - centered principles and the disproportionate emphasis on technology, contending that these frameworks inadequately address broader urban issues such as mental health, social justice, and cultural sustainability.

Lastly, the research finds gaps in the real-world applications of these criteria in smart neighbourhoods. These gaps include issues such as privacy and data security, accessibility for underrepresented communities, and the incorporation of cultural and psychological well - being.

The second purpose of this research is the development of smart neighbourhoods with a focus on inclusiveness and sustainability. Despite the acclaim for numerous smart neighbourhood programs as novel remedies for urban challenges, their implementation often uncovers deficiencies and unintended consequences. This aim assesses how these projects integrate technological innovation with broader goals such as social equality and environmental sustainability, highlighting their merits and drawbacks. This research investigates the implementation of environmentally sustainable practices in smart neighbourhoods, highlighting social justice and environmental effect while considering the risk of gentrification. It also addresses obstacles to participation, such as insufficient stakeholder engagement and hierarchical planning.

This research employed a purposive, multi - stage case selection design to conduct an in - depth investigation of twenty smart neighbourhoods from an initial pool of approximately 200. A systematic search method was employed to minimize the sample size in accordance with the research aims, given the vast number of potential cases. The process aimed to tackle many urban situations and themes within the realm of smart urbanism, while also being pragmatic in meeting practical criteria regarding timeliness and data accessibility. The selection of 20 neighbourhoods was predicated on specific criteria: geographical diversity across Europe, various neighbourhood classifications (brownfield, greenfield, suburban, rural, mixed-use, or historic/preservation districts), differing sizes and populations, and diverse smart objectives including environmental sustainability, innovation, social inclusion, and quality of life. Furthermore, neighbourhoods with adequate and dependable data regarding their smart initiatives were given precedence.

From an initial set of 20 European smart neighbourhoods, five were chosen through a two-step purposive method that integrates criterion sampling (considering data sufficiency, project maturity, and program scope across various domains) with maximum - variations sampling (accounting for geography, scale, governance structures, and thematic focus). Instances lacking sufficient public documentation or those with very restricted pilots were omitted; analogous entries were eliminated to prevent redundancy.

The research used a six - domain smart - city paradigm, concentrating its investigation on three key dimensions: Smart Environment, Smart Living, and Smart People. Each case categorizes objectives, interventions, outputs, outcomes, and evidence into the aforementioned three primary dimensions; the supplementary dimensions (Mobility, Governance, Economy) are considered facilitators - contextual factors, and are assessed solely to the degree that they illuminate or impede the outcome.

The third purpose of this research is to provide revised criteria for the design and planning of smart neighbourhoods that harmonize human - centered values with technological progress. The aim is to establish a comprehensive set of criteria that emphasize resident welfare, social inclusion, and equitable access, while recognizing the deficiencies of existing frameworks and the obstacles to implementation.

The research aims to redefine smart neighbourhood criteria by prioritizing human - centered design concepts that emphasize the needs of people, incorporating mental health, community engagement, and cultural identity into the planning process. The research prioritizes social inclusion, ensuring that marginalized groups such as the elderly, individuals with disabilities, and low-income inhabitants are integrated into smart neighbourhoods. The criteria prioritize environmental and social sustainability by integrating green infrastructure, renewable energy, and sustainable urban mobility alternatives.

The last purpose is to underscore the importance of equitable access to municipal resources and services within the smart city paradigm. This purpose is to guarantee that the advantages of smart city technology and services are accessible to all residents, irrespective of socioeconomic status, digital proficiency, or geographic location. This purpose prioritizes equality to cultivate inclusive and sustainable urban environments while addressing systemic inequalities that may arise in technology-driven urban planning.

This research technique aims to comprehensively examine and reinvent the planning and design criteria for city neighbourhoods within the framework of the smart city platform. It employs a mixed - methods approach to assure comprehensive research by integrating qualitative and quantitative data, comparative analyses, and theoretical evaluations. This methodology segments the research into eight chapters, each focusing on a distinct aspect of smart city planning. This framework is carefully crafted to deliver a comprehensive analysis of the theoretical, practical, and human - centered dimensions of smart neighbourhoods, with each chapter building upon the preceding one to ensure a coherent progression from foundational notions to actionable recommendations. To assist readers in understanding the context and significance of the research. The first and second chapters comprehensively delineate the foundational concepts of smart cities. Chapters three and four provide critical insights into current practices, highlighting the need to re-evaluate established paradigms. The focus next shifts to practical solutions in Chapters Five and Six, which present case studies and propose innovative, human - centered standards. The research is consolidated in Chapters Seven and Eight, ensuring that the conclusions are comprehensible and applicable for practical purposes.

The initial chapter, **"Theoretical Research Section",** effectively establishes the context for the dissertation by situating the research within the ongoing discourse surrounding smart cities. It commences with intelligent urban development, encompassing its components and the myriad issues it presents to contemporary city planning. The overarching theme pertains to the rapid advancement of technology, which appears to conflict with the principle of prioritizing human experiences in urban living. This conflict has resulted in a disorganized approach, characterized by inconsistency and a lack of a coherent plan. This research intends to critically evaluate current smart city design practices and develop a set of criteria that harmonizes digital, environmental, and social dimensions in a more inclusive manner. This research posits that many existing smart city frameworks are excessively centered on technology. However, there is optimism that a forward - thinking strategy may yield improved iterations of these programs.

The second chapter, **“Context analysis”,** contextualizes the research by providing an extensive review of the evolution of smart cities as places of innovation and sustainability, addressing the principal trends, technologies, and challenges that have influenced the smart city framework. This chapter establishes a basis for comprehending subsequent discussions, characterizing smart cities as both prospects and challenges in contemporary urban development. The initial chapter explores the history of smart cities, focusing on their evolution through digital technologies, IoT, and big data, while characterizing smart cities as metropolitan areas that leverage technology to enhance efficiency, sustainability, and quality of life. This chapter encompasses essential technologies, including IoT for real-time data collection and infrastructure management, AI for decision-making and predictive capabilities, and big data analytics for optimizing municipal operations. It also examines how smart cities address urban challenges such as transportation congestion, environmental sustainability, and resource management. The data is illustrated through case studies and examples, such as Barcelona's integration of IoT into urban infrastructure, Singapore's application of AI and big data, and Copenhagen's Nordhavn District, which also highlighted challenges including the need to balance efficiency and equity, the exacerbation of social inequities, and the requirement for comprehensive planning. The chapter concludes by characterizing smart cities as a double-edged sword: they provide unparalleled opportunities for innovation and sustainability, yet also generate significant challenges regarding equity, inclusion, and ethical governance.

The third chapter **“Smart City Concept”,** delves deeper into the conceptual framework of smart cities, including its definition, evolution, and diverse interpretations and at the same time it lays the framework for understanding how the smart city concept has shifted from a primarily technology focus to include larger human - centric and socio - environmental concerns. Ultimately, this chapter focuses on the complexity and diversity of approaches to developing and implementing smart cities. This chapter discusses how smart cities have developed over time, with developments in digital technology, urbanization pressures, and sustainability aims influencing their definition. It also focuses how the concept has developed from a technology-driven perspective to one that incorporates human-centric and inclusivity-focused approaches as it discusses the main stakeholders in the smart city ecosystem which include technology corporations such as IBM, Google, and Siemens, governments and municipalities, and residents who are frequently excluded from planning and decision-making processes. This chapter also delves into how smart cities are divided into four categories: technology - driven cities, data - driven cities, human-centric cities, and hybrid models. These cities prioritize infrastructure, IoT, AI, big data, and sustainability and they also cover smart governance, smart mobility, smart environment, smart economics, and smart living. Case studies of Singapore, Songdo, South Korea, and Amsterdam Smart City serve as examples for technological determinism, exclusionary behaviors, and worries about surveillance and privacy. In conclusion, the chapter underlines the importance of a nuanced and inclusive view of smart cities, moving away from exclusively technological models and toward hybrid methods that balance innovation with social, cultural, and environmental sustainability.

The fourth chapter **“Smart City Strategies”,** then critically evaluates the main top - down methodologies used in smart city development. These approaches, which are often headed by governments, municipal authorities, or huge technological companies, prioritize centralized decision-making and large-scale infrastructure construction. While such tactics are efficient and quick to execute, they are frequently criticized for ignoring community involvement, social inclusion, and flexibility to local situations. Thus, this chapter provides a basis for understanding the limitations of centralized structures and the need for more participatory alternatives. In detail, this chapter focuses how top-down planning is a centralized, hierarchical strategy in which authorities or organizations make choices without considering local feedback while it provides benefits like efficiency, scale, resource allocation, and coordination. However, it frequently excludes community feedback, oversimplifies solutions, and jeopardizes technocratic administration. In this chapter, we used the case research of Barcelona's Technological Transformation highlight the limitations of top - down tactics. As the chapter compares top-down techniques to participatory, bottom-up models, this chapter proposes that combining the strengths of both approaches can result in hybrid planning models and it recommends for overcoming restrictions which include increased community engagement, localized planning, and transparent governance. This chapter concludes that while top - down solutions provide advantages in terms of efficiency and scalability, their limits highlight the significance of including community participation and human-centric principles.

The fifth chapter **“Smart City Criteria”,** continues to critically evaluate the current criteria for evaluating and implementing smart cities, focusing on their strengths, limits, and applicability. These requirements, generally driven by technology and economic measurements, serve as the foundation for modern smart city frameworks. However, the chapter identifies considerable inadequacies in addressing social, cultural, and human-centric factors, emphasizing the importance of restructured evaluation standards. With that in mind, this chapter addresses the current evaluation frameworks for smart cities, such as worldwide standards, ISO 37122, and the World Bank's urban development policies, as these frameworks emphasize governance, administrative efficiency, technical preparedness, environmental sustainability, and economic productivity and innovation. However, this chapter then discusses how these frameworks frequently ignore social elements, overemphasize technology, and fail to address discrepancies in access to urban resources. While using case studies from the Barcelona Smart City Framework, Copenhagen, among others, this chapter reveals the frameworks' weaknesses. This chapter concludes that while existing smart city standards are a good place to start, they fall short of meeting the complex needs of urban people.

The six chapter **“Projects / Neighbourhoods – Bottom-up approach”,** focuses on the practical application of smart city ideas at the local level, rather than the broader notion of smart cities and it investigates how smart communities function as microcosms of smart cities, showing both the benefits and drawbacks of combining technology, sustainability, and human - centered design. The chapter goes into ways for designing neighbourhoods that are inclusive, sustainable, and responsive to the needs of various populations. In detail, this chapter discusses how smart neighbourhoods are localized implementations of smart city principles that use technology to improve quality of life, promote sustainability, and increase connections, as the key characteristics include integrated technology such as IoT-enabled infrastructure, smart grids, and digital services, as well as sustainable design and community-centric planning. These areas serve as trial grounds for novel urban ideas, bridging the divide between top-down planning and community needs. Furthermore, the chapter discusses how neighbourhoods' technological integration includes IoT sensors and systems, smart mobility solutions, and digital platforms for resident involvement and how renewable energy sources, urban green spaces, and waste reduction methods all help to integrate sustainable and green infrastructure. This chapter concludes by highlighting smart neighbourhoods' revolutionary potential in changing the future of urban living. It highlights how smart neighbourhoods, which combine technology, sustainability, and inclusivity, can serve as models for comprehensive urban development. However, their success is dependent on balancing innovation with human-centric principles and meeting the needs of all people. This chapter lays the groundwork for Chapter six, which presents revised criteria for planning and creating smarter, more inclusive communities.

Chapter seven then, **“Criteria – Planning research section”,** presents a revised set of planning and design requirements for smart cities and neighbourhoods. This chapter seeks to fill the gaps and issues indicated in previous chapters by offering a balanced framework that combines technical improvements with human - centric and environmental principles. The goal is to rethink what it means to be "smart" in urban planning by changing the emphasis away from efficiency and innovation and toward inclusivity, equity, and adaptability. This chapter begins by highlighting the necessity for a multifaceted approach to smart community design, with an emphasis on social, cultural, and environmental factors. Inclusivity, sustainability, human-centered design, participatory governance, ethics, and privacy are among the new criteria as they advocate for technological integration, social equality, cultural preservation, sustainable measurements, and scalability and adaptability. This chapter uses case studies to demonstrate how these criteria could improve current smart neighbourhoods, including Barcelona's participatory government, Copenhagen's Nordhavn, among others. Finally, chapter seven closes by providing the recommended criteria as a road map for building smarter, more inclusive, and sustainable communities. These redesigned guidelines seek to redefine success in smart city planning by moving away from a narrow focus on technology innovation and toward a holistic strategy that values people and the environment. This chapter lays the groundwork for Chapter eight, in which the practical consequences and potential applications of these criteria are discussed.

Last but not least, chapter eight **“Discussion on the scientific contributions and applications of the research results in scientific, professional and educational domains”,** summarizes the findings and discusses the practical implications of the proposed criteria for smart city neighbourhoods into the smart city platform. This chapter discusses the research contributions to urban planning theory, practice, and policy. It also makes concrete recommendations to urban planners, legislators, and stakeholders, guaranteeing that the proposed framework can be effectively implemented in real - world circumstances. This chapter further emphasizes the importance of smart city planning using a balanced framework that incorporates technology and human - centric principles, as it presents a complete framework that includes social, cultural, and environmental components while emphasizing inclusivity and equity. The framework specifies concrete criteria for smart neighbourhood development, such as sustainability, community well - being, and equity metrics, while it also makes policy proposals to match urban planning practices with the new standards and encourages their incorporation into national and international urban development strategies.

The research presents an innovative methodology for urban planning within the smart city framework, emphasizing the critical interaction among technological advancement, sustainability, and human - centered principles. The research methodically investigates the evolution, implementation, and impact of smart cities and neighbourhoods, providing a balanced assessment of current practices and proposing reformed standards to guide future improvements. Then, this research examines the development and evolution of smart cities, emphasizing their dual character as innovation hotspots and potential drivers of inequity. It emphasizes the technological advances that have transformed urban living while also highlighting ethical and social issues like as privacy problems, digital divisions, and the risk of exclusion. The research gives a complete grasp of the gaps in existing models and the need for a paradigm shift by delving into top - down approaches, present evaluation frameworks, and smart neighbourhood initiatives in depth.

The research objectives - identifying limits in established guidelines, analyzing smart neighbourhood implementation, establishing restructured criteria, and emphasizing equal access to urban resources - are realized through a rigorous mixed - method approach. This comprises comparative analysis, case studies, and theoretical critiques, which ensure a comprehensive and interdisciplinary approach.

The proposed criteria represent a substantial divergence from previous technology - centric paradigms, promoting inclusivity, sustainability, and adaptability. The research redefines "smart" urban planning by including human - centered design concepts, participatory governance, and ethical issues. Case studies from cities such as Barcelona, Copenhagen, and Vienna, show how these new criteria might be successfully used, bridging the gap between theoretical ideas and real - world implementation.

The research concludes with specific recommendations for urban planners, legislators, and stakeholders, emphasizing the significance of collaboration and adaptation in the development of smart cities. It suggests a method for creating neighbourhoods that are not only technologically advanced, but also socially inclusive, environmentally sustainable, and culturally responsive. The research pioneer's urban environments that prioritize the well-being of all individuals while leveraging the transformative potential of technology by redefining success in smart city planning.

In summary, this research serves as a valuable resource for individuals who are engaged in the planning and design of smart cities and neighbourhoods, as well as a critique of current methods and a visionary framework for the future. It motivates urban planners and policymakers to consider alternatives to efficiency and innovation, advocating for a more comprehensive approach that prioritizes fairness, sustainability, and humanism in the development of smart cities. In order to improve the quality of life, the research has substantially advanced scientific knowledge by establishing criteria for the planning and design of urban neighbourhoods within the smart city initiative. These contributions are structured into three primary research phases and address the research issues, aims, and hypotheses. Scientific theory is enhanced by theoretical investigation. Contextual analysis research offers a methodological scientific contribution. Spatial planning research provides a contextual scientific contribution that is pertinent to the criteria for planning and designing. Subsequently, professional guidelines for the planning and design of city neighbourhoods that strike a balance between environmental sustainability, social inclusion, and technological innovation, were developed based on the analyses of extant smart neighbourhoods that have been examined thus far in this research. Based on the analyses of extant smart neighbourhoods analyzed thus far in this research, this research offers professional guidelines for the planning and design of criteria for city neighbourhoods that strike a balance between environmental sustainability, social inclusion, and technological innovation. This section is designed for urban planners, architects, and city authorities who wish to implement smart city concepts without compromising the privacy or well-being of humans.

Finally, research contributes to the education system by integrating smart city findings and best practices into the academic curriculum. We are of the opinion that universities are indispensable for the education of future technology developers, architects, and urban planners. By effectively incorporating the scientific and professional contributions from this research into university instruction, it is possible to effectively address the challenges and principles of human - centered design.

Prošireni (strukturirani) sažetak

KRITERIJI ZA PLANIRANJE I PROJEKTIRANJE GRADSKIH SUSJEDSTVA U KONTEKSTU SMART CITY PLATFORME

Ovaj doktorski rad istražuje koncept pametnih gradova te naglašava načine na koje je uvođenje digitalnih tehnologija dovelo do značajnog porasta u području urbanističkog planiranja diljem svijeta. Rezultati istraživanja ističu važnost tehnologije u rješavanju urbanih problema kao što su upravljanje resursima i održivost, povećanje energetske učinkovitosti i smanjenje prometnih gužvi. Ipak, prisutne su zabrinutosti vezane uz dugoročnu održivost okoliša, uključivanje javnosti i zaštitu privatnosti. Stoga se u istraživanju zagovara metodologija dizajna usmjerena na čovjeka, koja uspostavlja ravnotežu između dobrobiti stanovnika i tehnoloških unapređenja.

Ovaj doktorski rad sustavno analizira nedostatke u standardima planiranja i dizajna koji su već prisutni u kontekstu pametnih gradova, a što predstavlja ključno pitanje u raspravama o urbanom razvoju. Istraživanje pruža čvrstu osnovu za preispitivanje dizajna pametnih susjedstava kroz analizu postojećih globalnih standarda, proučavanje praktičnih implementacija te predlaganje inovativnih alternativa. Glavni ciljevi rada su identificirati i procijeniti postojeće smjernice i njihove manjkavosti, kritički sagledati implementaciju pametnih susjedstava iz perspektive inkluzivnosti i održivosti, razviti revidirane kriterije koji uravnotežuju tehnološke inovacije s vrijednostima usmjerenima na čovjeka, te naglasiti važnost pravednog pristupa urbanim resursima i uslugama.

Prvi cilj je otkriti propuste u postojećim smjernicama, osobito njihovu ovisnost o tehnološkim mjerama umjesto o društvenim, psihološkim i kulturnim aspektima urbanog života. Kroz detaljnu analizu tih zahtjeva istraživanje nastoji izgraditi osnovu za razvoj inkluzivnijih i pravednijih planerskih smjernica. Ocjenjuju se postojeći okviri, uključujući one Europske unije i Europske investicijske banke, s naglaskom na pojedinca, okoliš i kvalitetu života. Rad naglašava odsutnost načela usmjerenih na čovjeka i nerazmjerni naglasak na tehnologiji, tvrdeći da ti okviri nedovoljno obuhvaćaju šira urbana pitanja poput mentalnog zdravlja, socijalne pravednosti i kulturne održivosti.

Nadalje, istraživanje prepoznaje praznine u stvarnoj primjeni ovih kriterija u pametnim susjedstvima, uključujući pitanja privatnosti i sigurnosti podataka, dostupnosti za nedovoljno zastupljene zajednice te uvažavanja kulturne i psihološke dobrobiti.

Drugi cilj rada jest razvoj pametnih susjedstava s naglaskom na inkluzivnost i održivost. Iako su brojni programi pametnih susjedstava hvaljeni kao inovativna rješenja za urbane izazove, njihova implementacija često otkriva manjkavosti i nepredviđene posljedice. Ovaj cilj ispituje kako ti projekti povezuju tehnološke inovacije s društvenom jednakošću i ekološkom održivošću, ističući njihove prednosti i slabosti. Istraživanje posebno analizira primjenu ekološki održivih praksi u pametnim susjedstvima, naglašava pitanja socijalne pravednosti i okolišnih učinaka, dok ujedno razmatra rizik od gentrifikacije. Također se problematizira nedovoljno uključivanje dionika i hijerarhijski model planiranja.

Za postizanje navedenog korišten je namjerni, višestupanjski odabir primjera s ciljem dubinske analize dvadeset pametnih susjedstava iz početnog skupa od približno 200. Primijenjena je sustavna metoda pretraživanja radi smanjenja uzorka u skladu s ciljevima istraživanja, s obzirom na velik broj potencijalnih primjera. Proces je bio usmjeren na raznovrsne urbane situacije i teme u okviru pametnog urbanizma, istovremeno zadovoljavajući praktične kriterije vezane uz dostupnost podataka i vremenske okvire. Selekcija 20 susjedstava temeljila se na specifičnim kriterijima: geografska raznolikost unutar Europe, različite tipologije susjedstava (brownfield, greenfield, prigradska, ruralna, mješovite namjene ili povijesno/zaštićene cjeline), različite veličine i populacije, te raznoliki pametni ciljevi uključujući ekološku održivost, inovacije, društvenu uključenost i kvalitetu života. Prednost su imala susjedstva s dovoljno pouzdanim i dostupnim podacima o pametnim inicijativama.

Iz početnog skupa od 20 Europskih pametnih susjedstava, pet je odabrano dvostupanjskim metodološkim postupkom koji kombinira uzorkovanje prema kriterijima (dostupnost podataka, zrelost projekta i širina programa u različitim domenama) s uzorkovanjem prema maksimalnim varijacijama (geografija, razmjeri, upravljačke strukture i tematski fokus). Primjeri bez dovoljne javne dokumentacije ili oni ograničeni na pilot-faze izostavljeni su; također su eliminirani slični primjeri kako bi se izbjegla redundancija.

Istraživanje se oslanja na šest-dimenzijski paradigmatski model pametnog grada, s fokusom na tri ključne dimenzije: Pametno okruženje, Pametan život i Pametni ljudi. Svaki slučaj kategorizira ciljeve, intervencije, rezultate i dokaze u navedene tri osnovne dimenzije; dodatne dimenzije (Mobilnost, Upravljanje, Ekonomija) tretiraju se kao faktori konteksta i vrednuju samo u onoj mjeri u kojoj pridonose razumijevanju ili otežavaju ostvarenje rezultata.

Treći cilj rada je formuliranje revidiranih kriterija za planiranje i projektiranje pametnih susjedstava koji povezuju ljudske vrijednosti s tehnološkim napretkom. Namjera je uspostaviti sveobuhvatan skup kriterija koji naglašava dobrobit stanovnika, društvenu uključenost i pravedan pristup, istovremeno prepoznajući nedostatke postojećih okvira i prepreke implementaciji. Poseban naglasak stavljen je na uključivanje mentalnog zdravlja, društvene kohezije i kulturnog identiteta u proces planiranja. Rad stavlja u središte društvenu inkluzivnost, uključujući starije osobe, osobe s invaliditetom i stanovnike s nižim prihodima. Kriteriji također naglašavaju okolišnu i društvenu održivost kroz zelenu infrastrukturu, obnovljive izvore energije i održive modele urbane mobilnosti.

Završni cilj je istaknuti važnost pravednog pristupa gradskim resursima i uslugama u okviru pametnog grada. Time se nastoji osigurati da koristi pametnih tehnologija i usluga budu dostupne svim stanovnicima, neovisno o socioekonomskom statusu, digitalnoj pismenosti ili geografskom položaju.

Cilj je razvijati inkluzivna i održiva urbana okruženja koja adresiraju sustavne nejednakosti u planiranju vođenom tehnologijom.

Prvo poglavlje, **“Teorijski istraživački odjeljak”**, uspostavlja kontekst disertacije smještajući istraživanje u aktualni diskurs o pametnim gradovima. Počinje s pojmom inteligentnog urbanog razvoja, obuhvaćajući njegove komponente i brojne izazove koje on predstavlja suvremenom urbanističkom planiranju. Ključna tema odnosi se na ubrzani tehnološki napredak, koji se često nalazi u sukobu s načelom davanja prioriteta ljudskom iskustvu u gradskom životu. Taj sukob doveo je do nekoherentnog pristupa obilježenog nedosljednošću i izostankom jasne vizije. Cilj je ovog dijela kritički sagledati postojeće prakse oblikovanja pametnih gradova te razviti kriterije koji uravnotežuju digitalne, okolišne i društvene dimenzije u inkluzivnijem okviru. Rad polazi od pretpostavke da su mnogi postojeći okviri pametnih gradova previše tehnološki orijentirani. Međutim, prisutna je nada da će se kroz strateški i unaprijed promišljen pristup razviti unaprijeđene i održivije verzije tih programa.

Drugo poglavlje, **“Analiza konteksta”**, kontekstualizira istraživanje pružajući iscrpan pregled razvoja pametnih gradova kao prostora inovacija i održivosti. Obrađuju se glavni trendovi, tehnologije i izazovi koji su oblikovali okvire pametnog grada. Ovo poglavlje stvara osnovu za razumijevanje daljnjih rasprava, pozicionirajući pametne gradove istovremeno kao priliku i kao izazov u suvremenom urbanom razvoju. Poglavlje analizira povijesni razvoj pametnih gradova kroz digitalne tehnologije, Internet stvari (IoT) i big data, pri čemu ih definira kao urbane cjeline koje koriste tehnologiju radi povećanja učinkovitosti, održivosti i kvalitete života. Posebno se obrađuju ključne tehnologije: IoT za prikupljanje podataka u stvarnom vremenu i upravljanje infrastrukturom, umjetna inteligencija za donošenje odluka i prediktivne analize te big data za optimizaciju komunalnih usluga. Analizirano je i kako pametni gradovi adresiraju izazove urbanizacije poput prometnih gužvi, okolišne održivosti i upravljanja resursima. Primjeri – uključujući integraciju IoT-a u infrastrukturu Barcelone, primjenu umjetne inteligencije i big data u Singapuru te razvoj Nordhavn distrikta u Kopenhagenu – ilustriraju i prilike i izazove. Istaknuto je kako pametni gradovi nose dvostruki karakter: s jedne strane nude neusporedive mogućnosti inovacija i održivosti, a s druge strane generiraju izazove u pogledu pravednosti, inkluzije i etičkog upravljanja. Poglavlje završava zaključkom da pametni gradovi predstavljaju “dvosjekli mač” – izvorište potencijala, ali i rizika koji zahtijevaju sveobuhvatan, etički i inkluzivan pristup.

Treće poglavlje, **“Koncept pametnog grada”,** detaljno razrađuje konceptualni okvir pametnih gradova, uključujući definicije, razvoj i različita tumačenja. Istodobno postavlja temelje za razumijevanje načina na koji se koncept pomaknuo s primarno tehnološke orijentacije prema širim humanističkim i socio–ekološkim perspektivama. Poglavlje naglašava složenost i raznolikost pristupa razvoju i implementaciji pametnih gradova. U fokusu su utjecaji digitalnih tehnologija, pritisaka urbanizacije i ciljeva održivosti na definiranje pametnih gradova. Koncept se s vremenom razvijao: od tehnološki vođenih modela prema humanističkim pristupima s naglaskom na inkluzivnost. Također se analizira uloga ključnih dionika u ekosustavu pametnog grada: tehnoloških kompanija (IBM, Google, Siemens), državnih i lokalnih vlasti te stanovnika, koji su nerijetko isključeni iz procesa planiranja i donošenja odluka. Poglavlje razlikuje četiri tipa pametnih gradova: tehnološki vođene, podatkovno vođene, humanističke te hibridne modele. Ovi modeli uključuju različite prioritete – od infrastrukture, IoT-a, umjetne inteligencije i big data, do održivosti, pametnog upravljanja, mobilnosti, ekonomije i stanovanja. Kao primjeri su uzuti Singapur, Songdo (Južna Koreja) i projekt *Amsterdam Smart City*, koji ukazuju na tehnološki determinizam, isključujuće prakse i zabrinutosti zbog nadzora i privatnosti. Zaključak poglavlja naglašava važnost nijansiranog i inkluzivnog shvaćanja pametnih gradova, pozivajući na odmak od isključivo tehnoloških modela prema hibridnim pristupima koji uravnotežuju inovacije sa socijalnom, kulturnom i ekološkom održivošću.

Četvrto poglavlje, **"Strategije pametnih gradova"**, kritički evaluira glavne top-down metodologije korištene u razvoju pametnih gradova. Ti pristupi, koje najčešće vode vlade, gradske vlasti ili velike tehnološke kompanije, naglašavaju centralizirano donošenje odluka i izgradnju velikih infrastrukturnih projekata. Iako su takvi modeli učinkoviti i brzo provedivi, često se kritiziraju zbog zanemarivanja sudjelovanja zajednice, socijalne uključenosti i prilagodbe lokalnim uvjetima. Poglavlje razrađuje top-down planiranje kao centralizirani, hijerarhijski model u kojem odluke donose autoriteti bez stvarnog uključivanja građana. Prednosti ovakvog pristupa uključuju učinkovitost, koordinaciju i mogućnost upravljanja velikim resursima, dok su nedostatci povezani s isključivanjem zajednice, pojednostavljenim rješenjima i rizikom tehnokratske dominacije. Kao primjer koristi se tehnološka transformacija Barcelone, koja ističe ograničenja top-down taktika. Usporedbom s participativnim, bottom-up modelima planiranja, poglavlje zaključuje da kombinacija snaga oba pristupa može rezultirati hibridnim modelima planiranja. Predlaže se prevladavanje ograničenja kroz povećano uključivanje zajednice, lokalizirano planiranje i transparentno upravljanje. Zaključno, poglavlje naglašava kako, iako top-down modeli donose prednosti u pogledu učinkovitosti i razmjera, njihova ograničenja potvrđuju nužnost participativnih procesa i ljudski orijentiranih načela u planiranju pametnih gradova.

Peto poglavlje, **"Kriteriji pametnih gradova",** nastavlja kritičku analizu postojećih kriterija za vrednovanje i implementaciju pametnih gradova, s fokusom na njihove prednosti, ograničenja i primjenjivost. Ti kriteriji, najčešće oblikovani kroz tehnološke i ekonomske pokazatelje, čine osnovu modernih okvira za pametne gradove. Međutim, u ovom poglavlju naglašava se kako takvi standardi imaju ozbiljne nedostatke kada je riječ o društvenim, kulturnim i ljudski usmjerenim čimbenicima. Analiza obuhvaća globalne okvire, poput međunarodnih standarda (npr. ISO 37122) i razvojnih politika Svjetske banke, koji naglašavaju upravljanje, administrativnu učinkovitost, tehnološku spremnost, okolišnu održivost i ekonomsku produktivnost. Premda korisni za definiranje osnovnih smjernica, ovi okviri često zanemaruju socijalne elemente, pretjerano naglašavaju tehnologiju i ne rješavaju dovoljno jasno pitanje jednakog pristupa gradskim resursima. Kroz primjere poput Barcelone i Kopenhagena, u radu se ukazuje na ograničenja postojećih kriterija. Zaključak poglavlja glasi: iako aktualni standardi za pametne gradove mogu poslužiti kao početna točka, oni ne zadovoljavaju kompleksne potrebe suvremenih urbanih zajednica. Potrebna je sveobuhvatna revizija evaluacijskih okvira koja uključuje i ljudsku dimenziju.

Šesto poglavlje, **"Projekti / Susjedstva – Bottom-up pristup",** usmjerava se na praktičnu primjenu koncepta pametnih gradova na lokalnoj razini, naglašavajući kako pametna susjedstva funkcioniraju kao mikrosvjetovi pametnog grada. Ona pokazuju i potencijale i ograničenja integracije tehnologije, održivosti i ljudski usmjerenog dizajna. U središtu poglavlja su pristupi dizajnu susjedstava koja su inkluzivna, održiva i osjetljiva na potrebe raznolikih populacija. Pametna susjedstva definirana su kao lokalizirane implementacije pametnih načela koja kroz tehnologiju nastoje poboljšati kvalitetu života, unaprijediti održivost i povećati povezanost. Njihove ključne značajke uključuju integrirane tehnologije poput IoT infrastrukture, pametnih mreža i digitalnih usluga, kao i održivi dizajn i planiranje usmjereno na zajednicu. Pametna susjedstva često djeluju kao eksperimentalna polja novih urbanističkih ideja, balansirajući između centraliziranih (top-down) i participativnih (bottom-up) pristupa. Tehnološka integracija obuhvaća IoT senzore, pametna rješenja za mobilnost i digitalne platforme za uključivanje stanovnika, dok se održivost postiže putem obnovljivih izvora energije, zelenih površina i sustava za smanjenje otpada. Zaključak poglavlja ističe transformativni potencijal pametnih susjedstava u oblikovanju budućnosti urbanog života. Ona mogu poslužiti kao modeli cjelovitog urbanog razvoja koji spajaju tehnologiju, održivost i inkluzivnost. Međutim, njihova uspješnost ovisi o ravnoteži između inovacija i ljudski usmjerenih načela te o stvarnom odgovoru na potrebe svih društvenih skupina. Ovo poglavlje priprema temelje za sljedeće, u kojem se predlažu revidirani kriteriji za planiranje i oblikovanje pametnih, inkluzivnih i održivih zajednica.

Sedmo poglavlje, **"Kriteriji – Istraživački dio planiranja",** donosi revidirani skup kriterija za planiranje i oblikovanje pametnih gradova i susjedstava. Cilj je nadomjestiti praznine i slabosti prepoznate u prethodnim poglavljima nudeći uravnotežen okvir koji spaja tehnološke inovacije s humanističkim i ekološkim načelima. U fokusu je redefiniranje pojma "pametno" u urbanom planiranju, pri čemu se naglasak premješta s puke učinkovitosti i inovativnosti prema inkluzivnosti, pravednosti i prilagodljivosti. Novi kriteriji naglašavaju važnost višedimenzionalnog pristupa koji uvažava socijalne, kulturne i ekološke faktore. Uključuju: inkluzivnost, održivost, dizajn usmjeren na čovjeka, participativno upravljanje, etičnost i zaštitu privatnosti. Zalažu se za tehnološku integraciju, ali i za društvenu pravednost, očuvanje kulturne baštine, mjere održivosti te skalabilnost i prilagodljivost. U poglavlju se koriste primjeri kako bi se prikazalo na koji način ovi kriteriji mogu unaprijediti postojeća pametna susjedstva, uključujući participativno upravljanje u Barceloni te projekt Nordhavn u Kopenhagenu. Zaključno, sedmo poglavlje predstavlja preporučene kriterije kao putokaz za izgradnju pametnijih, inkluzivnijih i održivijih zajednica. Time se redefinira uspjeh u planiranju pametnih gradova, pomičući fokus s tehnoloških inovacija na holistički pristup koji vrednuje ljude i okoliš. Ovo poglavlje ujedno priprema teren za osmo, koje se bavi praktičnim posljedicama i mogućnostima primjene novih kriterija.

Osmo poglavlje, **"Rasprava o znanstvenim doprinosima i primjenama rezultata istraživanja u znanstvenom, stručnom i obrazovnom području"**, sažima nalaze istraživanja i obrađuje praktične implikacije predloženih kriterija za pametna susjedstva u okviru platforme pametnog grada. Naglašava se doprinos istraživanja teoriji, praksi i politici urbanog planiranja. Poglavlje nudi konkretne preporuke urbanistima, donositeljima politika i dionicima, kako bi se osiguralo da se predloženi okvir može učinkovito implementirati u stvarnim okolnostima. Dodatno, ističe važnost planiranja pametnih gradova kroz uravnotežen pristup koji kombinira tehnologiju s humanističkim načelima. Predložen je sveobuhvatan okvir koji uključuje socijalne, kulturne i ekološke komponente, s naglaskom na inkluziju i pravednost. Okvir precizira konkretne kriterije za razvoj pametnih susjedstava, uključujući održivost, dobrobit zajednice i mjerne pokazatelje pravednosti. Također se daju prijedlozi politika radi usklađivanja urbanističke prakse s novim standardima i poticanja njihove primjene na nacionalnoj i međunarodnoj razini. Istraživanje se ističe inovativnom metodologijom koja naglašava međudjelovanje tehnološkog napretka, održivosti i ljudski usmjerenih načela. Sustavno se analizira razvoj, implementacija i utjecaj pametnih gradova i susjedstava, pružajući uravnoteženu ocjenu aktualnih praksi i predlažući reformirane standarde za budući razvoj. Rad također ukazuje na dvojaku prirodu pametnih gradova – kao žarišta inovacija, ali i potencijalne izvore nejednakosti. Posebno se naglašavaju etički i socijalni izazovi, poput privatnosti, digitalne podjele i rizika od isključivanja. Kroz detaljnu analizu top-down pristupa, postojećih evaluacijskih okvira i pametnih susjedstava, rad potvrđuje nužnost paradigme koja spaja inovaciju s inkluzivnošću. Predloženi kriteriji predstavljaju značajan odmak od dosadašnjih tehnološki centričnih paradigmi, promovirajući inkluzivnost, održivost i prilagodljivost. Primjeri iz gradova poput Barcelone, Kopenhagena i Beča pokazuju kako se ovi novi kriteriji mogu uspješno primijeniti, premošćujući jaz između teorijskih ideja i stvarne implementacije.

Istraživanje predstavlja inovativnu metodologiju urbanističkog planiranja u okviru platforme pametnog grada, naglašavajući kritičnu međuovisnost tehnološkog napretka, održivosti i načela usmjerenih na čovjeka. Sustavno se istražuje razvoj, implementacija i učinci pametnih gradova i susjedstava, pružajući uravnoteženu procjenu postojećih praksi te predlažući reformirane standarde za buduća unaprjeđenja. Nadalje, istraživanje analizira razvoj i evoluciju pametnih gradova, naglašavajući njihovu dvojnu prirodu – kao žarišta inovacija, ali i potencijalne izvore društvenih nejednakosti. Posebno se ističu tehnološki napretci koji su transformirali urbani život, uz istodobno ukazivanje na etička i društvena pitanja poput problema privatnosti, digitalnih podjela i rizika od isključivanja. Rad nudi cjelovito razumijevanje praznina u postojećim modelima i potvrđuje potrebu za paradigmatskim zaokretom kroz detaljnu analizu top–down pristupa, aktualnih evaluacijskih okvira i inicijativa pametnih susjedstava.

Ciljevi istraživanja – identifikacija ograničenja postojećih smjernica, analiza implementacije pametnih susjedstava, uspostava revidiranih kriterija i naglašavanje jednakog pristupa urbanim resursima – ostvareni su rigoroznim kombiniranim metodološkim pristupom. On uključuje komparativne analize, analize primjera i teorijske kritike, čime se osigurava sveobuhvatna i interdisciplinarna perspektiva. Predloženi kriteriji predstavljaju značajan odmak od dosadašnjih tehnološki centričnih paradigmi, promovirajući inkluzivnost, održivost i prilagodljivost. Istraživanje redefinira "pametno" urbano planiranje uvođenjem načela dizajna usmjerenih na čovjeka, participativnog upravljanja i etičkih pitanja. Primjeri iz gradova poput Barcelone, Kopenhagena i Beča pokazuju kako se ti novi kriteriji mogu uspješno primijeniti, premošćujući jaz između teorijskih ideja i stvarne implementacije. Istraživanje završava konkretnim preporukama za urbaniste, zakonodavce i dionike, naglašavajući važnost suradnje i prilagodbe u razvoju pametnih gradova. Predlaže se metoda stvaranja susjedstava koja nisu samo tehnološki napredna, nego i društveno inkluzivna, okolišno održiva i kulturno osjetljiva. Rad pionirski definira urbane prostore koji daju prednost dobrobiti svih stanovnika, istodobno koristeći transformativni potencijal tehnologije i redefinirajući pojam uspjeha u planiranju pametnih gradova. Zaključno ovaj doktorski rad predstavlja vrijedan resurs za sve koji se bave planiranjem i oblikovanjem pametnih gradova i susjedstava, istodobno funkcionirajući kao kritika postojećih metoda i vizionarski okvir za budućnost. On može potaknuti urbaniste i donositelje politika da razmotre alternative pukoj učinkovitosti i inovacijama, zagovarajući sveobuhvatniji pristup koji u središte razvoja pametnih gradova stavlja pravednost, održivost i humanizam. Kako bi se unaprijedila kvaliteta života, istraživanje je značajno obogatilo znanstvena saznanja kroz uspostavu kriterija za planiranje i dizajn urbanih susjedstava u okviru inicijative pametnog grada. Doprinosi su strukturirani u tri osnovne istraživačke faze i adresiraju istraživačke probleme, ciljeve i hipoteze. Teorijska istraživanja obogaćuju znanstvenu teoriju, kontekstualne analize donose metodološki znanstveni doprinos, dok istraživanja prostornog planiranja nude kontekstualni doprinos relevantan za kriterije planiranja i projektiranja. Na temelju analize postojećih pametnih susjedstava, razvijene su stručne smjernice za planiranje i oblikovanje kriterija gradskih susjedstava koje uspostavljaju ravnotežu između ekološke održivosti, društvene uključenosti i tehnološke inovacije. Ovaj je dio posebno namijenjen urbanistima, arhitektima i gradskim vlastima koji žele implementirati koncepte pametnog grada, a da pritom ne ugroze privatnost niti dobrobit stanovnika. Konačno, istraživanje pridonosi i obrazovnom sustavu integriranjem nalaza i najboljih praksi pametnih gradova u akademske kurikulume. Kako su sveučilišta nezamjenjiva u obrazovanju budućih tehnoloških stručnjaka, arhitekata i urbanista, učinkovitom integracijom znanstvenih i stručnih doprinosa iz ovog istraživanja u sveučilišnu nastavu moguće je pomoći u stvaranju sustavnog odgovorg na izazove i načela dizajna usmjerenog na čovjeka.

Content Overview of the Doctoral Dissertation

BOOK I – DOCTORAL DISSERTATION

CRITERIA FOR CITY NEIGHBOURHOODS’ PLANNING AND DESIGNING IN THE CONTEXT OF THE SMART CITY PLATFORM

Content Overview of the Doctoral Dissertation

BOOK II – APPENDIX – RESEARCH CATALOGUES

CRITERIA FOR CITY NEIGHBOURHOODS' PLANNING AND DESIGNING IN THE CONTEXT OF THE SMART CITY PLATFORM

1. **CATALOGUE 1 (Book I – Chapter 4)**
   RESEARCH CATALOGUE OF SMART CITY STRATEGIES ACROSS EUROPE.
   Strategies, based on official documents of cities-smart cities

2. **CATALOGUE 2 (Book I – Chapter 5)**
   RESEARCH CATALOGUE OF SMART CITY CRITERIA.
   Criteria by Smart city associations, EIB

3. **RESEARCH CATALOGUE 3 (Book I – Chapter 6)**
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   Criteria, based on official documents of smart neighbourhoods

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BOOK I – DOCTORAL DISSERTATION

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THEORETICAL RESEARCH SECTION

Photograph 1
'Place de la Nation', one of the squares transformed by the 15-minute city concept in Paris.
Author: Dmitry Kostyukov, April 2022

1. THEORITICAL RESEARCH SECTION

1.1. INTRODUCTION TO THE RESEARCH OF CRITERIA FOR CITY NEIGHBOURHOODS' PLANNING AND DESIGNING IN THE CONTEXT OF THE SMART CITY PLATFORM

The rapid integration of digital technology has resulted in a significant transformation in urban development around the world. Smart cities are at the forefront of this transformation, addressing urbanization issues such as sustainability, efficiency, and resource management. These cities use technology to improve energy efficiency and reduce traffic congestion. However, new challenges emerge, such as privacy, social inclusion, environmental sustainability, and balancing technology and human well-being. **This research examines smart cities, highlighting both their potential and limitations. Firstly, it examines case studies of prominent smart neighbourhoods and proposes a rethinking of smart city criteria. Secondly, it emphasizes the importance of human-centered approaches that prioritize well-being, privacy, and social inclusion, as well as technological innovation, in order to create a more sustainable and inclusive urban environment.**

Smart cities are emerging as a response to urbanization's demands for sustainable, efficient, and resilient environments (Caragliu, Del Bo, and Nijkamp, 2011; Harrison and Donnelly, 2011; Anthopoulos, 2017). By utilizing IoT (Zanella et al. 2014), data-driven solutions (Kitchin, 2014), and AI-based systems (Bibri, 2018), cities can manage resources more effectively, monitor public spaces in real time, and deliver services with unprecedented speed and accuracy. These cities address challenges like population growth (Angelidou, 2014), environmental degradation (Joss, Cowley, and Tomozeiu, 2013), and modern urban life pressures by reducing energy consumption (GhaffarianHoseini et al., 2013), improving public safety (Kumar, Kumar, and Shah, 2019), and optimizing transportation systems (Nam and Pardo, 2011), thereby – enhancing the quality of life for residents.

However, smart cities face issues such as privacy (Kitchin, 2016), surveillance (Lyon, 2018), and the digital divide (Van Dijk, 2020). These authors echo that surveillance technologies increase safety and efficiency while raising ethical concerns about privacy and autonomy, while the widespread collection of data can erode trust between citizens and city officials. Furthermore, these scholars agree that the digital infrastructure prioritizes efficiency above human-centered design, which may aggravate or alienate some groups, especially the less tech-savvy or the underprivileged. **That being said, this research suggests that instead of focusing just on efficiency, smart cities should embrace a more inclusive, socially conscious, and human-centered approach.**

1.2 RESEARCH PREMISES AND IDENTIFIED PROBLEMS

In addition, **this research promotes a human-centered approach to urban design in smart cities, putting residents' needs, well-being, and dignity first.** Despite technological advances, urban planners frequently overlook residents' social, psychological, and emotional needs. We consider that smart technologies, such as IoT devices, can create environments that promote social isolation, digital exclusion, and psychological stress, emphasizing the need for a more comprehensive approach. With that being said, this research explores the tension between technological efficiency and human well-being in neighbourhoods like Aspern Seestadt and Nordhavn, among others. Smart technologies are used to optimize energy use, manage public spaces, and reduce environmental impact. However, these technologies also introduce privacy and surveillance challenges. Sensors in public parks collect vast data, raising concerns about misuse and personal freedoms. Amnesty International (2019) support this claim as they warn that the increasing use of surveillance technologies can turn idealized environments into "surveillance nightmares," where residents feel constantly monitored and stripped of their autonomy.

Furthermore, the digital divide, which exists between those who have access to digital technologies and those who do not, impedes the development of inclusive smart cities. According to the research studies (Van Dijk, 2020; Hargittai, 2002; Norris, 2001), among others, low-income individuals, the elderly, and those with lower levels of education are disproportionately excluded from the benefits of smart technologies. Another example are cases of Brainport and Merwede, two smart neighbourhoods, where the emphasis on high-tech solutions may marginalize residents who lack the necessary skills, resulting in a two-tiered society in which only digitally literate individuals can fully benefit from city services and opportunities.

Another crucial aspect of this research emphasizes the importance of public spaces in smart cities, such as parks and pedestrian zones, for encouraging social interaction and community well-being. From the different case studies, such as the neighbourhoods of Merwede and Aspern Seestadt, we have seen how urban prioritize green spaces and pedestrian-friendly areas as part of their smart city initiatives, with the goal of encouraging physical activity, social interaction, and community engagement, all of which are essential for residents' mental and emotional well-being in a digital world (Gehl, 2011). However, as this research explores, the integration of technology into public spaces must be carefully managed to avoid creating environments that feel overly controlled or monitored. While IoT devices and smart sensors can improve public spaces, they can also limit the freedom and spontaneity that make them so useful for social interaction. Kitchin's (2016) research supports this, as he discusses how the use of IoT devices and smart technologies in public spaces can improve efficiency and management while also limiting freedom and spontaneity due to increased surveillance and monitoring, which can inhibit natural social interactions. Thus, we suggest that urban planners must strike a balance between technological advancement and maintaining an open, inclusive environment free of intrusive surveillance.

Smart city initiatives prioritize sustainability by lowering carbon footprints, conserving energy, and encouraging green living. Smart neighbourhoods such as Nordhavn, Brainport, and Schumacher Quarter incorporate renewable energy sources, smart grids, and energy-efficient buildings to address global climate change and environmental degradation. However, the emphasis on environmental sustainability in smart cities often comes at the expense of human well-being. With that being said, this research emphasizes the importance of rethinking sustainability in smart cities by taking into account social and psychological dimensions. While Merwede's car-free design promotes environmental sustainability, residents who are unfamiliar with alternative modes of transportation may experience increased stress. At the same time, we have noted in the case studies that those who struggle with digital platforms may experience mental fatigue and alienation as a result of the constant adaptation to modern transportation and smart technologies. As a result, we suggest that the concept of sustainability to be reframed. **Ultimately, this research advocates for a comprehensive approach to sustainability in smart cities that balances environmental efficiency with residents' needs. It suggests that cities be designed to reduce energy consumption and carbon emissions while also promoting social inclusion, mental health, and community well-being.**

This research also proposes a new perspective for smart cities that goes beyond technology, attempting to incorporate human-centered values by emphasizing the need of integrating technology while preserving citizens' dignity, privacy, and well-being. We believe that smart cities should be distinguished by their ability to cultivate thriving, inclusive, and socially connected neighbourhoods. To that end, this research proposes that smart city planning prioritize the human experience, create public spaces that encourage social interaction, ensure equitable access to digital technologies, protect residents' privacy, and foster mental and emotional well-being. This research also reexamines the use of technology in urban living, moving away from a focus on efficiency and toward a more balanced strategy that considers the wider social and psychological ramifications. Not to mention, keeping all of the above in mind, this research offers useful recommendations for legislators, architects, and urban planners. These recommendations center on issues like digital literacy, community involvement, privacy protection, and sustainable urban design, all of which are essential for the development of successful smart cities.

1.3 RESEARCH OBJECTIVES, HYPOTHESES, AND EXPECTED SCIENTIFIC CONTRIBUTIONS

The structure of the main scientific research objectives, hypotheses, and expected contributions includes:[1]

- **O1:** Analysis of Existing Criteria: To investigate the planning and design criteria currently employed by international agencies for new communities in smart cities. This will serve as a foundation for understanding the global standards that guide smart city development.
- **H1:** Present smart neighbourhood planning and design standards need to be restructured to better reflect various urban demands and lifestyles.
- **C1:** Critical discussion of Smart city ideals, programs and criteria for design for Smart neighbourhoods.
- **O2:** Critical Assessment of Smart Neighbourhoods: This research will examine the implementation of long-term architectural principles in the context of smart city planning, highlighting strengths and limitations.
- **H2:** A comparative investigation of current smart neighbourhoods in the EU will provide benchmarks for defining new criteria.
- **C2:** Based on analysis of Smart Neighbourhoods propositions and developed criteria produce professional guidelines for planning and design of new city neighbourhoods.
- **O3:** New Criteria Development: By conducting a comparative examination of smart neighbourhoods and new technologies, develop improved criteria for planning and designing of city neighbourhoods.
- **H3:** By introducing a new set of smart city standards, this research can establish architectural rules that support a higher quality of life through improved urban planning and design.
- **C3**: Incorporating scientific and professional contributions of doctoral research into university teaching curriculum.

By addressing these issues, this research hopes to contribute to the developing debate on smart city development by providing insights and practical guidance for policymakers, urban planners, and architects.

[1] The main scientific research objectives, hypotheses, and expected contributions are taken from Dr.Sc.-01 form of the University of Zagreb - Request for approval of the dissertation topic. The dissertation Criteria for city neighbourhoods' planning and designing in the context of the smart city platform was confirmed by the University of Zagreb Senate, Zagreb, 15th February 2022.

Table 1.0. Structured responses to research problems in research levels, relevance of the research topic, research objectives, research hypotheses, and expected scientific contributions.

RESEARCH LEVELS	**RELEVANCE OF THE TOPIC IN RESEARCH PROBLEMS**	**RESEARCH OBJECTIVES**	**RESEARCH HYPOTHESES**	**EXPECTED SCIENTIFIC CONTRIBUTIONS**
THEORETICAL LEVEL	The lack of consistent human-centered planning standards in smart city research shows a gap in the theoretical treatment of neighbourhood development within the smart city framework.	To investigate and clarify the conceptual foundations of smart neighbourhood planning criteria.	Current smart neighbourhood planning approaches lack a comprehensive human-centered framework for planning and design.	Establishment of a conceptual framework for evaluating and developing human-centered smart neighbourhoods.
URBAN CONTEXTUAL ANALYSIS LEVEL	Case studies across European cities show that current smart neighbourhoods differ significantly in design quality, inclusiveness, and responsiveness.	To critically compare representative smart neighbourhoods to identify shared strengths and gaps in planning approaches.	Comparative case analysis reveals inconsistencies and opportunities for standardizing smart neighbourhood planning criteria.	Development of evaluative benchmarks to guide future smart neighbourhood design based on observed best practices.
SPATIAL PLANNING RESEARCH LEVEL	Current planning documents show inconsistent or missing criteria for human-centered design in smart neighbourhood development.	To analyze existing planning documentation and propose a revised set of spatial planning criteria for smart neighbourhoods.	Revised spatial planning criteria can improve alignment with human-centered smart city goals.	Development of a new criteria for planning and designing of city neighbourhoods that balances innovation and social wellbeing.

1.4 RESEARCH METHODS, MATERIALS, AND PLAN BY CHAPTERS

In order to establish the planning criteria that are aimed at improving the quality of life, research is conducted on three levels:

— **Theoretical framework level,** which relies on existing knowledge;
— **Urban Contextual analysis level,** which includes case comparisons and the problems cities face today;
— **Spatial planning research level,** which includes a comparative analysis of smart neighbourhoods planning documents.

All of this research is supported by research catalogues, which can be found in Book II – Appendix. Three different levels of inquiry are broken down into eight different chapters, each of which makes use of scientific techniques, materials, and technology.

1.4.1 Applied science methods

Under the framework of the smart city platform, scientific research is applied in the evaluation of criteria for the planning and designing of city neighbourhoods. Emphasizing the methods of observation, description, and interpretation helps one to develop a strong and context-sensitive knowledge of urban activities and occurrences. The research is grounded on the comparative case research approach, which offers several data collecting techniques for a predefined sample count. This research employs logical reasoning, literature review, contextual historical method, comparative case research, and field investigation among other scientific approaches.

— **Logical reasoning:** The purpose of this research is to contribute to the formulation of planning standards that are not only technologically informed but also socially responsive and environmentally adaptive. This research is positioned as an important component of the larger smart city platform. As a result of this, it provides assistance for the development of communities that are smart, connected, and human - centered within the ever-changing terrain of modern cities.
— **Literature review:** Entails conducting a comprehensive analysis of research publications and documents that are pertinent to the research phenomenon and the field of research being investigated. Additionally, it entails the identification and articulation linked between the existing knowledge and the research topic. This is in addition to the fact that it makes it possible to obtain information. As a source of knowledge and a theoretical foundation for the succeeding research chapters, the literature review is utilized in chapters two and three of the dissertation.
— **Contextual Historical Analysis:** The contextual historical method involves accessing evidence from the past and undertaking activities such as identifying, evaluating, organizing, and analysing the data. It entails conducting research on historical materials (including historical pictures, maps, records, and publications on historical subjects), in order to establish cause-and-effect relationships

for the purpose of comprehending the current conditions in the smart neighbourhoods. There is an application of the historical approach in chapter one, five, and six.

— **The comparative case studies**

A method that is quite complex and involves comparing the results that were achieved via different types of research by employing case studies in order to derive general conclusions. As a result, it is essential to accomplish the reduction of the number of variable factors by selecting case studies and comparison criteria with great care. An application of the comparative case research can be found in chapters three, through six.

1.4.2 Research materials and tools

Within the framework of the smart city platform, the use of mutually overlapping scientific procedures, research materials, and research instruments enables the interaction of three levels of research - theoretical, spatial, planning and designing of city neighbourhoods. (See Table 2.0). In theoretical research, a technique used is the choice of pertinent publications to be examined in the literature from European policy documents, international policy papers, and theoretical frameworks. The approaches used in the process of undertaking physical research are comparative case research, the contextual historical method, field research with the use of pertinent books, historical maps and illustrations, modern maps, and photographic evidence. Comparative case studies of resources related to both historical and present planning help the research on planning.

Research catalogues, tables, schemes, and photographs are some of the research tools that are utilized while conducting research criteria for city neighbourhoods planning and designing in the context of the smart city platform. These resources are employed for analysis and synthesis throughout the research process. The theoretical, physical, and planning research catalogues (Research Catalogues 1–4, Book II – Appendix) provide support for the three (3) different levels of research. Despite the fact that theoretical research catalogues are a useful addition to the method of literature review, the primary instrument that is utilized in the comparative case research is classified as physical and planning catalogues.

Table 2.0 Structure of used research materials in scientific methods and research chapters.

Research materials and tools	**Applied scientific methods**	**Application in chapters**
Publications and Planning Documents		
Publications from theoretical framework	Literature review	1 – 6
Smart city strategies and urban policy papers	Literature review, Comparative case research	3
Publications on Smart Neighbourhood programs	Comparative case research, Literature review	6 – 7
Planning documents from selected smart neighbourhoods	Comparative case research, Literature review	6 – 7
Maps and Zoning Resources		
Smart mobility infrastructure maps	Comparative case research, Field research	4,5
Urban planning zoning maps for smart districts	Comparative case research, Field research	4, 5
Visual and Spatial Observations		
Photographic documentation of public space and smart installations	Field research, Comparative analysis	6, 7
Digital Platforms and Interaction Records		
Diagrams of digital infrastructure	Interpretative analysis	1 – 7
Screenshots and content from citizen engagement platforms	Field research, Comparative case research	1 – 7
Social media and digital participation data	Interpretative analysis, Field research	1 – 7
Analysis and Synthesis Tools		
Research catalogues (criteria, typologies, benchmarks)	Literature review, Field research	3 – 6
Research tables of criteria application	Comparative case research, Field research	3 – 7
Schematic diagrams (conceptual models)	Literature review, Synthesis method	3 – 8

Research tables: A type of research tool that are utilized for the purpose of organizing, synthesising, and structuring different inputs, as well as providing support with drawing conclusions. In both the catalogues (Book II – Appendix) and the chapters (one) through (seven) of the dissertation (Book I – Dissertation), research tables are utilized on a continuous basis. Inputs include several types of data, including textual and numerical information, schematics, and photos. For the purpose of graphical presentation, analysis, and drawing conclusions on the connections between the many inputs of research results, research schemes are utilized as a tool. The scientific approaches that are used in the investigation of the criteria for city neighbourhoods planning and designing in the context of the smart city platform are supplemented by the photography. This tool offers a visual representation of the phenomenon that is being investigated and validates the visual perception of certain constituents of the neighbourhoods that are related. Photography tool is utilized in a consistent manner in physical research catalogues (Research catalogues 1, 2 and 3, Book II – Appendix), with the primary focus being placed on field research and perceptual research catalogues (Research catalogues 3 and 4, Book II – Appendix).

1.4.3 Research plan by chapters

This research consists of seven chapters and each chapter delves into specific areas of smart cities, such as technological integration and human-centric methods, to provide complete insights into the changing urban development scenario.

Chapter one, named: **"Theoretical Research Section"** really sets the stage for the dissertation by placing the study right in the middle of the whole smart cities conversation that's been unfolding. It kicks off with smart urban development - you know, what it involves and the whole range of challenges it throws at city planning these days. Now, the big picture here is about how technology has surged forward, sort of clashing with the idea of keeping human experiences at the center of urban life. This clash has led to a bit of a messy approach - a mixed bag, and there's no clear strategy guiding it all.

Chapter two, named: **"Context analysis"** looks closely at how smart cities have emerged as hubs of innovation and sustainability, with a focus on technological integration and governance and at the same time it investigates how smart cities face difficulties such as traffic, pollution, and resource management utilizing IoT, AI, and other modern technology.

Chapter three, named: **"Smart City Concept"** Explanation of the Smart City Concept" provides a detailed analysis of the phrase "smart city," describing its evolution and numerous interpretations, and at the same time it explores multiple classifications, from technologically driven cities to human-centered urban environments, and investigates major stakeholders, including tech titans like IBM and Google.

Chapter four, named: **"Smart City Strategies"** examines how urban planners and officials in major European cities implement smart city ideas using a top-down approach and it examines the smart city policies of cities like Paris, London, and Vienna, assessing their plans for sustainability, technological integration, and urban development.

Chapter five, named: **"Smart City Criteria"** covers the criteria used to assess smart cities, researching several frameworks such as the EU and the European Investment Bank and it examines how cities reconcile technological innovation with inclusion and sustainability, focusing on categories such as smart economy, governance, environment, and mobility.

Chapter six, named **"Projects/Neighbourhoods–Bottom-up approach"** focuses on smart neighbourhood projects, specifically green infrastructure, public areas, and functional design, while at the same time focuses on the integration of smart technologies into urban design to improve sustainability and community well-being.

Chapter seven, named: **"Criteria – Planning research section"** examines smart cities' technology focus and proposes a more human-centered strategy and it proposes new smart city standards that prioritize well-being, social inclusion, and community connection, while also addressing privacy, social isolation, and the digital divide. This chapter presents an updated set of planning criteria to promote wellbeing, accessibility and community participation, to ensure the future of smart neighbourhoods focuses on both the socio-technical system and social dimensions of urban life.

Finally, Chapter eight named: **"Discussion on the scientific contributions and applications of the research results in scientific, professional and educational domains"** provides a typological taxonomy of smart neighbourhoods, with a focus on balancing technology and human well-being while it gives professional standards for urban planners, advocating for the gradual incorporation of technology, with a focus on livability, sustainability, and social inclusion.

Conclusion as the synthesis of the established research results, formulates the theoretical, spatial, and planning research findings into an integrated framework for smart neighbourhood development. The established research is developed for the focused research on human-centered planning principles that balance technology, innovation, inclusivity, wellbeing, and community identity. The established metrics are derived from a comparative analysis on existing planning approaches and smart city development and provide a recommendation for future neighbourhood development.

1.5 STRUCTRE OF RESEARCH DESIGN

The structure of research design interconnects three research levels, research catalogues, and planning criteria with research methods and materials in the development of planning criteria for the planning and designing of city neighbourhoods. This threefold structure of theoretical, contextual, and spatial research planning responds to the research premises, and identified problems and to the research objectives, hypotheses, and expected scientific contributions.

Structure of research levels, criteria, and catalogues

The research design integrates theoretical, contextual, and spatial planning research steps in developing planning and designing criteria for city neighbourhoods in the context of the smart city platform that are followed by research chapters and research catalogues:

— **Systematisation of theory-based criteria for planning and designing criteria** from the literature review of relevant policy documents and scientific approaches (Chapter four + Theoretical research catalogues 1,3 and 4),

- **Systematisation of contextual criteria for planning and designing of city neighbourhoods in the context of the smart city platform.** Overview Examples (Chapter six + Spatial research catalogue 3) and Research Cases (Chapter six + Physical research catalogue 4),
- **Systematization of the existing and missing criteria for planning and designing city neighbourhoods in the context of the smart city platform** from plans of Representative Research Cases (Chapter seven + Spatial planning research catalogue 4).

Table 3.0 Research design and structure of research catalogues for establishing the criteria for evaluating and planning the enhancement of smart city neighbourhoods.

Research levels	Theoretical framework and case studies	Research catalogues	Structure of criteria
Theoretical research	Smart city principles, policy frameworks, and scientific literature	Research catalogue of theory-based criteria for planning and designing smart neighbourhoods	Theory-based criteria for defining smart neighbourhood objectives and design parameters
Contextual spatial research	Overview Examples of smart neighbourhoods	Comparative research catalogue of physical and spatial smart neighbourhood cases	Spatial criteria for analyzing and evaluating urban and architectural components of smart neighbourhoods
Spatial planning research	Smart planning documents, masterplans, zoning regulations, and development frameworks	Research catalogue of planning criteria from selected smart neighbourhood cases	Existing and missing criteria for implementing human-cenetred and smart urban strategies

The structure of research design is further elaborated in integrating the research levels, types of research evidence, sections and chapters, research questions, methodological approach, objectives with expected contributions, and topics opened for further research.

CONTEXT ANALYSIS

Photography 2
Nordhavn promenade
Author: Cobe, 2020.

2. CONTEXT ANALYSIS

2.1 SITUATION WITH CITIES TODAY – CHALLENGES

It is without doubt that smart cities have emerged as focal points of modern urban living, providing cutting-edge technology (Dirks and Keeling, 2009; Nam and Pardo, 2011), improved services (Kanter and Litow, 2009), smart governance (Al-Hader et al., 2009), advanced infrastructure (Giffinger et al., 2007), cultural diversity (Winters, 2011), sustainable development (Hollands, 2008) and global connectively (Al-Hader et al., 2009), among other aspects of urban life – in order to enhance the quality of life for their residents (Lom, Pribyl & Svitek, 2016; Lim, Edelenbos & Gianoli, 2023). Because of the sustainable practices that smart cities provide; people are preferring to live in such places. In Europe, 75 percent of the population already lives in urban areas and the number is expected to reach 80 percent by 2020 (UN, 2008).

Due to such a big interest, smart cities around the globe are prioritizing population management as the number of people interested to live and make business (Winters, 2011; Zygiaris, 2013) in raising due to the above-mentioned urban developments. By incorporating new technologies (Atitallah, Driss, Boulila & Ghézala, 2020) different smart cities are expanding their population and drawing in new residents. While smart cities are using a combination of top-down and bottom-up approach in order to accommodate both governmental and people's needs, they're creating an inclusive environment by also integrating tech developments such at IoT devices, smartphones, and AI, to address different urban challenges. **As we can see, with the dominance of cities in society, smart cities have become central hubs of innovation and progress.** As they're continuing to grow and evolve, it's essential to recognize the multifaceted nature of urban development.

Until now, there are many studies that focus on smart city concepts and their strategies (Kummitha and Crutzen, 2017); however, there is not much information available on technological trends that come with smart-cities, as well as how smart-cities solve problems regarding environment, pollution, traffic, brownfields, etc. As we know, smart city projects include huge investments of financial, technological, human, and institutional capital; thus, it is pivotal to also reflect on the impact and results of smart city projects (Lim, Edelenbos & Gianoli, 2023).

In addition to the extensive literature on the smart city, there are also some pivotal researchers who contributed to the development of smart city platforms, such as Carlo Ratti and Antoine Picon. For example, their study "The Atlas of the Senseable City" they showcase the MIT Senseable City Lab (SCL) which was created in 2004 and has grown to become one of the world's most significant urban research institutions, producing hundreds of projects, patents, and exhibitions while also partnering with municipalities and organizations all over the world. Because of its multidisciplinary approach, including designers, engineers, scientists, and policymakers, the lab demonstrates how smart city platforms can cross traditional research-practice boundaries by connecting technical experimentation with urban governance and citizen engagement (Picon and Ratti, 2023). With that being said, one of the most important themes of this research is the transition from “smart” to “senseable” cities, which demonstrates what this research echoed as well – a shift that emphasizes the integration of digital data with human experience. Besides this, Picon and Ratti (2023) also describe the Trash Track project which goes in the same lines, that by digitally tracing discarded objects across waste systems, the Lab not only reveals inefficiencies but also reframed waste management as a question of urban awareness and behavioral change. Ultimately, their research is pivotal when discussing smart city platforms as it showcases how platforms developed by SCL function not only as technical tools but also as mediators of knowledge and civic responsibility, thereby expanding the very definition of what a smart city platform can achieve (Picon and Ratti, 2023).

In this regard, smart cities signify a dramatic change in the governance and development of metropolitan areas. Smart cities leverage technology to address major urban issues including environmental sustainability and transportation congestion, while also enhancing efficiency and ease. Modern technologies like artificial intelligence (AI), big data analytics, and the Internet of Things (IoT) have the ability to change urban landscapes into interconnected, effective, and resilient ecosystems. These claims, however, bring up significant issues related to privacy, equality, and the actual usefulness of technology solutions in resolving challenging socioeconomic problems. Thus, navigating the route towards inclusive and sustainable urban futures requires a thorough awareness of the trends and promises of smart city programs

Because of this, this chapter will first look closely at the trends in smart cities and then discuss how smart cities are tackling current urban issues and the opportunities they present. In order to create inclusive and sustainable urban settings, this chapter will first examine the complex relationships between top-down and bottom-up methods in smart city development. Second, this chapter will critically examine how technology has shaped the landscape of smart cities, looking at both the revolutionary potential of technology and the ethical issues it brings up.

This chapter seeks to contribute to the continuing discussion on smart cities by presenting a nuanced knowledge of their evolution, effect, and future trajectories by a thorough research of the literature and case studies. In the process, it hopes to give insightful information about various smart city programs. Finally, by combining the body of available information and pointing out critical topics for further research, this chapter seeks to improve informed decision-making and encourage the development of smarter, more inclusive, and sustainable cities that benefit all people.

2.2 THE DOMINANCE OF CITIES IN SOCIETY (POPULATION, INDUSTRY, CULTURE, GLOBALISM)

For thousands of years, cities have been the epicenters of human civilization, and they continue to rule in society today, and without a doubt, population is one of the most significant ways that cities dominate. Cities have the highest population density in the globe, and they continue to attract new residents year after year. According to the United Nations, world population will also increase by 1.4-1.5 billion in 2050.

There are many reasons why people choose to live in big cities. For starters, cities provide a diverse range of economic chances that cannot be found elsewhere. This is especially true in today's economy, where many jobs demand specialized skills and knowledge found only in urban areas. As a result, people flock to cities in quest of better job opportunities and higher pay, as what we're calling, smart cities. Hollands (2020) questions the concept of smart cities, on the other hand, regarding their ideological implications and assumptions behind the label "smart city". He agrees that the term "smart" is connected with technological advancements, economic growth, and social progress, but what he focuses on is how this term "smart city" is reflecting the complexities of urban development and governance. Holland echoes the need to a more inclusive and progressive approach to urban development, while also challenging the prevailing narratives surrounding smart cities. According to Holland (2020), smart cities can be understood as urban areas that leverage information and communication technologies (ICTs) to enhance economic, social, and environmental outcomes. However, he argues that the term "smart city" often carries connotations of technological determinism and a focus on business-led development, overlooking issues of social justice and sustainability. By critically examining the rhetoric and practices of designated smart cities, Hollands aims to untangle the elements involved and explore the underlying assumptions and contradictions within the smart city discourse. Regarding people moving to cities, many researchers debate whether "better urban living" means more than just technological advancement (Glasmeier & Christopherson, 2015). According to Caragliu, Del Bo, and Nijkamp (2011) people move to cities not only because of technological advancements, but also because of the overall quality of life. These authors discuss how the planners have created a dynamic ecosystem in cities that foster innovation, collaboration, and sustainability and at the same time discuss how data-driven solutions, digital connectivity, and sustainability, are some of the factors driving the migration of people towards these hubs.

Moving further, the authors Deaking and Al Waer (2011), offer a comprehensive analysis of the transition from traditional urban places to cities. They trace the evolution of urban planning and governance, highlighting the shift from mere technological integration to a more holistic approach focused on enhancing the overall quality of life for urban residents. In addition, cities are dominant in many aspects of civilization (Hartig and Kahn, 2016), perhaps none more so than in terms of population.

As noted in Hartig and Khan's research (2016) cities provide economic opportunities, cultural and social experiences, as well as the opportunity to travel the globe and meet new people. While this has many advantages, it also has significant societal implications, especially in terms of politics, income inequality, and social stratification (Glaeser, Resseger & Tobio, 2019). As Glaeser et al (2019) explain, one-half of the variation in income inequality can be explained by the occupation-based inequality. In addition, their research showcases that traditional economic model try to explain the location of skilled and unskilled workers with differences in the returns to skill and differences in amenities (Dahl, 2002). Although they agree with this, they find that history and immigration seem to be the most important determinants of inequality today. As cities expand and change, it is critical that we consider these issues and work to create a more equitable and just society for all (Peter, 2013). Moreover, according to the Greek philosopher Aristotle, humans are basically urban animals that require urban settlements, particularly cities, to survive and develop. From a theoretical standpoint, this is an important point because it conveys the idea that the condition of humanity is dependent on the condition of urbanity and that cities are required for humankind to thrive. Regardless of one's philosophical position, it is a well-known truth that the majority of the world's population now lives in cities, and human life has largely become urban life. For these reasons alone, the urban equation is an unavoidable research subject. If human nature cannot be altered, and thus the urban nature of the global population distribution, it is critical to understand how cities can become more sustainable. In order to do so, it is critical to first define municipal sustainability. Aristotle contends that in cities with too many inhabitants, it is nearly impossible for them to even see each other, let alone know each other closely. Government and elections 'operate on guesswork' in these instances. (Aristotle, 2000: 263). **In terms of geography, urban planning, urban design, and economics, the Greek philosopher observes that the larger a city, the more difficult it is to find space for it, to build enough buildings and infrastructures, and to obtain and circulate all of the resources that its population requires, particularly commodities that the city does not produce.**

2.3 THE PROBLEM WITH CITIES TODAY

Cities now house more than half of the world's inhabitants. North America (82 % of the population resides in cities), Latin America and the Caribbean (81%), Europe (74%), and Oceania are the world's most urbanized regions. (68%). Africa is still mostly rural, with only 43% of the people living in cities. We are unavoidably becoming an urban world. The metropolitan population increased from 751 million to 4.2 billion between 1950 and 2018. **By 2050, two-thirds of us will live in cities. Clearly, the world of future will be a city-centered one. Every month, five million more people move to developing-world cities, and by 2011, more than half of the world's population lived in cities.** Cities are also well known for their approach to industry (Lom., et al, 2016). Lom et al. (2016) discuss smart city initiative and the concept of industry 4.0. They agree with other researchers that by including sustainable initiatives in projects, the quality of life of their citizens will improve. Furthermore, they discuss how the Internet of Things (IoT) shall be used for the development of so-called smart products, together with Internet of Energy (IoE), Internet of Service (IoS), Artificial Intelligence of Things (AIOT) – all elements that can create a connection of the city initiatives and industry 4.0. In the same line, many authors have been researching how the use of technology is increasing efficiency and effectiveness in various fields, specifically industry in cities (Chataut and Phoummalayyane, 2023; Javidroozi, Shah & Feldman, 2019; Saluky, 2017; Marine, 2023). Marine (2023) in her research "A Review: Application of AIOT in Smart Cities in Industry 4.0 and Society 5.0" highlights that in the era of industry 4.0 and society 5.0, utilizing AIOT technology in cities, the quality of life of the residents will improve regarding public services, transportation, water processing, and other infrastructure.

In addition to industry and its elements, cities are also recognized for their culture and globalism. Expanding on the cultural and global aspects of smart cities, it's imperative to recognize the multifaceted nature of culture within urban contexts. Culture in the context of cities encompasses various elements, including urban cultural heritage, creative industries, and the promotion of livability for citizens (Allam & Newman 2018; Garcia, 2004; Rutten 2006; Piccialli, 2018). Urban policy, when viewed through a cultural lens, acknowledges cities as cultural microcosms fostering innovation, creativity, and economic development while ensuring access to essential services and facilities (Piccialli, 2018; Rutten 2006). Piccalli on his research (2018) "The Internet of Cultural Things: Towards a Smart Cultural Heritage" indicates that cultural heritage represents an industry that significantly contributes to the economic growth of cities by attracting millions of visitors to cultural events, art galleries, monuments, and historical centers. However, he echoes that to fully realize the potential of cultural heritage, cities need to adopt pervasive solutions leading to "smart cultural heritage". **On the other hand, cities serve as interconnected hubs of innovation and collaboration, attracting multinational businesses, fostering cultural exchange, and contributing to global efforts in sustainable development – ultimately becoming hubs of cultural exchange that welcome people from all around the world.** In the same line, Kominos' (2014) research suggests that throughout history, prioritizing innovation has been a central objective in designing the built environment. This focus on innovation has served as the cornerstone for various theoretical discourses centered on human needs, aiming to facilitate the development of innovative design solutions. Kominos (2014) also explains that spatial intelligence arises from the interplay of informational, cognitive, and innovative processes occurring within urban environments and according to him these processes empower both citizens and organizations to effectively tackle the challenges they encounter. It denotes the capacity of a community or city to integrate its intellectual resources, foster collaborative institutions, and implement intelligent infrastructure to establish knowledge-driven functions. These functions are aimed at maximizing resource utilization across various sectors and addressing diverse urban challenges (Kominos, 2014). He further adds that by integrating innovative design approaches that prioritize spatial intelligence, cities can optimize their functionality and adaptability to better serve the needs of their population.

As we can see, the trends that are influencing the evolution of cities in the context of industry, culture, and globalism, underscore the dynamic nature of urban development. As cities continue to dominate society in terms of population, industry, and culture, the concept of cities emerges as a multifaceted approach to urban governance and development.

Since 1995, there have been significant developments in the technology landscape that have affected industry, consumer behavior, and social conventions. With businesses like Airbnb and Uber serving as examples, the growth of the sharing economy has been one of the most changing trends. By utilizing digital platforms to link homeowners with tourists looking for housing instead of going through hotel chains, Airbnb, which was created in 2008, completely changed the hospitality sector (Zervas et al., 2017). Similar to this, Uber launched the taxi business in 2009 by launching a smartphone app that let customers request trips whenever they wanted, upending the established taxi firms' monopoly (Cusumano et al., 2019). The growth of these platforms was made possible by developments in mobile technology, GPS, and safe online payment methods that allowed for quick scalability and smooth user experiences (Cusumano et al., 2019). On the other hand, The COVID-19 further accelerated the adoption of these technologies even more by forcing customers to look for alternatives that reduced their interaction with others due to travel limitations and social distancing measures. For example, as more people avoided public places, Uber increased the scope of its delivery services to meet the growing demand for food and grocery delivery (World Health Organization, 2021). On the other hand, travel restrictions caused a brief downturn for Airbnb, but the company quickly adjusted by emphasizing short-term and long-term rentals as remote work increased in popularity (Zervas et al., 2017).

Further emphasizing the critical role that technology plays in helping societies respond to global crises, this era also saw a rise in digital health technologies, such as telemedicine, which allowed for remote medical consultations (World Health Organization, 2021). The pandemic brought to light how crucial innovation and technical resilience are to preserving continuity across many industries. As we can see, we're navigating every day the digital world, and of course that the emerging concept of smart cities is also connected to the cutting-edge technology development that are used to make the residents lives easier and with better quality. **By using smartphones, to the proliferation of interconnected devices through the Internet of Things (IoT), and the harnessing of Big Data and Artificial Intelligence (AI), smart cities are leveraging cutting-edge technologies to optimize urban operations and foster sustainable development.** In this chapter, the research explores the transformative impact of these tech developments within the context of smart cities, highlighting their role in driving innovation, efficiency, and connectivity in urban environments.

Many researchers agree that smart city is an application of Internet of Things (IoT) notion (Silva, Khan & Han, 2018; Rathore, Ahmad & Rho, 2016). IoT development has been a key trend in European cities in recent years, with a wide range of linked devices being used to improve efficiency, convenience, and sustainability (Silva et al, 2018). IoT is a basic concept: it entails linking common objects to the internet, allowing them to communicate with one another and with us (Rathore et al., 2016). From smart household gadgets like thermostats and security systems to industrial sensors that monitor and manage production processes, this can cover everything. With that being said, IoT is being utilized to improve a variety of areas in European cities, including transportation, energy, and healthcare. In the same line, Silva et al. (2018) reports that the growth of population and urbanization has propelled the exploration of innovative approaches to manage urban development while minimizing disadvantageous impacts on the environment, citizen lifestyles, and governance structures. With that being said, smart cities leverage IoT technology to intelligently support various city operations with minimal human intervention, hoping to address the challenges arising from rapid urbanization and population growth. Similarly, Rathore et al., research (2016) echoes that because of the growth of the population in smart cities, the request for embedded devices, such as sensors, actuators, and smartphones has grown too, leading to considerable business potential for the era of the IoT, in which all devices are able to connect and communicate with each other through internet. As we see, IoT technology is used in smart cities to monitor and manage infrastructure in real time, improving efficiency and lowering costs (Ejaz, Naeem, Shahid, Anpalagan & Jo, 2017).

Moreover, The Internet of Things is also being utilized to increase energy efficiency in European cities (Metallidou, Psannis & Egyptiadou, 2020). For example, smart meters can track electricity consumption in real time, helping consumers to better understand and manage their energy usage. Furthermore, IoT devices can be utilized to regulate lighting and heating systems, minimizing energy waste and expenses. As Metallidou et al. 2020 reports, the Internet of Energy (IoE) influences the power sector of smart cities by integrating Internet of Things (IoT) technology into decentralized energy systems. The authors add that its objective is to enhance energy efficiency, reduce wastage, and enhance environmental sustainability. Similarly, IoE technology encompasses various components, such as smart sensors and the integration of renewable energy sources. Consequently, IoE is emerging as an essential tool within the legal and scientific framework to advance the objectives of smart cities (Humayun, Alsaqer, & Jhanjhi, 2022).

Beyond energy efficiency, IoT is being applied in healthcare to improve patient outcomes while lowering costs (Kodali, Swamy, & Lakshmi, 2015). IoT technologies, which have advanced human detecting skills, are employed in medicine for remote health monitoring, early diagnosis, and senior care (Nweke, The, Mujtaba & Al-garadi, 2019). These IoT applications in the healthcare industry have the potential to increase patient well-being while also lowering service costs, such as preventing unneeded hospitalizations and providing better care to individuals in critical circumstances. IoT-based healthcare services, which affect the whole value chain, will cause a revolution in the healthcare sector say the authors Dey, Ashour & Bhatt (2017) in their research “Internet of things driven connected healthcare”. In addition, there are different technologies that are used that help both patients and staff.

For example, wearable health monitors can monitor patients' vital signs and notify healthcare practitioners if anything changes, allowing for early intervention and improved care. Patients can also receive care from the comfort of their own homes, minimizing hospitalizations and boosting quality of life.

Although there are many positive factors, there are certain reservations about the growth of IoT in European cities. The main important source of concern is data privacy and security (Andrea, Chrysostomou, & Hadjichristofi, 2015). As more gadgets connect to the internet, there is an increased risk of sensitive data being intercepted or stolen, in addition to the concerns regarding the possibility of IoT devices being hacked or utilized for malevolent purposes (Friedemann and Floerkemeier, 2010). Another source of concern is the potential for IoT to worsen existing inequities (Dutton, 2014). For example, if only certain groups of people can afford to buy IoT devices, this could lead to even greater inequities in access to technology and resources. Despite these reservations, the development of IoT in European cities is projected to accelerate in the next years. With the potential to enhance efficiency, save costs, and improve quality of life, there is a lot of interest in adopting IoT to address the complicated difficulties that European cities face (Humayun, Alsaqer, & Jhanjhi, 2022). As technology advances, policymakers, corporations, and consumers must collaborate to ensure that IoT is used in a sustainable and equitable manner.

With the raise of interest of population to live in cities (Jin, Gubbi, Marusic & Palaniswami, 2014; Yang, Faqiri, Shafik, Abdulrahman, Yusug, Sharawy, 2021), billions of devices will also communicate with each other; thus, produce Big Data (Rathore et al., 2016). Big data development in European cities has been a key trend in recent years, with a wide range of applications in industries such as healthcare, transportation, and energy (Alam, Sajid, Talib, & Niaz, 2014; Yang et al., 2021). The rise of smart cities has been one of the most significant advancements in big data in European cities and because of such big flow, smart cities monitor and manage infrastructure in real time using a range of sensors and data sources, enhancing efficiency and lowering costs (Yue, Jiang, Yin & Wilson, 2020). Essentially, big data offers the potential for the city to obtain valuable insights from a considerable amount of data collected through various sources (Hashem, Chang, Anuar, Adewole, Yaqoob, Gani & Chiroma (2016). Big data in smart cities plays a pivotal role as it allows city administrators to make informed decisions based on insights derived from large volumes of data (Alam, Sajid, Talib, & Niaz, 2014; Yang et al., 2021), enables predictive modeling and forecasting which allows city authorities to anticipate and mitigate various urban challenges such as traffic congestion, energy consumption, and public safety incidents (Gharaibeh, Salahuddin, Hussini, Khreishah, Khalil, Guizani, & Al-Fuqaha, 2017; Ahmed, Abu Alnaaj, Saboor, 2020; Yang et al., 2021), enables the customization of social services and promotes real-time information access and sharing (Wang, Wang, & Liu, 2020), and last but not least, help optimize the utilization of resources such as energy, water, and infrastructure in smart cities (Yue, Jiang, Yin & Wilson, 2020).

These authors give different examples how big data can be used to make the life of the residents easier and better. For example, data from traffic cameras and sensors can be utilized to optimize traffic flow and alleviate congestion (Gharaibeh, Salahuddin, Hussini, Khreishah, Khalil, Guizani, & Al-Fuqaha, 2017; Ahmed, Abu Alnaaj, Saboor, 2020; Yang et al., 2021). Similarly, data from air quality sensors can be used to pinpoint polluted locations and devise tailored interventions to enhance air quality. In addition, big data also is very useful in medicine, as to enhance patient outcomes and save expenses. (Rghioui, and Oumnad 2018.) These authors claim that in medicine, electronic health records enable healthcare providers to access detailed patient information and detect patterns that can aid in the diagnosis and treatment of ailments. Furthermore, data analytics can be utilized to identify individuals who are at high risk of developing specific diseases, allowing for focused interventions and preventative therapy. Another industry where big data is being utilized to increase efficiency and cut costs is transportation. Data on traffic patterns and transit usage in real time can be utilized to enhance transportation routes and schedules, lowering wait times and boosting service quality (Yue, Jiang, Yin & Wilson, 2020). The same authors add that data from linked vehicles can be utilized to monitor driving behavior and highlight areas for development, hence increasing road safety and lowering accidents.

In the same line, Nuaimi, Neyadi, Mohamed, and Al-Jaroodi (2015) in their research "Applications of big data to smart cities" highlight that big data allowed smart cities to maintain standards, principles, and requirements of the applications of smart city through realizing the main smart city characteristics such as sustainability, resilience, governance, enhanced quality of life, and intelligent management of natural resources and city facilities. As we can see, big data is essential in smart cities for driving innovation, improving decision making, enhancing service delivery, and fostering sustainable urban development. The article "Addressing big data challenges in smart cities: a systematic literature review" by Chauhan, Agarwal, and Kar (2016) identifies eight major challenges related to Big Data in smart cities: human dynamics, privacy, security, volume, velocity, variety, veracity, and value. Subsequently, the research synthesizes existing literature to propose solutions to tackle these challenges effectively.

As researched and discussed until now, there are many studies that directly question whether urban space is becoming "computable." In the same vein, Picon and Hill (2020) in their study references experiments conducted by the Senseable City Lab, such as the Real-Time Talk map in Singapore, which visualized mobile phone communication across the city. With this project, among many others, the authors claim that such projects are an example how smart city platforms can translate invisible data flows into legible urban patterns, transforming our understanding of collective behaviors and providing insights into the social dynamics of digital cities. The authors furthermore echo that the smart city platforms are not neutral technologies, but they shape debates around participation, control, and governance. By framing Ratti's work within this broader critical discourse, Picon and Hill (2020) describe how platforms such as those developed by the Senseable City Lab empower citizens and risk new forms of surveillance. In this sense, the Lab's projects reveal the dual nature of smart city platforms: they are both infrastructures for managing flows of information and arenas for negotiating the cultural and political meanings of urban life (Picon and Hill, 2020).

The chapter's conclusions advance knowledge about big data management in smart cities and offer insightful information to professionals working in the area. This chapter also provides recommendations for further research in this field. However, there are certain reservations about the growth of big data in European cities (Rghiou and Oumnad, 2018; Gahi, Guennoun & Mouftah, 2016). These authors say that the most important source of concern is data privacy and security. As more data is collected and processed, there is a risk that sensitive information will be intercepted or stolen. Furthermore, there are fears that big data may be exploited for discriminatory purposes, such as identifying locations with high levels of poverty or crime and using this information to target specific groups of individuals (Gillis and Spiess, 2019). Despite these reservations, big data growth in European cities is projected to accelerate in the next years. There is a lot of interest in using big data to address the complicated difficulties that European cities face since it has the potential to enhance efficiency, cut costs, and improve quality of life. As technology advances, it will be critical for politicians, corporations, and consumers to collaborate to guarantee that big data is used in a sustainable and equitable manner. This will necessitate a focus on data privacy and security, as well as a determination to use big data to address current disparities and promote social justice (Dencik, Hintz & Cable, 2019).

On the other hand, Artificial Intelligence (AI) plays a crucial role in smart cities as it enhances the functionality and efficiency of IoT, Big Data, etc. Fundamentally, AI and Big Data in smart cities aim to increase the livability of the city structure while boosting economic growth and opportunities (Allam and Dhunny, 2019). While many smart cities have used the analysis of Big Data that was conducted through AI in urban fabrics (2017a) the accuracy of the achieved results were positive, resulting in governments and decision makers to collect data regarding different issues (Abaker, Hashem, Chang, & Anuar, 2016; Souza, Figueredo, Cacho, Araújo, & Prolo, 2016). In addition, the report of the European Commission on "European approach to artificial intelligence" highlights the EU's emphasis on quality and trust in the development and implementation of AI technology. It explains the EU's goal for being a worldwide leader in AI while keeping AI human-centric and trustworthy. The European AI Strategy seeks to create a resilient Europe for the Digital Decade, in which consumers and organizations may benefit from AI while feeling safe and secure. The approach outlines specific guidelines and strategies to foster excellence and confidence in AI.

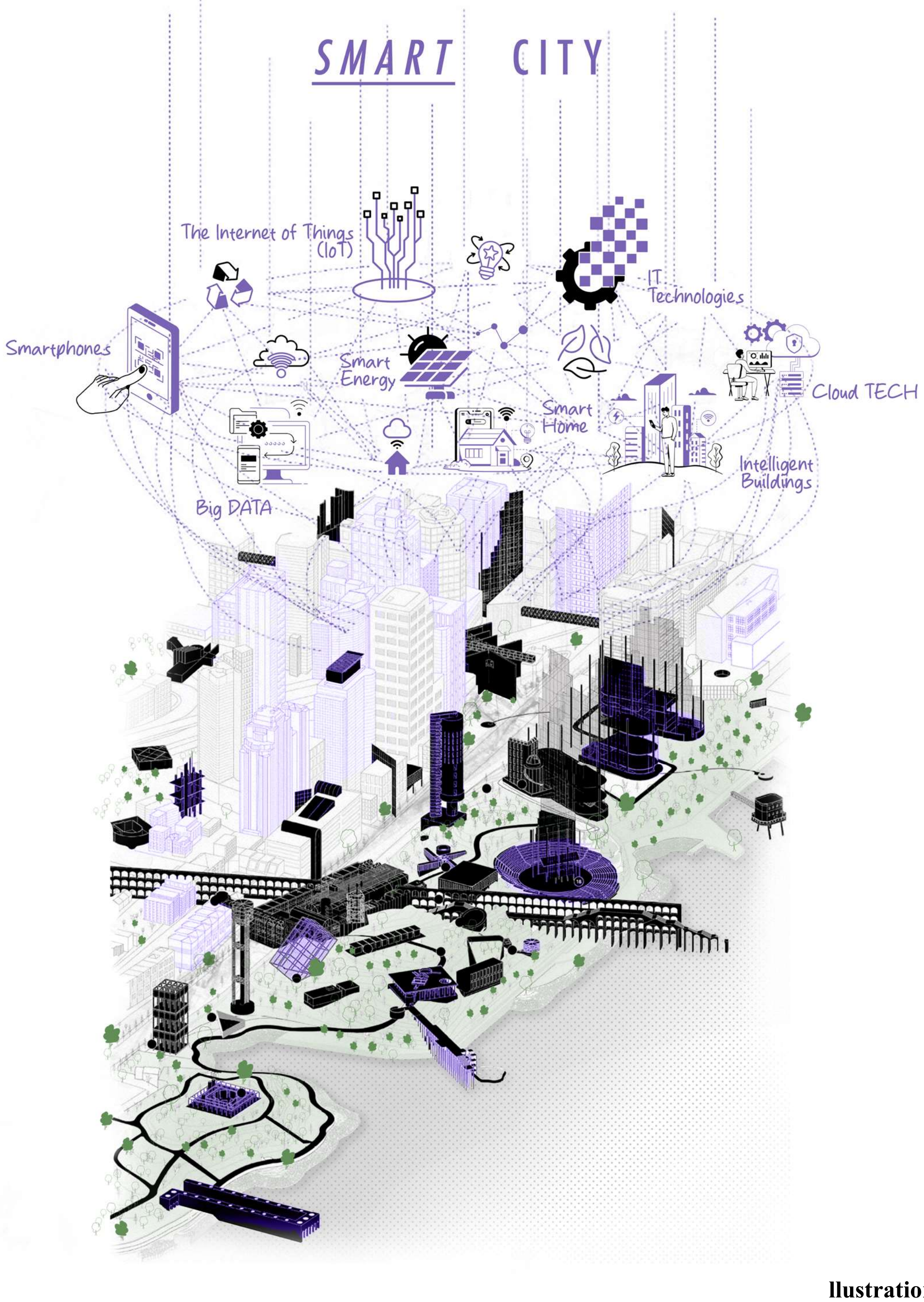
2.4 BIG TECH PROMISES FOR CITIES – SMART CITIES

2.4.1 Overview and explanation of new technologies affecting smart city concept

The emerging concept of smart cities is also connected to the cutting-edge technology development that is used to make the resident's lives easier and with better quality. By using smartphones, the proliferation of interconnected devices through the Internet of Things (IoT), and the harnessing of Big Data and Artificial Intelligence (AI), smart cities are leveraging cutting-edge technologies to optimize urban operations and foster sustainable development. In this part, the research will explore the transformative impact of these tech developments within the context of smart cities, highlighting their role in driving innovation, efficiency, and connectivity in urban environments.

Astounding advancements in technology have changed the conventional concept of urbanization into a more sophisticated view, as noted by Silva et al. (2018). Many authors (Yigitcanlar, O'Connor, Westerman, 2008; Caragliu et al., 2011) have researched the use of ICT in public administration, among other sectors, that have positively influenced the urban wealth in smart cities. The IoT notion has been strengthened by different smart technological advancements such as ubiquitous computing (UC), wireless sensor networks (WSN), and machine-to-machine (M2M) (Silva, Jung, & Han, 2017a). Because of such extensive attention gained from different groups from IoT, now IoT notion has pioneered striking applications with its expansion, for example, smart home, smart city, smart warehouse, smart health, and so forth (Jin et al., 2014, Khan et al. 2016). These advancements underscore the transformative potential of IoT technologies in reshaping urban environments and improving the quality of life for citizens. In addition to the IoT technologies, currently, several other emerging technologies are poised to further develop the landscape of smart cities, including smart assistants which have emerged in smartphones, smart cars, etc. (Elahi, Wang, Peng, Chen, 2019).

As noted by Elahi et al. (2019), establishing comfortable personal spaces in smart cities requires that these smart assistants are transparent in design and implementation - a fundamental trait required for their validation and accountability. In their research, they take the example of Google Assistant (GA), which they call "a state-of-the-art smart assistant" and claim that smart assistants, like GA, are taking diverse roles and positions in our lives. As we know, GA is embedded in everyday technology, such as phones, speakers, smart displays, cars, TVs, laptops, and smartwatches (20). Similarly, a research conducted by UNESCO, claims that AI and smart assistants are ushering humanity into an era that portends changes as deep, expansive, personal, and long-lasting (2019). Apart from Google Assistant, there are other smart assistants such as Alexa and Cortana, which are voice-controlled. Although studies show that such smart assistants are easily exploited to collect user data and share knowledge without their knowledge (Alepsis and Patsakis, 2017; Zhang, Chen, Lu, Wen, Nepal, Xiang; 2018; Elahi, Wang, Peng, Chen, 2019), we cannot deny the significant role they play in the evolution of smart cities. In fact, according to Sarah's research (2019), it is estimated that by 2023, there will be 8 billion smart assistants in the world.



llustration 1.0.

Smart city concept with different icon and elements. Modern city design with future technology for living.

Author: Dashnor Kadiri, 2025[2].

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[2] Base illustration source:
Smart city concept with different icon and elements. Modern city design with future technology for living. Illustration of innovations and Internet of things.Internet of things/Smart city Stock Vector | Adobe Stock (Accessed: 25 May 2025)

Beyond voice-controlled assistants, smart cities are also harnessing the potential of smart cars to revolutionize urban mobility and transportation systems (Yaqoob, Khan, Kazmi, Imram, Guizani, Hong, 2019; Edwards, 2014; Arena, Pau & Severiono, 2020). Yaqoob., et al (2019) add further that traditionally, vehicles exhibited a limited ability to communicate with each other. But, in smart cities, they claim that soon of autonomous cars is becoming a reality because of the fifth-generation (5G) standard, which ensures low latency and provides high data rates (Mehmood., et al, 2017). At the same time, they highlight how autonomous cars send and receive data from multiple sources, such as traffic signals and parking spaces, autonomous vehicles, and the cloud, which demand highly reliable communication technologies, ultimately simplifying the driver's life (Arena et al., 2020).

In addition, Yaqoob et al.'s (2017) research "Enabling communication technologies for smart cities. IEEE Communications Magazine" provides an analysis of the communication and networking technologies employed in smart cities, along with the challenges they face and potential future directions. The research acknowledges the significant advancements in heterogeneous communication technologies that facilitate interactions among smart city objects. However, it highlights the challenges posed by the coexistence of numerous devices, leading to connectivity issues. Most importantly, the article presents a taxonomy for classifying literature on smart cities based on various parameters such as future and emerging technologies, modern communication technologies, IEEE wireless technology standards, objectives, network classes, and mode of operations. They research cities like Barcelona, Stratford, Singapore, and Porto to illustrate real-world implementations of communication technologies in smart city contexts. As we can see, the evolution of new technologies has profoundly impacted the trajectory of urban development, ushering in an era of unprecedented connectivity, efficiency, and innovation.

2.4.2 Promises of IT companies to smart cities (new market or real solution)

The promises made by IT companies to smart cities pose a critical question: are they offering genuine solutions or merely tapping into a new market? IT companies have long promised cities that their products and services have the capacity to alter cities and IT businesses have promised to bring new markets and actual answers to the complicated difficulties that cities throughout the world face, from smart city platforms to big data analytics tools. As technology giants increasingly invest in urban infrastructure, they often tout innovative solutions to longstanding urban challenges (Green, 2019; Goh, 2015) and the goals of sustainable development (Martin, Evans, Karvonen, 2018). As the research of Martin et al., (2018) showcases, digital technologies are deployed to "solve" urban sustainability problems; however, such visions have been critiques in the urban studies literature for reflecting techno-utopian, neoliberal approaches to the developments of smart cities. In this case, we see that while IT companies emphasize the transformative potential of their solutions, critics (Martin et al., 2018; Söderström, Paasche, & Klauser, 2020; Anthopoulos, 2017; Janssen, Anthopoulos, Weerakkody, 2016) that the primary goal of IT companies is profit-driven rather than the real solution. On the other hand, Angelidou (2014) in his research "Smart City Policies: A Spatial Approach" focuses on how smart-cities should focus on areas that are shortage and in urgent need for improvement, rather than the multi-faceted investments with existing resources and funds.

Moreover, Townsend (2013) carried out a research titled "Smart cities: Big data, civic hackers, and the quest for a new utopia," which examines the digital master plans of different cities from 2011 to 2015. The research focuses on the promises made to smart cities by IT companies and whether or not these promises actually represent a real solution or a new market. New York (2011), Barcelona (2012), Chicago (2013), Dublin (2013), London (2013), Hong Kong (2014), Singapore (2014), and San Francisco (2015) are among the proposals that were examined. Townsend's analysis includes the content, process, and use of these plans. In terms of substance, the essay aims to comprehend the plans and the commitments that IT businesses are making to smart cities. Since there were few formal planning requirements in existence, the process of drafting these plans is also examined, revealing the ways in which cities developed their own planning procedures. Various implementation strategies are seen in each city: crowdsourcing in Dublin, big steering committees in London, community engagement in Chicago, and integration with IT budget procedures in San Francisco, among other places. Lastly, Townsend suggests that in an effort to meet urban difficulties and adapt to new technology, cities were experimenting with various methods for creating digital master plans.

— **Smartphones empower the citizens**

Smartphones play a pivotal role in empowering citizens within smart cities by serving as multifunctional tools that enhance connectivity (Hou, Arpan, Wu, Feiock, Ozguven, & Arghandeh, 2020) accessibility, and participation. Seeing such benefits in citizens' interest, smart cities have started to adopt city service mobile applications in their smart city initiatives (Ganapti, 2015). With the proliferation of mobile applications tailored to urban living, individuals can conveniently access a wide range of services and information, from transportation schedules to real-time updates on environmental conditions, says Hou et al (2020) in their research "The road toward smart cities: A research of citizens' acceptance of mobile applications for city services". In addition, studies (Mattson, 1968) have shown how the role of citizens from passive consumers of public services to co-producers who are active in jointly tackling social problems. As we can see, smartphones give people the ability to communicate and access information, enabling them to actively contribute to the sustainable development and urban planning of their communities. Furthermore, through smartphone apps, residents can actively engage with their surroundings by reporting issues such as potholes, waste management concerns, or public safety issues, thereby contributing to the maintenance and improvement of urban infrastructure. For example, in Gutiérrez, Amaxilatis, Mylonas, & Muñoz (2017)'s research "Empowering citizens toward the co-creation of sustainable cities", the authors show an experiment that was carried out in Patras (Greece) which showcases the smartphone crowdsourcing capabilities of of smart apps, while demonstrating how an experiment similar to the one carried out in Santander, a city with extensive IoT infrastructure, can be carried out in a location with no IoT infrastructure. The results of this experiment show the willingness of the residents living in smart cities to make the co-creation process more inclusive. Additionally, smartphones enable seamless communication and collaboration among citizens, community groups, and local authorities, fostering a sense of civic responsibility and collective problem-solving. By placing the power of information and communication in the hands of individuals, smartphones empower citizens to actively participate in shaping the future of their cities and promoting sustainable development.

In further significant research titled "Empowering citizens toward the co-creation of sustainable cities," Gutiérrez, Amaxilatis, Mylonas, and Muñoz (2017) emphasize the value of data literacy, citizen involvement, and the establishment of personal services. They both think that smartphones may be extremely helpful in tackling these issues since they provide people quick access to information and services, let them actively engage in local government, and give them the power to make wise decisions for their everyday life. They also talk about how citizens may communicate with local government and other stakeholders using cellphones. Feedback methods can be facilitated via mobile applications and platforms, enabling citizens to report problems, offer recommendations, and take part in decision-making procedures. In the end, more responsive and citizen-centric government results from this direct interaction between citizens and authorities in smart cities, which promotes responsibility, transparency, and teamwork between the two groups.

— **Smart Infrastructure (Smart Grids, IoT Sensors)**

The foundation of contemporary smart cities is smart infrastructure, especially smart grids and Internet of Things sensors, which allow for real-time control and monitoring of urban services. Cities can more effectively control the supply and demand of power, minimizing energy waste and improving grid stability, by integrating advanced metering infrastructure (AMI), distributed energy resources, and energy storage (Gungor et al., 2011). In order to help municipal officials, make educated decisions and maximize resource utilization, Internet of Things (IoT) sensors are placed across urban areas to gather data on a variety of characteristics, including energy consumption, traffic flow, and air quality (Cugurullo, 2018). For instance, waste management and the effectiveness of public transportation have significantly improved as a result of the use of IoT sensors in Barcelona's smart city effort (Bibri & Krogstie, 2017). In order to create resilient, sustainable urban settings that can change to meet changing requirements and challenges, several components of smart infrastructure are crucial.

— **Enhanced Connectivity (5G, Wi-Fi Hotspots)**

A key component of smart city projects is enhanced connection, which is made possible by the installation of 5G networks and Wi-Fi hotspots. This allows for dependable, fast communication between systems and devices. Real-time applications like augmented reality (AR), remote healthcare, and autonomous cars are made possible by 5G technology's high bandwidth and low latency, which meet the demands of smart cities (Osseiran et al., 2014). Wi-Fi hotspots are positioned thoughtfully around cities to offer ubiquitous internet connectivity to locals and tourists alike, guaranteeing that everyone can connect to vital services from anywhere (Han & Kim, 2019). By facilitating seamless connectivity for IoT devices, mobile applications, and digital services, the integration of 5G and Wi-Fi in smart cities improves overall quality of life and makes urban settings more effective, secure, and responsive to the requirements of their residents.

— **Data Analytics and AI for Urban Management**

In order to manage urban environments more successfully, data analytics and artificial intelligence (AI) are being used more and more. This gives city planners and administrators the resources they need to handle challenging urban issues. In order to find patterns, forecast trends, and assist in decision-making, AI-driven analytics can process enormous volumes of data from numerous sources, including social media, traffic cameras, and Internet of Things sensors (Manyika et al., 2011). For instance, real-time adjustments to signal timings by AI-based traffic management systems can optimize traffic flow, reduce congestion, and enhance air quality (Li et al., 2020). Furthermore, by evaluating data from security cameras and identifying possible security risks before they materialize, artificial intelligence (AI) can improve public safety (Chen, Cheng, & Hsu, 2020). In addition to increasing operational effectiveness, the use of AI and data analytics in smart cities helps to create more resilient and sustainable urban ecosystems.

— **Renewable Energy Solutions**

As a means of lowering carbon emissions and advancing sustainable development, renewable energy solutions are an essential part of smart city plans. To supply clean and sustainable energy, solar panels, wind turbines, and other renewable energy sources are being incorporated into metropolitan infrastructure. Innovations in energy storage technologies also contribute to the usage of renewable energy by reducing the erratic nature of renewable sources and guaranteeing a steady supply of energy (Lund et al., 2015). All things considered; renewable energy solutions are essential to the agenda for smart cities since they allow them to lessen their environmental impact while promoting sustainable urban growth.

— **Efficient Waste Management Systems**

For urban areas to remain sustainable and clean, effective waste management systems are essential. IoT-enabled waste systems are one example of a technology that smart cities are embracing more and more. These systems can optimize waste collection routes and monitor fill levels, which lowers operational costs and has a positive environmental impact (Gutiérrez et al., 2017). For instance, to boost output and reduce the carbon footprint of garbage collection, smart waste management systems have been implemented in places like Seoul and Barcelona (Bibri & Krogstie, 2017). To further enhance resource management and lessen the need for landfills, data analytics is essential for predicting patterns in trash generation and expediting recycling processes (Zaman & Lehmann, 2013). Incorporating state-of-the-art waste management technology can also help manage trash in smart cities more sustainably and effectively.

— **Water Management Technologies**

Water management technologies are critical for addressing urban water supply difficulties and ensuring sustainable use of water resources. Smart cities use IoT sensors and data analytics to monitor water quality, detect leaks, and improve water distribution networks (Mutchek & Williams, 2014). Smart meters and other advanced technology give users with real-time information about their water usage, encouraging more responsible consumption. Smart irrigation systems in urban parks and green areas also ensure that water is used efficiently, which contributes to the long-term sustainability of urban water supplies. These technologies enable cities to better manage their water resources, guaranteeing that they can satisfy the needs of rising urban populations while reducing environmental damage.

— **Advanced Surveillance Systems**

Advanced surveillance systems are becoming more integrated into smart city infrastructure, improving security and public safety. These systems frequently combine CCTV cameras, AI-powered analytics, and IoT sensors to monitor and analyze real-time data from several sources (Chen, Cheng, & Hsu, 2020). Cities must strike a balance between ensuring public safety and safeguarding residents' rights, even as new technologies increase security and give rise to privacy and misuse problems. When properly implemented, advanced surveillance systems can greatly improve urban settings' safety and security by strengthening their resistance to terrorism and crime (Chen, Cheng, & Hsu, 2020).

— **Cybersecurity Measures**

Effective cybersecurity measures are essential as smart cities depend more and more on digital infrastructure and networked technologies. In smart cities, cybersecurity entails defending people' privacy, maintaining data integrity and confidentiality, and defending vital infrastructure from cyberattacks. The growing prevalence of IoT devices in urban settings creates new security risks since hackers might use these gadgets to compromise vital services or steal private data (Rose, Eldridge, & Chapin, 2015).

— **Emergency Response Systems**

Smart cities must have emergency response systems in place to respond to accidents, natural disasters, and other emergencies quickly and effectively. These systems coordinate emergency services and provide quick information to the public by utilizing IoT devices, real-time data analytics, and contemporary communication networks (Chatfield & Reddick, 2018). Additionally, Reddick, Chatfield, and Jaramillo (2016) point out that there is an increasing trend in the use of social media and mobile applications for the purpose of notifying citizens about emergencies and gathering their opinion in real time. Smart cities can improve citizen protection and crisis management by incorporating technology into emergency response systems.

2.5 TOP-DOWN VS BOTTOM-UP APPROACH

In the realm of smart cities, the debate between top-down and bottom-up approaches is crucial in determining their development trajectory. At the same time, many authors (Vasile and Mocan, 2019; Capdevila and Zarlenga, 2015) highlight that it is clear there will always be a diversity of approaches from one community to another, from one city to another, from one state to another, depending on their general status, culture, population, business needs, and governmental maturity, which of course will include top-down and bottom-up approaches; however, there must be a “common language” and solutions to interconnect all implemented systems in order to facilitate collaboration and prosperity. In addition, Capdevila and Zarlenga (2015) echo that top-down and bottom-up initiatives are not opposed forces but, on the contrary, can have a synergistic effect on the innovation capacity of the city.

In detail, the top-down approach typically involves centralized planning and decision-making by governmental bodies or large corporations that strives to respond effectively to the societal challenges of our times (Ludlow, Khan, Soomro, Marconcini, Jose & Malcorps, 2017). It essentially emphasizes strategic initiatives, infrastructure investments, and policy implementations driven by overarching visions of urban development. However, as many cities are adopting the urban developments of a smart city, researchers are arguing that in the top-down approach, the citizens’ voice is largely absent in smart city policies and plans (Foster, 2020). Foster (2020) further discusses this on his paper “Smarten up: Paths to bottom-up smart cities the risks of top-down smart governance” where he argues cities have adopted a top-down approach, which does not encourage participation and carries the risk of deepening inequality. Instead, he suggests that cities should adopt a bottom-up approach and learn from initiatives by civil society and NGOs how to use technology to put citizens at the center of participatory governance. Similarly, Goodspeed (2015) argues that there is a need to emphasize the role of grassroots movements such as civic hackers and Thompson (2004) on the other side, highlights the need to increase in stakeholder participation as a means of effectively fostering local innovation.

Conversely, the bottom-up approach empowers local communities, entrepreneurs, and grassroots organizations to initiate and implement innovative solutions with an emphasis on stakeholder engagement and public participation (Davies, Selin, Gano & Pereira, 2012; Poplin, 2011; Hanzl, 2007). Two examples for bottom-up approaches are for example the visualization and stimulation tools (Khan, Loibl & Soomro, 2014) and mobile phone 3D augmented reality application for Vienna (Lang and Sittler, 2012). While the top-down approach may ensure consistency and alignment with broader urban goals, the bottom-up approach fosters inclusivity, agility, and responsiveness to local contexts. A successful smart city strategy often integrates elements of both approaches (Capdevila and Zarlenga, 2015), striking a balance between centralized planning and local empowerment to create sustainable and resilient urban environments.

2.6 THE PROBLEM WITH CITIES THAT SMART-CITIES SOLVE

Cities play a prime role in social and economic aspects worldwide, and have a huge impact on the environment (Mori and Christodoulou, 2012). However, because of the fast urbanization, nowadays we see a lot of challenges that threaten the sustainability and well-being of urban populations. Environmental degradation (Pena et al., 2016; Barreri, 2018), pollution (Jamil et al, 2015; Toma et al., 2019), traffic congestion (Djahel et al., 2014; Soomro et al., 2018), the presence of brownfields (Stewart, 2004), and issues related to governance are among the pressing issues faced by cities globally. These challenges not only undermine the quality of life for residents but also pose significant risks to public health and economic stability.

Air pollution is one of the major issues for the health of people. According to a research conducted by The World Health Organization states that 2.4 million people die each year from causes directly attributable to air pollution, with 1.5 million of these deaths attributable to indoor air pollution. Smart cities have offered innovative solutions to address these complex problems by leveraging technology, data analytics, and sustainable practices. For example, smart cities have implemented air quality monitoring systems equipped with IoT sensors to continuously measure pollution levels in real-time (Jamil et al., 2015; Toma et al, 2019). According to Toma et al. (2019) research, the IoT solution to pollution includes having multiple IoT devices and attached sensors in several areas of the city. These sensors then upload and send data to the IoT cloud, and with this data, authors can use AI and other technologies, such as HMS Netbiter, to monitor the air quality. In the same vein, Jamil et al., research (2015) "Smart Environment Monitoring System by employing Wireless Sensor Networks on Vehicles for Pollution Free Smart Cities", focuses on developing a Smart Environment Monitoring System with the goal of creating pollution-free smart cities. To achieve this, they utilized Wireless Sensor Networks (WSNs), which are networks of small, autonomous sensor nodes capable of monitoring physical and environmental conditions. One key aspect of their approach was the deployment of these WSNs on public transport vehicles. By placing sensors on buses and cars that regularly traverse urban areas, the researchers aimed to gather real-time data on air pollution levels throughout the city. These mobile sensor nodes on public transport vehicles continuously collect data on various air pollutants such as gases, smoke, and dust particles. Supporting Jamil et al.'s research (2015), the authors Banach, Talaśka, Dalecki and Długosz have researched air pollution and new technologies in smart cities in their paper "New technologies for smart cities – high-resolution air pollution maps based on intelligent sensors". Same as Jamil et al. (2015), the authors are developing a WSN that can collect data on air pollution levels throughout a city in real-time. This network consists of small, autonomous sensor nodes equipped with various sensors to measure pollutants such as gases, particulate matter, and other contaminants in the air. By using data collected by the WSN, the authors aim to create detailed and dense air pollution maps for compact urban areas. These maps will provide visual representations of air quality levels across different parts of the city, allowing users to identify and avoid highly polluted areas. In addition, the authors specifically mention that their system will benefit cyclists and pedestrians moving through the city. By accessing real-time air pollution data and the corresponding maps, cyclists and pedestrians can make informed decisions about their routes, choosing paths that minimize exposure to pollutants.

In line with air pollution, environmental degradation is also a critical concern facing urban areas worldwide. In 2015, the United Nation developed 17 Sustainability Development Goals that aim to act as an urgent call for action for countries all over the world (United Nations, 2018). Studies show that by improving energy efficiency (Pena et al., 2016; Barreri, 2018, Bhati, 2017) smart cities can significantly reduce their environmental footprint and enhance sustainability (Soomro et al., 2018). For example, Calvillo et al. (2018) focused on buildings, as one of the bigger energy users of the city. The paper proposed a linear programming model which finds optimal operation and planning of distributed energy sources in a residential district in Madrid. In the same vein as Pena et al., (2016), Barreri (2018), Bhati (2017), Kahn (2014) in his research "Sustainable and smart cities" which is a World Bank Policy Research Paper, he delves into the intricate dynamics between environmental degradation and the development of smart cities, particularly in the context of developing nations. Kahn (2014) acknowledges the daunting challenges faced in achieving environmental progress in these cities, where the concentration of people and firms often leads to increased pollution unless effective incentives are in place for polluters. He further adds that while government engagement is regarded as a possible option, budget restrictions frequently limit authorities' ability to properly monitor and regulate pollutants. However, environmental economists are optimistic about the possibility for growing cities to emit less pollution during periods of economic expansion. The research assesses urban sustainability using factors such as day-to-day quality of life, greenhouse gas emissions, and natural disaster resilience, emphasizing the benefits of sustainable cities, such as increased public health and productivity. Finally, it proposes various policy suggestions for mitigating pollution, including encouraging firms to move to dedicated industrial parks, implementing pollution permits, and disclosing information about industrial polluter activities.

Same as air pollution, in the pursuit of more sustainable land use in terms of economy, environment and society, many planners and developers are looking to brownfield redevelopment as a viable alternative to further greenfield conversion (Stewart, 2004). Yount (2003) defines brownfields as properties that have been abandoned or are underutilized and are frequently contaminated with hazardous substances or contaminants and can be found in both urban and rural environments, but they are more common in cities. Brownfields can cause substantial issues for cities, ranging from environmental concerns to economics ones (Yount, 2003). The research of Stewart (2004) titled "Smart

Development for Brownfields: A Futures Approach using the Prospective through Scenarios Method" explores the nexus between urban development, environmental sustainability, and the revitalization of brownfield sites, particularly in the context of contemporary societal changes and challenges. The research highlights the shift in global dynamics towards urbanization and acknowledges the pivotal role of cities in shaping the future quality of life. Furthermore, the research introduces the concept of Smart Development, which emphasizes economically sound, environmentally responsible, and socially supportive growth strategies and it advocates for the adoption of future methodologies like the scenario planning to facilitate the transition towards Smart Development principles. Ultimately, the research underscores the need for innovative approaches to urban development that prioritize sustainability, community livability, and economic viability, with brownfield redevelopment playing a crucial role in achieving these objectives.

Moreover, traffic congestion is a pervasive issue plaguing urban areas, leading to wasted time, increased fuel consumption, air pollution, and reduced quality of life for residents. In smart-cities, authors have designed several solutions to assist the Traffic Management System (TMS) in dealing efficiently with the aforementioned issues (Djahel et al., 2014). These solutions have spanned the whole life cycle of traffic data in smart transportation domain, ranging from advanced data collection devices and protocols using WSNs (Wireless Sensor Networks) technology to route planning and short-term traffic prediction techniques. In addition, Djahel et al.'s research (2014) highlights how the capabilities offered by a TMS are not confined to serve drivers and road authorities only, but can also contribute significantly to the economic growth of a country, to the preservation of citizens' safety and to the support of national security. They further add that the currently deployed technologies for road traffic surveillance still suffer from a lack of traffic parameters measurement accuracy and real-time report of events that occur on the roads, especially in developing countries.

Last but not least, smart governance plays a crucial role in addressing these multifaceted challenges and ensuring the effective implementation of solutions in smart cities (Pereira, Parycek, Falco, Kleinhans, 2018). Meijer and Bolívar (2016) in their research "Governing the smart city: a review of the literature on smart urban governance" define smart governance in regards to smart cities. They say that smart governance is conceptualized as the collaborative process of crafting new forms of human collaboration through the use of information and communication technologies (ICTs) to achieve better outcomes and more open governance processes in smart cities. In detail, the authors discuss smart governance within the context of smart cities, emphasizing the importance of collaboration among various stakeholders in urban governance processes. The authors highlight that smart governance in smart cities involves fostering productive interactions between networks of urban actors, including government entities, businesses, research institutions, and citizens. This collaborative approach is essential for developing innovative solutions to urban challenges and improving the quality of life for citizens.

In addition, Pereira et al.'s research (2018) research shows that with the use of ICT, smart-cities are improving decision-making through better collaboration among different stakeholders, including government and citizens, can be strongly related to government approaches. They further add that ICT-based tools, such as social media, and openness can be factors that increase citizen engagement and support the development of new governance models for smart government. By leveraging data-driven decision-making, digital platforms (Nastjuk, Trang, & Papageorgiou, 2022).and citizen engagement initiatives (Alsaid, 2021; Castelnovo, Misuraca & Savoldelli, 2016), smart governance frameworks empower city officials to identify priorities, allocate resources efficiently, and collaborate with stakeholders across sectors. We can see that from implementing smart transportation systems to reduce traffic congestion and emissions, to deploying IoT sensors for environmental monitoring and early detection of epidemics, smart cities are at the forefront of fostering resilience, efficiency, and inclusivity in urban environments.

Beyond voice-controlled assistants, smart cities are also harnessing the potential of smart cars to revolutionize urban mobility and transportation systems (Yaqoob, Khan, Kazmi, Imram, Guizani, Hong, 2019; Edwards, 2014; Arena, Pau & Severiono, 2020). Yaqoob., et al (2019) add further that traditionally, vehicles exhibited limited ability to communicate with each other. But, in smart cities, they claim that sion of autonomous cars is becoming a reality because of the fifth-generation (5G) standard, which ensures low latency and provides high data rates (Mehmood., et al, 2017). At the same time, they highlight how autonomous cars send and receive data from multiple sources, such as traffic signals and parking spaces, autonomous vehicles, and the cloud, which demand highly reliable communication technologies, ultimately simplifying the driver's life (Arena et al., 2020). In addition, Yaqoob et al.'s (2017) research "Enabling communication technologies for smart cities. IEEE Communications Magazine" provides an analysis of the communication and networking technologies employed in smart cities, along with the challenges they face and potential future directions. The research acknowledges the significant advancements in heterogeneous communication technologies that facilitate interactions among smart city objects. However, it highlights the challenges posed by the coexistence of numerous devices, leading to connectivity issues. Most importantly, the article presents a taxonomy for classifying literature on smart cities based on various parameters such as future and emerging technologies, modern communication technologies, IEEE wireless technology standards, objectives, network classes, and mode of operations. They research cities like Barcelona, Stratford, Singapore, and Porto to illustrate real-world implementations of communication technologies in smart city contexts. As we can see, the evolution of new technologies has profoundly impacted the trajectory of urban development, ushering in an era of unprecedented connectivity, efficiency, and innovation.

2.7 CONCLUSION: FROM STRATEGIC INTENT TO IMPLEMENTABLE SMART CITY VISIONS

Conclusively, the examination of smart cities and their technological progress exposes a multifaceted and intricate landscape that presents prospects for urban growth. The emergence of smart cities signifies a significant transformation in urban planning and management, using state-of-the-art technology to optimize productivity, ease of use, and sustainability - but above all, to improve the quality of life for inhabitants. According to this chapter on the developments in smart cities, cities are becoming more and more important in society due to factors including population growth, economic opportunities, and cultural experiences. It also draws attention to the necessity of an approach to urban development that is more inclusive and progressive that goes beyond advances in technology.

Additionally, this chapter examined how technological innovations like big data, the Internet of Things (IoT), smartphones, and artificial intelligence (AI) have changed civic engagement and urban operations. As evidenced in this extensive literature review and by many instances in the research, these technologies have the power to reshape urban environments, improve municipal services, and enable inhabitants to actively engage in urban government. On the other hand, despite the promises made by IT businesses and the rise of smart technology, fundamental problems remain concerning their genuine effectiveness in tackling complex urban difficulties. Although digital technologies provide novel solutions, concerns have been raised about how well they align with the more expansive objectives of sustainability and social equity. In summary, navigating the environment and promises of smart cities demands a full grasp of technology developments, urban challenges, and governance dynamics. Stakeholders may work together to create smarter, more inclusive, sustainable cities that benefit all residents by critically evaluating these elements. In conclusion, this chapter adds value to the current discourse on smart cities by offering insightful analysis and highlighting important areas requiring more research and intervention.

SMART CITY CONCEPT

Photography 3
as created in the 19th century, when Barcelona destroyed the city walls which were limiting its growth and built a promenade to unite the upper part of the city with the sea.
Author: Noppasin Wongchum

3. SMART CITY CONCEPT

In the rapidly evolving landscape of urbanization, the concept of “smart city” has become more and more popular in scientific literature and international policies. **With the growth of digital technology and networked systems, cities throughout the world are working to leverage these advancements to address serious urban concerns and improve the quality of life for their residents.** However, the concept of what constitutes a smart city is multidimensional, with several interpretations and developing meanings throughout time.

First, we need to answer the question of why are there cities? Zubizarreta et al (2016) explain that “cities are a human invention; they were born from the human need for security, the convenience of living together, easier management of resources, better quality of life, and smaller mobility distances”. On the other hand, the author says that people can strengthen their position and proximity within the city with smart city technology. The smart method, smart approach, smart development, and smart applications - as well as the fusion of languages, the overlay of information, and the overlay of systems - have evolved into the actual mode of city governance. As many other researchers claim, the majority of the population will reside in cities in the upcoming years. Zubizarreta (2016) suggests that working to integrate the smart cities concept implies connecting the instrument with the end in light of these historical and contemporary events; the relevance of this process then causes the smart city to become an icon. Saunders and Baeck (2015) in their research “Rethinking Smart City from the Ground” give us a short timeline on how the smart cities evolved. They say that the first use of urban modelling tools was back in the 1950 where transport planners began to use rapidly developing computer technologies to model transport flows in cities. Moving to 1990, when e-government becomes famous as cities start using the internet and digital technology to improve internal government processes and deliver public services. Moving further to 2000, where the building of smart cities stared by constructing entirely new technology. As we see, from 1950 and forward, smart cities have been constantly being influenced and shaped through thinking about urban development, economic growth and urban technology (Angelidou, 2014). Considering that cities started implementing smart-city projects since then, then we see that the historical roots go back far in time, although the idea of smart cities is new to some countries.

3.1 SMART CITY DEFINITIONS

This chapter delves into the intricate tapestry of Smart Cities, aiming to provide clarity amidst the complexity by answering the fundamental question: "What is a Smart City?". This chapter also navigates through various definitions, explores shifts in focus across different eras, elucidates working definitions, and investigates the key stakeholders driving the development of the Smart City concept. When reading the scientific literature on smart cities and seeking for a description of the smart-city idea, it is evident that the phrase "smart city" does not have a comprehensive and widely acknowledged meaning by the scientific community and allied institutions. That is why many authors label the smart-city concept as “fuzzy” (e. g. Caragliu et al., 2009, Dameri et al., 2019, Lara et al., 2016). In addition, Coacchia (2014) explains why it is difficult to provide one definition of a smart-city. She says that that there are two aspects we need to consider when it comes to smart-cities. First of all, “smart” as an adjective has a broad meaning and can be interpreted in very different ways. The scientific literature refers to several smart city concepts and their offshoots or predecessors such as, among other labels, “Intelligent City, Knowledge City, Wired City, Digital City” (Cocchia, 2014, p. 18). As many studies also suggests, there are many terms that define the word “smart” are often these words are also used interchangeably (Albino et al., 2015; Hollands, 2008; Komninos, 2012) Secondly, because many notions are sometimes ambiguous and contradictory, many cities regard themselves as Smart Cities by identifying (or selling) their policies as "smart" without referring to a widely agreed and unified definition.

However, many authors do define smart-cities and those definitions will be explained in a chapter below. Specifically, the research will confront the myriad definitions that have been proposed by scholars, policymakers, and practitioners. By analyzing these definitions, we discern similarities and differences, unraveling the core elements that constitute the essence of Smart Cities. For example, Lom and Pribyl (2020) conceptualize also the differences between “traditional cities” and “smart cities” on the basis of systems theory by quoting D. Rousseau (2015). "Traditional cities" and its accompanying subsystems are considered autonomous systems incapable of communicating with their immediate contexts. In contrast, “smart cities” are defined by urban systems and subsystems communicating and exchanging information with other systems and subsystems, respectively. Furthermore, this chapter examines the evolution of these definitions throughout time, offering light on the shifting dynamics and objectives that have impacted the conversation about Smart Cities.

Furthermore, this chapter investigates the driving forces behind the development of Smart Cities, highlighting the pivotal role played by tech giants such as IBM, Google, and Amazon, alongside governmental bodies, municipalities, and initiatives driven by public interest. As we know, IBM was one of the first stakeholders contributing to the smart city notion. According to IBM Global Business Services (2009) the smart city concept is purely technology-driven with the claim to make urban infrastructure systems more efficient. Their research showcases that smart-cities “make their systems instrumented, interconnected and intelligent” (p.10). With that being said, by examining the landscape of research on Smart Cities, we identify key players and trends, discerning the pulse of innovation and inquiry in this burgeoning field. Finally, this chapter serves as a comprehensive guide to understanding the essence of smart cities, offering insights that are essential for policymakers, urban planners, researchers, architects, researchers, and stakeholders invested in shaping the cities of tomorrow.

3.1.1 Many definitions – what is similar or different in their descriptions

"Intelligent", "Digital", "Technology-driven", "Innovation", are some of the synonyms of a smart-city concept. The use of the term "smart-city" is growing rapidly nowadays in many sectors with no agreed upon definitions (Albino et al., 2015), and not a "one-size-fits-all" definition of it (O'Grady and O'Hare, 2012). Many authors (Dameri et al., 2019; Nam and Pardo, 2011) derive the definition of the smart city through the combination of technological, human, and institutional factors that constitute a smart urban development, as seen in the figure below.

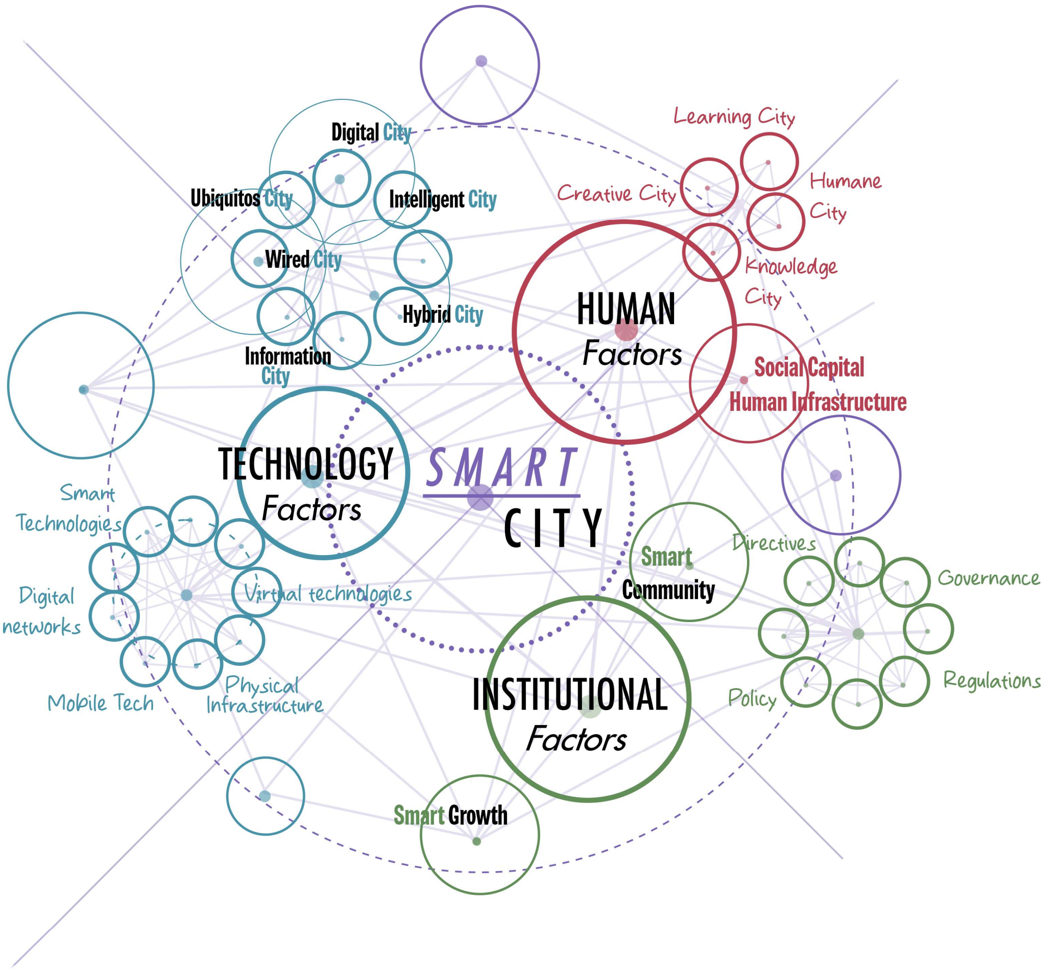


illustration 2.0.

Conceptualizing smart city with dimensions of technology, people, and institutions

Author: Dashnor Kadiri, 2025[3].

[3] Base illustration source:
Managing future cities: media and information and communication technologies in the context of change (Accessed: 26 May 2025)

Nam and Pardo (2011) explain thoroughly the above-mentioned factors. The authors in their paper "Conceptualizing Smart City with Dimensions of Technology, People, and Institutions" provide an overview of technological domains within the smart city domain as they delve into the concepts of digital city, intelligent city, virtual city, ubiquitous city (U-city), and information city. They explain that technological factors create an environment where the residents may collaborate, share information, have smooth interactions, and work together. Below, we can see definitions provided by Cocchia (2014, p. 19f) of such concepts of the technology factors.

Table 4.0. Definitions of Digital, Intelligent, Virtual, Ubiquitous, and Information City

Concept	Definition	Reference
Digital City	The digital city is as a comprehensive, web-based representation, or reproduction, of several aspects or functions of a specific real city, open to non-experts. The digital city has several dimensions: social, cultural, political, ideological, and also, theoretical"	Couclelis (2004)
Intelligent City	"Intelligent cities are territories with high capability for learning and innovation, which is built-in the creativity of their population, their institutions of knowledge creation, and their digital infrastructure for communication and knowledge management"	Kominos (2006)
Virtual City	"Virtual City concentrates on digital representations and manifestations of cities"	Schuler (2011)
Ubiquitous city	"Ubiquitous city (U-City) is a further extension of digital city concept. This definition evolved to the ubiquitous city: a city or region with ubiquitous information technology"	Anthopoulos & Fitsilis (2010).
Information city	"Digital environments collecting official and unofficial information from local communities and delivering it to the public via web portals are called information cities"	Anthopoulos & Fitsilis (2010).

Nam and Pardo (2011) explain thoroughly the importance of human, technology, and institutional aspects in a smart-city. Essentially, their article emphasizes the importance of human aspects in the development of smart cities. It emphasizes the significance of education, creativity, social inclusion, and communal intelligence. They add up that education emerges as a primary magnet for luring businesses, organizations, and individuals to dynamic learning settings in cities. Furthermore, according to them, the definition of "smart people" includes characteristics such as lifelong learning, social diversity, adaptability, and participation in public life.

Planning for smart cities has typically placed a strong emphasis on implementing cutting-edge technologies, under the presumption that these advancements will be the primary drivers of economic growth, sustainability, and urban efficiency. In order to maximize municipal operations and services, the focus has frequently been on implementing cutting-edge infrastructure, such as IoT devices, big data analytics, and smart grids (Harrison et al., 2010; Townsend, 2013). Nevertheless, the vital role that the people who live in these urban places play has often been ignored by this technocentric approach. Many smart city programs have fallen short in addressing the social, cultural, and human components necessary to create truly livable and inclusive urban settings because they have focused primarily on technology. This chapter emphasizes the significance of human-centered planning in smart cities, shifting the focus towards a more balanced viewpoint. It makes the case that smart cities should be judged not just on how far technology has come, but also on how well they improve people's quality of life, advance social justice, and give residents the power to actively shape their urban environments (Nam and Pardo, 2011; Hollands, 2008).

The definition of smart cities from a human-centered perspective places a strong emphasis on the welfare of people and their essential role in the development of metropolitan areas. According to this viewpoint, inclusive, participatory, and human-centered urban design is the key to making smart cities more than just technological structures and more about enhancing the quality of life for their residents (Deakin and Al Waer, 2011; Allwinkle and Cruickshank, 2011). Similarly, Deloitte (2018) emphasized how "the focus of any smart city should be its people, providing benefits such as a better quality of life for residents and visitors, economic competitiveness to attract industry and talent, an environmentally conscious focus on sustainability." They further add that these three goals—quality of life, economic competitiveness, and sustainability—can provide the foundation for a smart city initiative.

Human-centered definitions frequently emphasize elements like cultural variety, social equality, and individual empowerment in urban settings (Nam and Pardo, 2011; Hollands, 2008). Hollands (2008), for example, contends that a smart city's true essence is not just the use of cutting-edge technologies, but also its ability to promote social inclusion and improve quality of life. According to Caragliu et al. (2011), Harrison et al. (2010), Chourabi et al. (2012), and others, smart cities should put a priority on human development by creating environments that encourage learning, creativity, and innovation. These factors all contribute to the community's overall well-being and social capital.

Additionally, a human-centered smart city places a strong emphasis on the value of citizen participation in decision-making processes and participatory governance. According to this perspective, smart cities ought to be planned with the purpose of enabling citizens to participate in civic life and influence policies that impact their day-to-day experiences. (Schaffers et al., 2011; Caragliu et al., 2011; Nam and Pardo, 2011). Schaffers et al. (2011), for instance, contend that co-creation of smart services and solutions by residents and the integration of technology into the social fabric are critical components of smart city success (Lombardi et al., 2012). In addition to promoting a feeling of community, this cooperative approach guarantees that the technological developments in smart cities are in line with the needs and goals of the populace (Komninos, 2011; Alawadhi et al., 2012). This results in the creation of urban environments that are more resilient, adaptive, and sustainable (Meijer and Bolívar, 2016; Vanolo, 2014).

In addition, the commitment to social justice and inclusivity is a key component of human-centered smart cities. By guaranteeing that all population, regardless of socioeconomic background, can benefit from smart city efforts, this strategy aims to close the digital gap. As studies say (Kitchin, 2015; Calzada and Cobo, 2015) prioritizing inclusivity, smart cities work to reduce disparities in metropolitan areas by ensuring that everyone has equal access to chances for work, healthcare, and education. These studies take the examples of smart technologies, for example, which can be used to improve public transit systems, and in this way, they can enhance mobility and economic possibilities by making them more accessible to underserved communities. In addition, these studies conclude that smart cities can promote social cohesiveness among various people and more balanced urban growth by tackling these disparities.

Apart from social justice, improving health and well-being is another essential focus of human-centered smart cities. Studies show (Allam and Newman, 2018; Neirotti et al., 2014) that smart cities generate environments that support mental and physical well-being by utilizing data-driven health initiatives and smart healthcare systems. These studies take different examples, for instance, in smart cities, environmental monitoring systems can check air quality and give citizens access to real-time data, empowering them to make health-related decisions. Additionally, they highlight how smart healthcare solutions can increase access to healthcare services, especially for the aged and disabled. This way we can say that smart cities that prioritize health and well-being can design urban environments that improve citizens' quality of life while simultaneously promoting physical health.

The preservation of local and cultural identity is another crucial component of the human-centered approach to smart cities. It is important that new technologies be integrated into urban areas in a way that respects and incorporates the local features and cultural traditions that constitute a city's identity (Campbell, 2012; Söderström et al., 2014). By leveraging technology to improve community participation in cultural events and increase access to cultural resources, smart cities may be key players in fostering cultural engagement.

In addition to the human aspect, the authors (Nam and Pardo, 2011) also emphasize the importance of technology in the development of cities into smart cities. They say that, while a well-functioning IT infrastructure is necessary, it is insufficient for achieving smart city designation. Rather, meaningful participation and collaboration among multiple sectors public institutions, private firms, non-profit organizations, schools, and citizens are required. Moreover, the emphasis is on the accessibility and availability of technological systems, particularly smart computing technologies applied to essential infrastructure components and services. They add up that mobile, virtual, and ubiquitous technologies are critical components of technological preparedness, as they ease the move from smart locations to networked residents. Furthermore, a pervasive computing infrastructure is emphasized as critical to the digital growth of cities. Last but not least, their article echoes the importance of institutional issues in the development and implementation of smart city initiatives as it emphasizes the importance of government policies and governance systems in creating a favorable environment for smart city development. They suggest that this includes not just supportive policies, but also the interaction of government agencies and non-governmental organizations, as well as transparent and integrated governance structures. Finally, they suggest that collaboration between agencies and with communities is emphasized as critical for promoting openness, accountability, and citizen-centric governance processes.

Along Nam and Pardo's (2011) work, Yovanof et al (2009) agrees that a ubiquitous and pervasive computing infrastructure is a key technological component in the build out of a digital city. They define the digital city as "a connected community that combines broadband communications infrastructure; a flexible, service-oriented computing infrastructure based on open industry standards; and, innovative services to meet the needs of governments and their employees, citizens and businesses". The very first European digital city to be realized was 'De Digitale Stad' (DDS), a grassroots platform launched in Amsterdam in 1994 (Angelidou, 2014). This platform was a form of a democratic electronic forum for the citizens of Amsterdam and brought them in contact with the local government (van den Besselaar et al., 2000). Following Amsterdam, other digital cities starting emerging, such as Berlin, Washington D.C., The Virtual Los Angeles (Oyama et al., 2001), the Iperbole initiative in Bologna (Graham and Aurigi, 1997), America Online, Helsinki and Kyoto (Ishida, 2000, 2002). On the other hand, Malek (2009) defined an intelligent city as a city with the most recent advancements in electronic, mechanical, and telecommunications technology, as well as all the information technology infrastructure. Moving further, with the latest technologic developments, digital cities are outmoded as the current trend for intelligence is to become as widespread as possible with urban environment (Komninos, 2009). As Angelidou (2014) highlights, interest is now centered on making cities more 'intelligent' and 'smart'. From 2000 and onwards, their research showcases that urban expansion policies have mostly focused on improving cities' social and physical inclusiveness, sustainability, and livability. Among the main drivers of urban growth have been the creation of thriving urban economies, the management of urban systems, the promotion of sustainable urban forms, the preference for participatory democracy, and the utilization of the population's collective abilities (Angelidou, 2014). As El Nasser (2011) illustrated this trend in a striking way: "Intelligent cities, the new darling lingo of planners, reflects the times. It captures the essence of 21st-century technology that can help track when and how many people cross a street, water and energy consumption and peak hours at every transit stop". For such reasons, academic institutions, think tanks, international consultancies, and global technology suppliers are all pursuing information about smart cities. In addition, city administrations from all over the world now pile up in their agendas a multitude of measures and strategies to become ‘smart’ and ‘intelligent’, in order to address the challenges of competitiveness, employment, and sustainability and thus, smart city programs are being implemented in hundreds of cities on a global basis (Angelidou, 2014).

However, instead of a city, some definitions also refer to “community” (Moura and Silva, 2019), and for such reasons that the term is being interchangeable, the label “smart city” is a fuzzy concept and is used in ways that are not always consistent (Albino et al. 2012). As Albino et al. (2012) echo, there is a lot of uncertainty surrounding the categories of smart cities because there are other terms that are comparable to the idea of a smart city, like digital, intelligent, virtual, and omnipresent with technology focus. The authors further add that these concepts relate to less inclusive and more specialized layers of a city, therefore the idea of a "smart city" frequently encompasses and extends them. Apart from the technology factors, human factors are centered around people, education, learning, and knowledge. These dimensions include the concepts of “Learning City” and “Knowledge City”, terms that are defined below.

Table 5.0. Definitions of Learning City and Knowledge City

Concept	Definition	Reference
Learning City	“The term ‘learning’ in ‘learning cities’ covers both individual and institutional learning. Individual learning refers to the acquisition of knowledge, skills and understanding by individual people, whether formally or informally. It often refers to lifelong learning, not just initial schooling and training. By learning, individuals gain through improved wages and employment opportunities, while society benefits by having a more flexible and technological up-to-date workforce”	Organization for Economic Cooperation and Development (OECD) (2010)
Knowledge City	“A Knowledge City is a city that aims at a knowledge-based development, by encouraging the continuous creation, sharing, evaluation, renewal and update of knowledge. This can be achieved through the continuous interaction between its citizens themselves and at the same time between them and other cities’ citizens. The citizens’ knowledge-sharing culture as well as the city’s appropriate design, IT networks and infrastructures support these interactions”	Ergazakis et al (2004).

As we see, the Knowledge City, or else known the KC, is actually very broad and may refer to diverse aspects of the social, economic and cultural life of a city. Scholars such as Carillo (2004, 2006), Chatzkel (2004), Dvir (2004), Martínez (2008), have contributed to the understanding of KC, as it facilitates ongoing processes of knowledge creation, sharing, evaluation, renewal, and updating (Ergazakis et al., 2004). In addition, Carillo (2004) and González et al. (2010) present the concept of "knowledge citizens," which describes people who actively engage in community cooperation and provide non-expert information to advance and disseminate knowledge in urban areas. This idea highlights a problem that smart cities are currently facing: reframing innovation and giving businesses, stakeholders, and residents the authority to influence how they will live in the future (Komninos et al., 2013). Overall, authors focus on technology, innovation, sustainability, quality of life, governance and citizen engagement, economic development, among others, to forge a holistic understanding of smart cities and guide policymakers, urban planners, and stakeholders in shaping the future of urban environments. The evolution of the smart city concept is intricately intertwined with the ideals of knowledge-centric urban development. Many definitions have been suggested for the concept of a smart city and the table below showcases different definitions.

Table 6.0. Most-used smart-city definitions divided into focus of technology, innovation, sustainability, quality of life, governance and citizen engagement, and economic development.

Dimension of smart city concept	**Definitions**
Technology	**Townsend (2014):** “Smart cities are as places where information technology is combined with infrastructure, architecture, everyday objects, and even our bodies to address social, economic, and environmental problems.” **Lombardi et al. (2012):** "The application of information and communications technology (ICT) with their effects on human capital/education, social and relational capital, and environmental issues is often indicated by the notion of a smart city." **Cretu (2012):** "Smart cities are all about networks of sensors, smart devices, real-time data, and ICT integration in every aspect of human life." **Bakıcı et al. (2013):** "Smart city as a high-tech intensive and advanced city that connects people, information, and city elements using new technologies in order to create a sustainable, greener city, competitive and innovative commerce, and increased life quality." **Dameri (2013):** "A smart city is a well-defined geographical area, in which high technologies such as ICT, logistic, energy production, and so on cooperate to create benefits for citizens..." **Hall et al. (2000):** "A city that monitors and integrates conditions of all of its critical infrastructures, including roads, bridges, tunnels, rails, subways, airports, seaports, communications, water, power, and even major buildings, can better optimize its

	resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens." **IBM (2010):** "A smart city is defined by IBM as the use of information and communication technology to sense, analyze, and integrate the key information of core systems in running cities." **Harrison et al (2010):** "A city connecting the physical infrastructure, the IT infrastructure, the social infrastructure, and the business infrastructure to leverage the collective intelligence of the city." **Chen (2010):** "Smart cities will take advantage of communications and sensor capabilities sewn into the cities' infrastructures to optimize electrical, transportation, and other logistical operations supporting daily life, thereby improving the quality of life for everyone." **Washburn et al (2010):** "The use of Smart Computing technologies to make the critical infrastructure components and services of a city – which include city administration, education, healthcare, public safety, real estate, transportation, and utilities – more intelligent, interconnected, and efficient." **Su et al (2011):** "Smart city is the product of digital city combined with the Internet of Things." **Caragliu et al. (2011):** "A city is smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance."
Innovation	**Kourtit and Nijkamp (2012):** "Smart cities are the result of knowledge-intensive and creative strategies aiming at enhancing the socioeconomic, ecological, logistic, and competitive performance of cities." **Zygiaris (2013):** "A smart city is understood as a certain intellectual ability that addresses several innovative socio-technical and socioeconomic aspects of growth." **Marsal-Llacuna et al. (2015):** "Smart cities initiatives try to improve urban performance by using data, information, and information technologies (IT) to provide more efficient services to citizens..." **Giffinger et al. (2007):** "The smart city generally refers to the search and identification of intelligent solutions which allow modern cities to enhance the quality of the services provided to citizens." **Komninos (2011):** "(Smart) Cities as territories with a high capacity for learning and innovation, which is built in the creativity of their population, their institutions of knowledge creation, and their digital infrastructure for communication and knowledge management." Thite (2011): "Creative or smart city experiments aimed at nurturing a creative economy through investment in the quality of life which in turn attracts knowledge workers to live and work in smart cities."

Sustainability	**Barrionuevo et al. (2012):** "Being a smart city means using all available technology and resources in an intelligent and coordinated manner to develop urban centers that are at once integrated, habitable, and sustainable." **Caragliu et al. (2011):** "Smart cities are cities that have a high quality of life, those that pursue sustainable economic development through investments in human and social capital and traditional and modern communications infrastructure (transport and information communication technology) and manage natural resources through participatory policies." **Thuzar (2011):** "Smart cities of the future will need sustainable urban development policies where all residents, including the poor, can live well and the attraction of the towns and cities is preserved." **European Commission (2012a):** 'The Smart Cities and Communities EIP (SCC) is a partnership across the areas of energy, transport and information and communication with the objective to catalyze progress in areas where energy production, distribution and use; mobility and transport; and ICT are intimately linked and offer new interdisciplinary opportunities to improve services while reducing energy and resource consumption and greenhouse gas and other polluting emissions'
Quality of Life	**Lazaroiu and Roscia (2012):** "A community of average technology size, interconnected and sustainable, comfortable, attractive, and secure." **Guan (2012):** "A smart city, according to ICLEI, is a city that is prepared to provide conditions for a healthy and happy community under the challenging conditions that global, environmental, economic, and social trends may bring" **Giffinger et al. (2007):** "A city well performing in a forward-looking way in economy, people, governance, mobility, environment, and living, built on the smart combination of endowments and activities of self-decisive, independent, and aware citizens." **Nam and Pardo (2011):** "A smart city infuses information into its physical infrastructure to improve conveniences, facilitate mobility, add efficiencies, conserve energy, improve the quality of air and water, identify problems and fix them quickly, recover rapidly from disasters, collect data to make better decisions, deploy resources effectively, and share data to enable collaboration across entities and domains."
Governance & Citizen Engagement	**Kourtit et al (2012):** "Smart cities have high productivity as they have a relatively high share of highly educated people, knowledge-intensive jobs, output-oriented planning systems, creative activities, and sustainability-oriented initiatives." **Zygiaris (2013):** "...the terms 'innovating' and 'knowledge' cities interchangeably refer to the city's ability to raise innovation based on knowledgeable and creative human capital." **Eger (2009):** "Smart communities are not, at their core, exercises in the deployment and use of technology, but in the promotion of economic development, job growth, and increased quality of life." **Caragliu et al. (2011):** "A city is smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable

	economic growth and a high quality of life, with a wise management of natural resources, through participatory governance."
Economic Development	**Kourtit et al. (2012):** "Smart cities have high productivity as they have a relatively high share of highly educated people, knowledge-intensive jobs, output-oriented planning systems, creative activities, and sustainability-oriented initiatives."

Notably, although many studies have been conducted and extensive discussions have taken place, there is no agreed definition of 'smart' and 'intelligent' cities, whereas strategic planning for smart cities is still a largely unexplored and complex field (Komninos, 2011; Nam and Pardo, 2011; Holland, 2008). However, as we see from these definitions, there is emphasis on Information and Communication Technology (ICT) as it such dimensions are crucial in smart city development. In one hand, we see that many of these definitions stress the importance of integrating different city systems, including physical infrastructure, social infrastructure, and business infrastructure, to enhance efficiency and effectiveness (Harrison et al, 2010; IBM, 2010). For example, in order to address social, economic, and environmental issues, Anthony Townsend's (2014) definition of smart cities places a strong emphasis on the integration of information technology with a range of urban elements, including architecture, ordinary objects, infrastructure, and even the human body. This term emphasizes how ubiquitous technology is in smart cities, where digital technologies are thoroughly ingrained in the urban environment and are not merely add-ons. Townsend (2014) proposes that smart cities make use of this technology to build an urban environment that is more responsive and linked. Finally, the term emphasizes the idea that smart cities are about more than just technological innovation; they are also about utilizing these technologies to address pressing issues facing contemporary cities and enhance the quality of life in urban areas.

On the other hand, several definitions showcase how pivotal it is to create sustainable and greener cities that improve the quality of life for the residents (Bakıcı et al, 2013; Caragliu et al., 2011). These studies, among others, stress the importance of technology, but most importantly, they echo that by integrating technology into urban development, smart cities can contribute to creating greener, more sustainable cities while simultaneously enhancing the well-being and quality of life for residents. Another research conducted by the Activity Leading Organization, StadtLABOR Graz (2013), also support that the utilization of Information and Communication Technologies (ICTs) to maximize urban activities, services, and processes in order to promote effectiveness and efficiency. This research showcases that the assimilation of ICTs creates a unified, communicative framework that recognizes their vital function in augmenting a city's competitiveness and advancing sustainability via various networks of individuals, enterprises, technology, and infrastructures. They conclude that while ICT is essential, smart-cities cannot only rely on technology implementations to advance, as this could result in a top-down, uniform strategy. Rather, smart cities are all-encompassing urban settings where technology integrates with many aspects of city life to improve efficiency, sustainability, and the quality of life for citizens.

Although the similarities are bigger when it comes to these popular definitions, there are definitely differences as well. Certain definitions, like those by Bakıcı et al. (2013) and Chen (2010), highlight the use of sensors, real-time data, and smart devices; other definitions, like those by Hall et al. (2000) and Washburn et al. (2010), offer a more comprehensive view by incorporating other essential infrastructure elements outside of ICT. The ways in which definitions approach integration differ. In order to utilize collective intelligence, for example, Harrison et al. (2010) emphasize the necessity of connecting physical, IT, social, and business infrastructures, while IBM (2010) concentrates on the integration of critical data from core systems in operating cities. Furthermore, some definitions, such as Caragliu et al. (2011), echo the role of participatory governance in smart city development, highlighting the importance of involving citizens in decision-making processes. Others, like Su et al. (2011), primarily focus on technological aspects without explicitly addressing governance and citizen engagement. And last but not least, Dameri (2013) specifically mentions a well-defined geographical area when discussing smart cities, suggesting a spatial dimension to smart city development that is not explicitly mentioned in other definitions.

Overall, while these definitions share common themes related to the role of technology in smart city development, they also exhibit variations in terms of the scope of technologies covered, perspectives on integration, inclusion of governance and citizen engagement, and considerations of geographical context. This reflects the diverse approaches and priorities within the broader discourse on smart cities.

Apart from the similarities and differences used by these authors to define the smart-city concept, we will also analyze some of the words that are linked with technology focus, innovation focus, and sustainability focus. From the definitions above, we see that words like “ICT”, “smart devices”, and “real-time data” are frequently used to highlight the technological infrastructure necessary for smart city initiatives. In addition, the term "high-tech intensive" highlights the technological sophistication of smart cities, implying a reliance on cutting-edge advancements. And of course, the term "integration" emphasizes the importance of multiple technologies working together seamlessly, implying a comprehensive approach to urban development. In addition to the technology focus, many definitions are also focused on innovation. From the definitions, the terms "knowledge-intensive," "creative strategies," and "intellectual ability" highlight the need of innovation in driving smart city projects. While the terms "socio-technical" and "socioeconomic aspects of growth" emphasize the multidimensional nature of innovation, which includes both technological and social progress. On the other hand, words like "sustainable," "habitable," "conservation," and "renewable resources" highlight the importance of environmental responsibility and long-term viability in smart city construction – ultimately focusing on sustainability. Besides, the term "Coordinated manner" refers to a systematic strategy to using resources efficiently, reducing waste, and fostering ecological balance. In the same vein, phrases like "comfortable," "attractive," "secure," and "healthy and happy community" emphasize the human-centric aspect of smart city development, putting inhabitants' well-being and pleasure first;

thus, showing us the focus on quality of life. The terms "conveniences," "efficiencies," and "mobility" all refer to improving the ease and convenience of daily life through technological and infrastructure advancements.

Besides the focus on the quality of life, we also have the governance and citizen engagement focus, such as the terms used "participatory governance," "aware citizens," and "knowledgeable and creative human capital", which emphasize the necessity of involving citizens in decision-making processes and instilling a feeling of community ownership. Just how Caragliu et al. (2011) highlighted the significance of participatory governance in their definition of smart cities, he also emphasized that smart cities are distinguished by investments in human and social capital, as well as contemporary communication infrastructure, to drive long-term economic growth and a good standard of living. This indicates a governance system in which citizens actively participate in decision-making processes. Similarly, Giffinger et al. (2007) described smart cities as those that are well-performing in various aspects, including governance. They emphasized the role of citizens as "self-decisive, independent, and aware," indicating a level of consciousness and engagement among residents in shaping the future of their cities. Or, how Kourtit et al. (2012) studied the productivity of smart cities and identified factors such as highly educated people, knowledge-intensive jobs, and creativity. This requires the existence of a trained and innovative workforce, often known as "knowledgeable and creative human capital," which is critical for driving economic growth and innovation in smart cities.

Last but not least, there is the economic development focus where the authors are using the words like: "high productivity," "knowledge-intensive jobs," and "creative activities", ultimately highlighting how smart city projects drive economic growth, stimulate innovation, and provide job possibilities. By examining the exact language used in each description, this research allows us to obtain a better grasp of the underlying concepts, beliefs, and goals that drive smart city rhetoric. These words express not only technical notions, but also broader societal goals such as sustainability, inclusion, and prosperity. Apart from definitions of smart-cities, Lombardi et al (2012) in his research "Modelling the smart city performance" discusses the dimensions of a smart city and the related aspects of urban life. The following table illustrates each dimension.

Table 7.0. Dimensions of a smart-city and related aspects of urban life (adapted by Lombardi et al., 2012).

Dimension of a smart city	**Related aspect of urban life**
Smart economy	Industry
Smart people	Education
Smart governance	E-democracy
Smart mobility	Logistics & Infrastructure
Smart environment	Efficiency & Sustainability
Smart living	Security & Quality

As we see, Lombardi (2012) draws on conventional regional and neoclassical theories of urban growth and development to examine six essential characteristics of the concept of a smart city. Theories of natural resources, human and social capital, transportation and ICT economics, quality of life, and public engagement in city administration are all included in these categories. Even though the phrase "smart city" is not yet often used in urban studies or spatial planning literature, there are still a number of characteristics that warrant further investigation. It's crucial to remember that the term "smart city" is used in a variety of contexts in the literature, from referring to an IT district to highlighting the intellect or education of its citizens. These dimensions provide a framework for understanding the various facets of a smart city and how they impact urban life.

In addition to the dimensions of a smart city and how they are related to urban life, Lombardi et al., (2012) in their research "Modelling the smart city performance" also create a framework analyzing knowledge-based innovation systems, highlighting the reciprocal linkages between universities, industry, and government, called "the triple helix model". The authors suggest that collaboration, knowledge exchange, and mutual support among academia, industry, and government are critical for fostering innovation-driven urban development and creating future-ready, inclusive, and resilient communities. Particularly, the table shown in Lombardi et al., (2012) research on smart city components, triple helix, and performance indicators showcases that Universities should focus on research and innovation (e.g., conduct academic research and foster innovation), quality education, knowledge dissemination, international collaboration, and resource mobilization for research and academic activities. In the same line with universities, the other triple helix, government (public sector) should focus on governance, policy making, infrastructure and services, regulation and compliance, and public interest. Last but not least, the triple helix focuses as well as on industry and how innovation and technology adoption, entrepreneurship, economic development, and market competition, should be on their focus.

By incorporating indicators from each component of the Triple Helix model, the table provides a holistic view of smart city development, emphasizing the importance of collaboration and synergy among universities, government agencies, and businesses in driving innovation, economic growth, and sustainability within urban environments. As we can see, Lombardi et al., (2012) perfectly relates the triple helix concept with the dimensions of the smart city. The triple helix concept, which includes academia, government, and business, is critical for the growth of Smart Governance, Smart Economy, Smart Human Capital, Smart Living, and Smart Environment in the context of smart city development. On the other hand, academic institutions contribute by conducting research, offering education, and driving innovation in a variety of fields, whereas governments play an important role in policy formulation, service delivery, and infrastructure development. Moreover, industries drive economic growth, technical innovation, and workforce development while working with universities and the government to address urban concerns and promote sustainability. These stakeholders work together to improve quality of life, promote economic success, and assure environmental sustainability in smart cities, emphasizing the necessity of synergistic alliances and interdisciplinary approaches to addressing complex urban issues.

3.1.2 How definitions have changed through the years – shift of focus

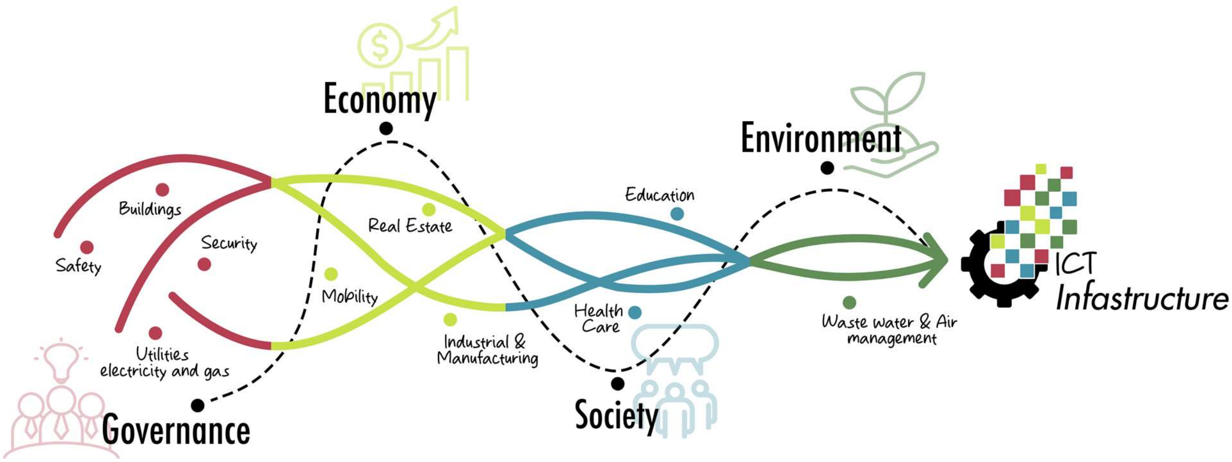
Smart city definitions have evolved noticeably over time, indicating a considerable shift in focus. As Fernandez-Anez (2016) said, since the 1990s, the notion of Smart Cities has grown alongside the deregulation of telecommunications and internet-based services. Initially, definitions focused on the integration of information and communication technologies (ICTs) to improve urban efficiency and effectiveness. However, as the notion progressed, there was a noticeable broadening of scope to include a more comprehensive approach. Modern definitions emphasize not just technical integration, but also sustainability, quality of life, public participation, and inclusive governance. This evolution reflects a better knowledge of the complex interactions between technology, society, and the environment in urban settings.

Cocchia (2014) in her research "Smart and digital city: A systematic literature review" gives a detailed literature review on when authors first started to use the term "smart-city" and how it has changed over the years. First of all, in 1994, it was the first time that a city implemented smart-city strategies, specifically in the city of Amsterdam, and was called "Digital City Amsterdam". Van Bastelaer and Lober-Maris (1998) say that this project was first seen as "a successful project", moving further to Dieberger and Frank (1998) who highlight that a part of that success was the use of virtual metaphor as it made it easier to understand and then use the modern information system. The research further explains that it was in 2000 when there was a huge widespread of internet in everyday life (Ishida, 2000; Schaffers et al., 2012). At this time, after the technological change was advanced, it led to the wider spread and popularization of ICTs, making them a part of everyday life (Angelidou, 2014). The World Wide Web (WWW) and the first web browsers made the Internet more accessible and easier-to-use and facilitated networking and information transfer, making the WWW broadly popular. The result was a new, enhanced generation of 'public' urban cyberspaces and virtual cities (Graham and Aurigi, 1997). By the mid-1990s, many studies featured visions about future cities where ICTs would be the main enabler of democracy and city management (Aurigi, 2006).

Right after that, in 2005, the Kyoto Protocol entered the force as well where many international initiatives regarding safeguarding of environment were spread to achieve the aims of Kyoto Protocol. This protocol, according to Cocchia's research (2004), has fostered the development of smart strategies all over the world. Finally, in 2008, the IBM Smart Planet concept and the Covenant of Mayors took place. Ever since the widespread adoption of the internet in everyday life, to Kyoto Protocol, and the

IBM launch, the concept of smart cities has gained momentum and evolved significantly. The first business to take notice of the "Smart Planet" idea is IBM. Global leaders in industry, government, and civil society could utilize Big Data to "transform enterprises and institutions through analytics, mobile technology, social business, and the cloud," according to IBM (2010), which views Smart globe as an instrumented, connected, and intelligent globe. Meanwhile, the Covenant of Mayors is an independent European city movement.

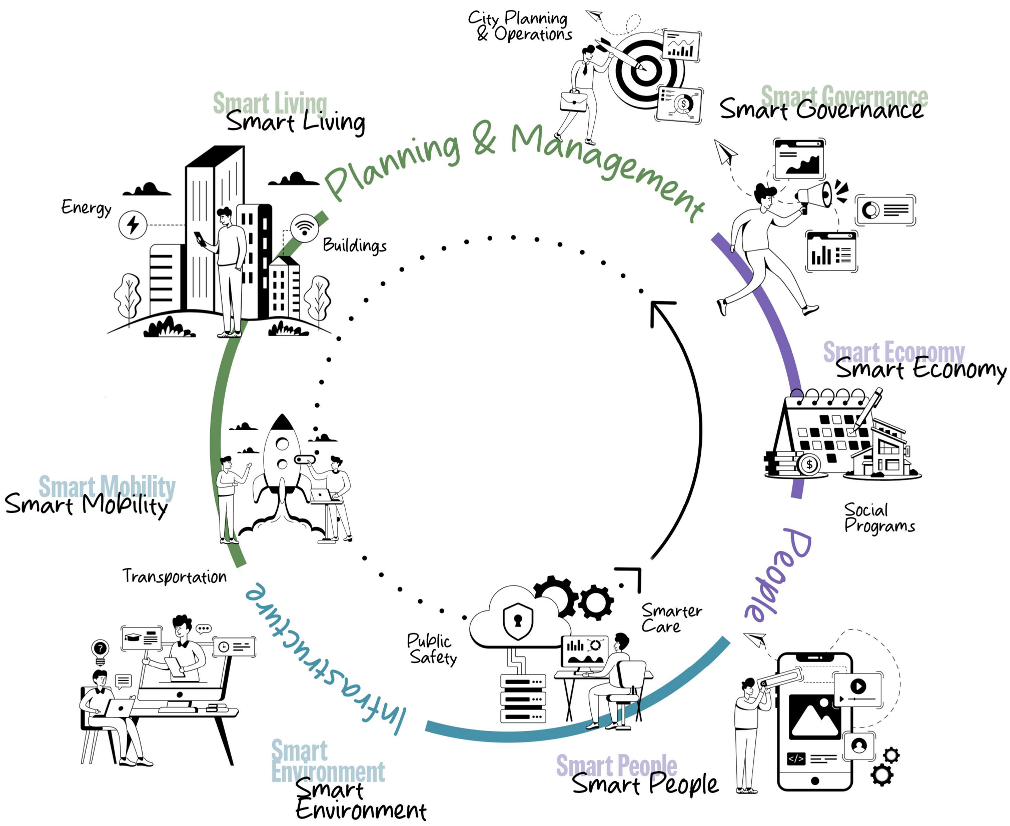
The goal of this effort is to decrease CO_2 emissions and promote the idea of smart cities. In addition, Cocchia (2014) analyzes also the terminology of smart-cities and how it has evolved in years. Up until about 2010, smart cities received little academic attention. After that, they began to grow rapidly. This change was accompanied by major developments in technology, including the growing use of smart devices and the internet, as well as governmental initiatives, such as the Europe 2020 Strategy, which put an emphasis on urban sustainability.



Shift of focus**: Technology Centered illustration 3.0.**

Author: Dashnor Kadiri, 2025[4].

[4] Base illustration source:
The Role of Communication Technologies in Building Future Smart Cities (Accessed: 29 May 2025)



Shift of focus**: People Centered illustration 4.0.**

Author: Dashnor Kadiri, 2025[5].

3.2 WORKING DEFINITION

A research conducted by (Angelidou, 2014) uses a working definition as follows: "Smart cities are all urban settlements that make a strategic effort to capitalize on the new ICT landscape, aiming for (i) environmental sustainability, (ii) urban system functionality, (iii) quality of life for all, (iv) knowledge-based development and (v) community-driven development. In this sense, their basic components are the urban setting, ICTs, people and communities and a strategic approach towards one or more of the previous aims. Without one of these components, a city cannot be regarded as a fullyfledged 'smart' city" (Angelidou, 2014).

As we see, according to (Angelidou, 2014), smart cities aim to achieve goals of environmental sustainability (e.g., implementing initiatives that reduce environmental impact but promote sustainability), urban system functionality (e.g., make sure that the city's infrastructure and systems

[5] Base illustration source:
Khon Kaen cashes in on IBM's 'Smarter Cities Challenge' programme (Accessed: 29 May 2025)

work in an efficient way and meet the needs of the population), quality of life for all (e.g., improve the well-being, regardless the socioeconomic status), knowledge-based development (e.g., echoing the importance of education and innovation to drive economic growth), and last but not least, community-driven development (e.g., engaging the community in decision-making processes). In the other hand, we see that at the core of this definition is ICT, urban setting, people and communities, and strategic approach.

Another research conducted by Stadt LABOR in Graz (2013) uses the following working definitions "A smart city is a livable city with a high quality of life for all citizens. It follows a human-centered approach with the needs of people as starting point for integrated urban development policy approaches. At government level the spatial, sectoral and temporal aspects of key areas of urban policy are well coordinated." According to this working definition focuses on livable city with high quality of life, rather than prioritizing the use of ICT, following with a human-centered approach, and then to integrated urban development.

Since the research analyzed these two working definitions before giving a working definition for this research, we can immediately see that both those working definitions share common goals such as improving the quality of life of residents and integrating urban development policies; however, they also differ from each other. While (Angelidou, 2014) focuses on leveraging technology in smart-cities, the research conducted by Stadt LABOR (2013) prioritized human-centered development and effective governance coordination.

Having analyzed these working definitions, for the purpose of this research, the working definition of the smart-cities is as follows:

"A smart city is one that integrates contemporary technology in a way that promotes inclusivity, social equity, and community engagement, with a focus on the welfare and quality of life of all of its citizens. Technology is used as a tool in smart cities to promote sustainable living, encourage lifelong learning and personal development, and give residents the capacity to actively shape their urban surroundings. By enhancing environmental sustainability, guaranteeing effective city services, and incorporating the community in decision-making processes, smart cities prioritize fostering an environment where everyone may prosper. **A city must effectively employ technology to improve the lives of its residents, promote meaningful civic engagement, and have a well-defined, people-centered strategy to accomplish these objectives in order to be deemed "smart".**

3.3 WHO IS DRIVING SMART CITY CONCEPT DEVELOPMENT (IBM, GOOGLE, AMAZON/ CITIES, PUBLIC INTEREST)

A wide range of stakeholders, including public interest organizations, local governments, and tech behemoths like IBM, Google, and Amazon, are driving the creation of smart cities. These entities collaborate to leverage advanced technologies such as IoT sensors, data analytics, and AI to enhance urban infrastructure and services (McNeill, 2015), aiming to improve efficiency (IBM, 2012), sustainability, and quality of life for residents. While tech companies often provide innovative solutions and expertise, city administrations play a crucial role in setting policies, regulations, and priorities aligned with public interests (Kim, 2022). Ultimately, the successful evolution of smart cities relies on a balanced partnership between technology innovators, governmental bodies, and community engagement to create inclusive and resilient urban environments. Byrne (2017) in his research "Eliminating the Human", the author argues that "smart" technology and services often promote individualism, solitude, and loneliness, whether intentionally or unintentionally. He identifies some consumer items and services that require minimum human interaction. For example, online ordering and home delivery services, such as Amazon, Deliveroo, and Instacart, have reduced the need for human interaction. On the other hand, digital music (iTunes, Spotify), ride-hailing apps (Uber, Lyft), driverless cars (Google, Apple), automated checkouts (Amazon Go, Tesco Express), and AI (Google, IBM, Apple, Faceresearch) are disrupting traditional social interactions. McNeill (2015) in his paper "Global firms and smart technologies: IBM and the reduction of cities" examines IBM's strategic path from being a loss-making computer hardware maker to an information technology consultancy, highlighting the significance of acquisitions, city partnerships, and research and development in that transition. Secondly, it describes how IBM has created a vertical specialized market inside its portfolio of markets for city or municipal services. The author claims that IBM views smart-cities as an effort to address three strategic issues facing the company: how to maximize its labor costs while ensuring that its stored knowledge generates significant added value; how to create new sectoral and geographic markets for this knowledge; and how to reduce, standardize, and simplify the knowledge's object, the city, as a scalable commodity. In the same vein, Albino (2015) in his research "Smart cities: Definitions, dimensions, performance, and initiatives" highlights that the technological aspect is central to the ideas of companies like Siemens AG, IBM, and Cisco Systems regarding smart cities. Likewise, many researchers have demonstrated how technology may be utilized in cities to empower people by customizing it to their requirements rather of forcing people to live their lives in response to technical demands (Cugurullo, 2013, Kitchin, 2014, Vanolo, 2014). In addition, Vanolo (2014) says that these cities, for example Korea, undoubtedly have a lot in common with neoliberal urban development strategies, where creating a smart city image helps draw in capital, top talent, and employees. Focusing on IBM, Albino (2015) states that IBM's Smarter Cities approach is actually the result of a "bigness" issue, where the numerous "communities" of expertise within the company are being "remixed" within the boardroom (p.563). These multinational firms, such as IBM, depend on the patience of their shareholders to accomplish this, even though they have the size and desire to greatly impact the form of urban management and technology infrastructure in the years to come. Because of this, they choose a deliberately limited range of urbanized service sectors for systematized research, which marginalizes the crowdsourced smart city's participatory behaviors as described by proponents like Townsend (2013). Townsend (2013) in his research "Smart cities: big data, civic hackers, and the quest for a new utopia" says that companies as IBM adopt a strategically narrow set of urbanized service areas for systematized analysis, thus marginalizing the participatory practices of the 'crowdsourced' version of the smart city. Likewise, Haarstad (2016) in his article "Who Is Driving the 'Smart City' Agenda? Assessing Smartness as a Governance Strategy for Cities in Europe, claims that the development of smart cities is seen as paradigm for policy signifies a deliberate attempt to address urban energy issues and promote economic sustainability. Haarstad also says that the most important part that service providers most notably, tech companies like IBM - play in advancing the agenda for smart cities. This drive comes from the deliberate marketing and promotion of cutting-edge technical infrastructures and urban environment-specific solutions. Moreover, this article suggests that corporate interests—rather than inclusive and participatory local government frameworks—are the primary forces driving the current trajectory of smart city development. This viewpoint emphasizes concerns about the prevailing pro-corporate governance tactics and technocratic principles, which could potentially eclipse more extensive public participation and forward-thinking urban policy initiatives.

In addition to Google, Amazon is also playing an important role in advancing smart city concepts. While Amazon is well-known for its e-commerce platform and cloud computing services, the business has broadened its focus to incorporate smart city solutions through efforts like Amazon Web Services (AWS) and the "Amazon Sidewalk" project. Amazon's AWS provides cloud-based services and infrastructure to assist the deployment of IoT devices and data analytics for smart city applications. Amazon Sidewalk wants to establish a low-bandwidth, long-range wireless network that will connect IoT devices across neighbourhoods, making it easier to adopt smart city technologies like smart lighting, environmental monitoring, and home automation.

Besides IBM, Google is also a prominent driver in the development of smart city concepts, leveraging its expertise in technology and data analytics to create innovative solutions for urban environments. Saunders and Baeck (2015) takes the example of Google Maps where they say that digital technologies offer people a way to campaign for city streets built for them, not just cars. They take another example of Google's Connected Citizen Program, where Google shares data from its Waze navigation app with ten cities in the world in order to help them understand better traffic conditions. The authors claim that this strategy has the benefit of not requiring cities to cultivate a user base for their own applications; but rather, they have access to a significant amount of pre-existing data and an audience that is already there. In addition to these projects, Google's expansion in Mountain View in the Silicon Valley, California, with the construction of the 'Google Charleston East' facility, displays the company's dedication to innovative and environmentally friendly architecture. Cooke (2020) in his research “Silicon Valley imperialists create new model villages as smart cities in their own image” explains that the campus was designed by famous architects and boasts a one-of-a-kind canopy structure with solar panels that provide natural light while also generating energy. The design integrates biophilic components and energy-efficient technology, such as underfloor air and cooled fabrics, to improve occupant comfort while reducing energy usage. However, critics have pointed out a lack of typical community amenities and public involvement in the development, raising concerns about its social impact and corporate priorities. Despite these issues, the proposal is consistent with a Silicon Valley paradigm in which high-profile design represents corporate status and innovation. In addition to the significant duties performed by IT companies such as IBM and Google, the consideration of public interest is a critical part of smart city idea development. While corporations and technology companies provide essential expertise and solutions, the success of smart city efforts is dependent on their connection with the needs and aspirations of urban people. Motivated by the projects of Paris and Porto Alegre on Participatory Budgeting, just how Morozov and Bria (2018) explain that city governments worldwide are implementing participatory budgeting efforts to increase citizen participation in public financial distribution. To be effective, participatory budgeting requires creating new democratic places. Participatory budgeting started over a decade ago in Porto Alegre, the capital of Brazil's southern state of Rio Grande do Sul. In this way, besides tech companies investing, citizens can offer recommendations and priorities to address social concerns and influence municipal budgets through collective debates and voting. In Porto Alegre, participatory budgeting improved decision-making for new welfare programs with 40,000 individuals participating annually. Another research conducted by Morgan and Webb (2020) called “Googling the City: In Search of the Public Interest on Toronto’s ‘Smart’ Waterfront” discusses how planners have not been actively involved in conversations about what is best for the public in Toronto's smart city ambitions. Instead, there has been a greater emphasis on making Toronto a major digital hub, which may imply less attention to what ordinary people want. The authors further suggest that there was a major dispute between businesses and regular people over Toronto's waterfront, but it appears that the regular people won this time. However, as they imply, planners must become more active in these talks to ensure that smart cities truly benefit everyone as they should collaborate with technology and data professionals to develop plans that are appropriate for the digital age. The article suggests that we investigate how different levels of government might collaborate to ensure that smart city plans comply with privacy and data protection regulations. Overall, planners must ensure that smart cities benefit the public and involve citizens in decision-making.

To summarize, the emergence of smart cities requires collaboration across a variety of stakeholders, including public interest organizations, local governments, and technology behemoths such as IBM, Google, and Amazon. While these tech businesses hope to use modern technologies to improve urban infrastructure and services, some are concerned about the possible negative effects on social relationships and community involvement. The lack of direct involvement by planners in smart city debates highlights the importance of interdisciplinary teams that combine urban planning and digital innovation. Encouragingly, initiatives like participatory budgeting demonstrate how citizens can actively shape smart city policies and priorities to address social concerns. Moving forward, stakeholders must emphasize public interest and promote participatory decision-making procedures to guarantee that smart cities comply with privacy standards.

3.3.1 Who is doing most research on the smart city phenomenon?

A wide range of stakeholders are conducting research on the smart city phenomena, including academic institutions, government agencies, and technological businesses. Academic institutions worldwide are at the forefront of this research, with prominent universities such as Massachusetts Institute of Technology (MIT), Stanford University, University College London (UCL), and Singapore University of Technology and Design (SUTD) leading the way. These institutions conduct interdisciplinary studies spanning urban planning, computer science, sociology, economics, and more to understand various aspects of smart cities. A recent research of Anttila and Jussilab (2018) on "Universities and smart cities: the challenges to high quality" echoes the importance of universities in driving innovation and contributing to the realization of smart, sustainable, and inclusive urban environments. In particular, this research emphasizes the need of high-quality education and research as necessary conditions for universities to effectively contribute to smart city efforts. They say that universities, as urban institutions, have traditionally played important roles in societal development by promoting regional cooperation, economic growth, and innovation. They are regarded as critical players in tackling societal concerns through multidisciplinary research and engagement with a variety of stakeholders. Furthermore, this article provides instances of colleges that are actively involved in smart city projects around the world, emphasizing the importance of institutions evolving and adapting to the demands of the digital age. Last but not least, it emphasizes that smart city development is a joint endeavor that includes commercial firms, public organizations, and influential individuals, with universities playing an important part in this ecosystem.

Moreover, the authors Carlo Ratti and Mathhew Claudel, known authors in exploring urban innovation, further introduce the concept of "futurecraft", now as a methodological framework in exploring urban innovation. Motivated by the Senseable City Lab, the project of "futurecraft" uses speculative design and prototyping to encourage public debate regarding urban features such as waste, infrastructure, consumption, and recycling, among other features. As mentioned before, the Trash Track initiative is an example of the "futurecraft" as it reveals hidden infrastructure while engaging citizens and policymakers in rethinking consumption and recycling (Ratti and Claudel, 2016). Such examples further broaden the function of smart city platforms as they focus on the broader aspects, such as cultural production and collective imagination, instead of focusing on the traditional methods such as efficiency. Lastly, as Ratti and Claudel argue, the aim is not to predict the city of the future but to actively shape it through participatory experimentation. This framing positions the Senseable City Lab's projects as exemplary cases where smart city platforms operate simultaneously as technical infrastructures, speculative tools, and democratic spaces for negotiation (Ratti and Claudel, 2016).

This chapter takes an example of the University of Helsinki in Finland where they say that it's easier for universities to stand out among smart city parties due to their involvement in multi-faculty education, research, and industrial engagement. In addition, this institution can supply diverse research teams for smart city development. Their example, the University of Helsinki (University of Helsinki, 2017) provides multidisciplinary educational, research, and collaboration services for smart city projects. This includes the Faculty of Science/Department of Computer Science (Information technology, 5G mobile communication, Internet of things, Information security, Artificial intelligence, etc.) and the Faculty of Biological and Environmental Sciences (Multidisciplinary urban research). In the same line, Alpopi and Silvestru (2016) "Urban development towards smart city – a case research" claim that universities and researchers are the key actors in the smart city. On the other side, Ardito et al., (2019) in his research "The role of universities in the knowledge management of smart city projects" say that after assessing smart city projects, no university holds a leadership position. However, they say that this is not because universities have "less relevant roles" but other roles are also necessary to handle knowledge management concerns. We can definitely say that universities continue to play an important role in developing smart city development through collaboration with commercial enterprises, governmental organizations, and influential individuals. On the other hand, government agencies play an important role in smart city research, frequently supporting programs and collaborating with academic institutions to investigate obstacles and opportunities in urban development. Examples include the US Department of Transportation (USDOT), the European Commission's Horizon 2020 initiative, and Singapore's Housing and Development Board (HDB).

Local governments define Smart Cities primarily around people (society and citizenship), but governance also plays a significant role (Fernandez – Anez, 2016). He further says that other components of sustainability, such as the economy and environment, are less frequently emphasized. According to his research, local governments prioritize sustainability, quality of life, and efficiency while implementing Smart Cities initiatives and government definitions focus on the features of a city and its residents, rather than specific objectives. Anthopoulos, Sirakoulis, and Reddick (2022) on their paper "Conceptualizing smart government: interrelations and reciprocities and smart city" examine how government agencies play an important role in the research and development of smart cities. They further add that non-profit groups and think tanks contribute valuable research insights into smart city initiatives. Organizations like the World Economic Forum (WEF), International Institute for

Sustainable Development (IISD), and Urban Land Institute (ULI) conduct studies, publish reports, and organize conferences to address sustainability, equity, and governance issues in smart city development. The article emphasizes the link between smart governance and smart cities, implying that smart governance is one of the features of smart cities. It implies that smart governance entails changing local governments into transparent, efficient, and open administrations using information and communication technology (ICT). This demonstrates the role of government agencies in implementing ICT solutions to improve city governance and services. Likewise, Lytras and Şerban (2020) research on "E-government insights to smart cities research: European union (EU) research and the role of regulations". Their research emphasizes the link between smart governance and smart cities, demonstrating that smart governance is an essential component of smart cities. It implies that smart governance entails changing local governments into transparent, efficient, and open administrations by leveraging information and communication technology (ICT). In addition, the article argues that government agencies play an important role in deploying ICT solutions to improve city governance and services. Government organizations can use technology to expedite operations, increase transparency, and provide better services to residents. This emphasizes the proactive involvement of government agencies in embracing and adapting to technological innovations to fulfill the changing needs of cities.

Besides academic institutions and government agencies, technological businesses are also doing research on smart-cities. Fernandez-Anez (2016) says that according to his research on definitions used by such technological business on smart-cities, the majority of them place the greatest emphasis on governance principles among the numerous activity sectors. His research suggests that the economy and environment are also significant, but phrases connected to people and services are underemphasized. In addition, mobility is a common theme in half of the definitions reviewed. However, efficiency is a fundamental goal in all definitions, with sustainability and quality of life coming up regularly. And undoubtedly, technology is considered as an intrinsic part of enhancing city efficiency, rather than just a tool. Essentially, he concludes that private enterprises define Smart Cities from an urban perspective, emphasizing management solutions that improve municipal efficiency and frequently coinciding with local government definitions. Van den Buuse and Kolk (2019) in their research "An exploration of smart city approaches by international ICT firms" underscores the active involvement of technological businesses, particularly those in the ICT sector, in researching, developing, and marketing technologies for smart cities. In this article, the authors look at how three MNEs in the ICT industry—IBM, Cisco, and Accenture—provide technologies for smart cities. This suggests that technology enterprises, particularly those in the ICT industry, are actively engaged in smart city research and development. According to the article, ICT MNEs disclose investments in creating and marketing technologies that would help create smart cities. It emphasizes the tremendous market potential for smart city technology and indicates that technological companies are aggressively investing in this sector to capitalize on new prospects. In addition to Van den Buuse and Kolk (2019), a research conducted by Mishra (2013) in “Role of Technology in Smart Governance” emphasized the urgent need for innovative approaches to transform cities into smart cities, particularly given the projected increase in urban populations by 2050 (Mishra, 2013). His research also focuses on the role of technology, specifically advanced analytics solutions, in enabling improved decision-making, proactive problem-solving, and resource coordination within cities. This emphasizes the importance of technological enterprises in developing and delivering the tools and solutions required for smart city implementations. Finally, Mishra (2013) advocates for a collaborative approach between government agencies, corporations, and citizens to achieve smart city goals. To effectively handle complex urban challenges, teamwork is required to leverage experience, resources, and innovation from many stakeholders.

In conclusion, a variety of stakeholders, including academic institutions, government agencies, and technology businesses are doing research on the smart city phenomenon. Academic institutions, such as world-class universities, are at the vanguard of research efforts, conducting multidisciplinary studies to better understand the various aspects of smart cities. Government agencies play a vital role in tackling urban development concerns by supporting research and collaborating with educational institutions. Furthermore, technology businesses, particularly those in the ICT sector, are constantly researching, developing, and marketing smart city solutions, driven by the industry's vast market potential. Collaboration among these stakeholders is important to attaining the vision of smart cities, which emphasizes governments, corporations, and individuals taking proactive steps to embrace technological innovations.

3.4 CONCLUSION: EVOLUTION OF SMART DEFINITIONS, WHO IS SHAPING THE DISCOURSE, AND KEY INSIGHTS FROM LITERATURE

Motivated by the working definition of this article, this chapter delved into various aspects of smart city development. By exploring definitions, tracking their evolution over time, and identifying key driving forces behind smart city initiatives, this article provided valuable insights into the multifaceted nature of smart cities. **The concept of smart cities has developed as an important topic in both academic literature and international politics, owing to rapid advances in digital technology and networked systems.** The emergence of smart city concepts indicates a holistic perspective that includes technological, human, and institutional components. While earlier definitions centered on the integration of information and communication technologies (ICTs) to improve urban efficiency, they have now expanded to include sustainability, quality of life, public involvement, and inclusive government. A detailed review of numerous definitions reveals that there is no widely agreed-upon definition of smart cities, with interpretations varied among scholars, policymakers, and practitioners. Common themes include environmental sustainability, urban functionality, quality of life improvement, and knowledge-based development. Furthermore, the creation of smart cities is being pushed by a diverse variety of stakeholders, including tech titans such as IBM, Google, and Amazon, as well as governmental organizations, municipalities, and public-interest projects. Collaboration across these groups is vital for using new technology and innovative solutions to improve urban infrastructure and services, with the goal of creating inclusive, resilient, and sustainable urban environments. **Finally, the future of smart cities depends on collaborative initiatives that prioritize technical innovation, inclusive governance, and community engagement in shaping the cities of tomorrow.**

SMART CITY STRATEGIES

Photography 4
Ljubljana City View
Author: Visit-Ljubljana.

4. SMART-CITY STRATEGIES: THE TOP-DOWN APPROACH

4.1 INTRODUCTION OF SMART CITY STRATEGIES IN EUROPE

Urban planners, policymakers, and technologists are all fascinated by the idea of the "smart city". Globally, cities are vying to integrate technology and data-driven solutions into their urban environments, with the goal of enhancing productivity, sustainability, and standard of living. But within all of this excitement about innovation, the question of what smart cities actually want to accomplish and how these objectives are turned into practical plans of action comes up.

This chapter next explores the intricacies of smart-city initiatives, keeping that question in mind and focusing especially on the top-down strategy used by lawmakers and urban planners. The smart-city policies of Paris, London, Barcelona, Milan, Vienna, Amsterdam, Copenhagen, Zurich, Luxembourg, Zagreb, Gothenburg, and Ljubljana will be specifically examined in this chapter. The research will present an in-depth comparative research by looking at techniques in the aforementioned cities of different sizes, from large metropolises to small towns, that clarifies the subtleties and commonalities that characterize these approaches.

This chapter also seeks to determine what lessons these tactics can teach us. Do they exhibit a deep comprehension of urban potential and difficulties, or are they just flimsy attempts to cash in on the newest digital trends? This chapter will also reveal the underlying motives and ideologies that impact urban planning decisions by examining the goals and substance of smart-city programs.

This chapter's examination primarily focuses on official documents that serve as guidelines for smart-city projects since they provide important insights into the strategic planning that informs urban development. This chapter will analyze these documents in order to pinpoint the main ideas, concerns, and approaches that will determine how smart-city projects develop. This chapter will also examine the initiatives and projects that have been put into practice to put these methods into practice. These programs, which range from sustainable energy solutions to intelligent transportation systems, show the efficacy - or lack thereof - of smart-city initiatives. Through an analysis of these projects' triumphs and failures, we intend to extract important lessons for next urban development initiatives.

This chapter's final goal is to simplify smart-city strategies by illuminating the goals, processes, and results that will influence how cities develop in the future. We aim to offer a thorough knowledge of cities' top-down approach to smartness by looking at official documents, initiatives, and projects. Ultimately, we want to make sure that the cities of the future are really inclusive, sustainable, and intelligent by using our findings to guide and inspire future urban development initiatives.

4.2 METHODOLOGY OF SELECTING CITIES

This chapter employs a structured, top-down method for selecting smart cities. It starts with a thorough review of all EU 28 cities that meet the requirements for population size and smart city attributes. A multi-tiered filtering procedure is part of the technique, which is intended to find and contrast smart-city ideas for various city sizes. This approach is essential to the comparison of smart city policies across 12 different cities, divided into groups based on population and urban features. First, 240 cities in the EU28 with a population of more than 100,000 were identified. The underlying dataset, from which the final choices were chosen, is represented by these cities. This wide spectrum guarantees consideration of a variety of urban contexts, all of which may have aspirations to become smart cities. The many cities included in this sizable initial dataset may also illustrate various strategies for smart urban development, illustrating the vast array of opportunities for infrastructure and technology advancement. These qualities come from recognized definitions and standards of what makes a smart city, like the incorporation of ICT solutions, environmentally friendly urban planning techniques, or data-driven infrastructure projects. To offer an all-encompassing comprehension of smart city tactics at various urban dimensions, the cities were subdivided into three groups according to their population size. This classification makes it possible to analyze how different smart-city techniques might be based on the complexity and size of a city. (See Appendix – Catalogue 1).

The classification falls as below:

- **Large Cities** (5-LSC): Five large-sized cities were chosen from Large sized cities that underwent filtering. Since more than one million people live in these locations, it is certain that large metropolitan centers with considerable infrastructure and technology issues are represented. These cities like London, Paris, Barcelona, Vienna and Milan, usually act as worldwide leaders in smart city efforts because of their extensive operations.
- **Medium-Sized Cities** (3-MSC): There are three medium-sized cities in the second category, having a population of between 700,000 and 1,000,000. In contrast to the larger metropolises, Amsterdam, among others offer insights into how medium-sized cities adopt smart city technology while addressing unique obstacles including scarce resources and scale.
- **Small-Sized Cities** (4-SSC): Ultimately, four cities with populations ranging from 100,000 to 700,000 were selected as small - sized cities. These smaller cities, like Luxembourg and Gothenburg, provide a unique viewpoint on how smart solutions can be innovatively implemented in smaller urban areas even in the face of limited financial or infrastructural resources.

Table 8.0. An Overview of Smart City Projects and Strategic Goals (Large, Medium and small-sized cities in EU)

Overview of selected Cities **1. CITY, STATE**	
LARGE SIZED CITIES	
Location (city, state)	/
Number of residents (projected)	/
Goals	/
PROJECTS	
Stimulating citizen participation and collaborative projects:	Engaging citizens in urban planning processes Co-design workshops with local communities and innovation hubs
Exchanging, sharing, and co-creating:	Partnerships with global research institutions Knowledge exchange platforms and urban living labs
Strengthening the Parisian innovation ecosystem:	Support for local start-ups and incubators Public-private innovation clusters Urban testbeds for prototyping technologies
Promoting public innovation:	Open government data portals Civic tech programs Participatory budgeting and digital democracy platforms
Developing support infrastructure for digital services:	City-wide IoT sensor networks Robust cloud and data center infrastructure Interoperable platforms for public services
Offering new public-interest services:	Integrated mobility apps Digital health services Smart waste and water management platforms
Using data to optimize public action:	Predictive analytics for traffic, crime, and energy use AI-enabled decision-making tools for city administration
Ensuring large-scale access to digital services and developing and promoting its uses:	Affordable high-speed internet for all Digital literacy programs for underserved groups
Carrying out Paris's energy transition and co-constructing smart networks and systems:	Deployment of smart grids Local energy production (e.g., solar panels) Energy-efficient urban design
Sustainably develop area:	Mixed-use, high-density urban planning Reduction of urban sprawl Ecosystem-based planning approaches
Strengthening the role of nature in the city:	Creation of urban forests and green roofs Biodiversity corridors and ecological restoration projects
Making mobility environmentally friendly:	Expansion of public transit and cycling infrastructure Promotion of electric vehicles and shared mobility
Responsible recycling and consumption	Circular economy initiatives Smart bins and dynamic waste collection Education on responsible consumer behavior
Making a more resilient city:	Climate adaptation strategies Flood and heatwave early warning systems Decentralized infrastructure for emergency response

The cities included in this research range in size and are spread geographically around Europe, providing a thorough picture of how various areas tackle smart city initiatives and enables a more detailed comparison of smart-city approaches. The goal is to comprehend the ways in which large cities, medium-sized cities, and small-sized cities are addressing the benefits and problems brought about by smart-city projects. Starting with 240 cities and a final selection of 12 cities through well-defined filters, this organized method offers a thorough and well-rounded framework for analyzing the various smart-city plans implemented in Europe. This methodology helps identify important trends, innovations, and obstacles that influence smart-city development in various urban contexts and it also exposes the top-down strategy used by city planners and policymakers.

4.3 WHAT ASPIRATIONS DO SMART-CITIES BUILD INTO THEIR STRATEGIES

— **PARIS, FRANCE**

Paris, as a global city, faces a variety of challenges resulting from rapid urbanization, resource scarcity, and the pressing realities of climate change. According to the index results of CIMI that Berrone and Enric (2016) evaluated in total 181 countries to determine the smartest cities around the world, Paris placed as the second smartest city in the world. According to this research, Paris has topped the list in the category of human capital followed by strengths in economy and international outreach (p.707). As a result, the city created a bold plan to reinvent its urban environment. This section explores the main obstacles, chances, and goals mentioned in Paris' smart-city plans, shedding light on the city's unique strategy for negotiating the complexity of contemporary urbanization.

Paris' strategic goal is centered on a cooperative endeavor to tackle the interrelated problems of resource scarcity, urbanization, and climate change. The city's commitment to lowering greenhouse gas emissions and mitigating the effects of climate change is evidenced by its move toward a post-carbon urban environment. Greening the city, sustainable multimodal mobility, and zero-waste policies are examples of Paris' proactive commitment to increasing environmental resilience and sustainability. In addition to environmental imperatives, Paris recognizes the transformative power of digital technologies in shaping the future of urban life. The city's embrace of digital transformation is multifaceted, ranging from smart transportation and mobility solutions to the use of urban data for informed decision-making. Digital inclusion emerges as a top priority, demonstrating Paris' commitment to ensuring equal access to the benefits of the digital economy for all citizens.

Paris' smart-city strategies are supported by a three-tiered framework that focuses on the open city, the connected city, and the sustainable city. In order to foster an open city ethos, Paris emphasizes citizen participation, collaboration with research institutions, and the promotion of public innovation. The connected city agenda prioritizes the development of digital infrastructure, the delivery of public-interest digital services, and the use of data to improve governance. Meanwhile, the sustainable city imperative includes initiatives aimed at energy transition, sustainable urban development, and increasing urban resilience. Paris' smart-city strategies chart a course for a more sustainable and livable urban future by taking a comprehensive approach that includes technological innovation, environmental stewardship, and social inclusion. (See Appendix – Catalogue 1).

— **LONDON, ENGLAND**

The Smart City London framework strategy is based on five key objectives that aim to improve Londoners' well-being and foster technological innovation. These aims include: enhancing the lives of Londoners, promoting open data and transparency, driving technology innovation, optimizing efficiency and resources management, and fostering collaboration and engagement. More than 81 initiatives in various domains, including infrastructure, digital services, and urban governance, support these goals. London, being among one of the first European cities to implement data-driven smart technologies to improve their services in the early 2010s (Bibri and Krogstie, 2020) leads with its green infrastructure, including green roofs, living walls, and access to outdoor green space as well as green-certified buildings and publicly accessible EV charging points.

In examining London's smart city initiatives, researchers have explored governance structures and technological innovation processes, assessing the city's progress and the application of smart city tools to tackle urban challenges (Odendaal, 2003, Shamsuzzoha et al., 2021). Shamsuzzoha et al., 2021 echoes that the emergence of today's globalization and industrialization in London has created a major shift from rural areas to urban ones; however, the urbanization comes with its fallbacks since even though it's developing cities globally, this will consume three-quarters of the world's natural resources, and ultimately generate three-quarters of its pollution, and waste (Hayat, 2016). On the other hand, the other challenge for London, is the smart city undertakings is the sheer scale of the city: Its population is set to reach 10 million people by 2030 with an urban area of 1,500 km² (more than 14 times the size of Paris). In regards to London's key concepts, we see that it's very successful in regards to urban innovation and technology integration, coupled with data-driven decision-making. The local government of London has been establishing a number of projects and implemented several planning measures for modernizing their ICT infrastructure and strengthening their readiness to integrate data-driven solutions and approaches into urban processes and practices. For example, London has initiated the project of implementing smart sensors in public spaces and the development of open data platforms. With this in mind, London has shown a commitment to enhancing efficiency, accessibility, and optimization in order to improve the quality of life for its residents. On the other hand, the city of London invests enormously on technological advancements that explore on betterment of future cities. Similarly, as Mora et al (2019) research highlight, in order to improve city populations, it is necessary to adapt technological advancement for the benefits of city populations. In fact, London, a data-driven future city, already has more 56 towers, EV charging stations, and green infrastructure than any other

European city, says Bibri & Krogstie (2020) in their research “Strategic principles for smart city development”.

The first project we will discuss on this chapter is the “Smarter London Together” which aims to enhance user-designed services, revolutionize city data access, spearhead connectivity and intelligent infrastructure, advance digital leadership and skills, and encourage city-wide collaboration. The second project is the “City Data: London Datastore” which is an comprehensive open data-sharing platform with over 700 datasets across multiple domains, has been launched, allowing all citizens to access critical city information. Using the London Datastore, City Hall uses over 700 datasets to inform policy decisions, improve public services, and address urban challenges. By leveraging data analytics, City Hall hopes to optimize resource allocation and improve the delivery of critical services, resulting in a more efficient and responsive governance framework. Then, the third project, called “Icity”, which is a groundbreaking digital hub located in Queen Elizabeth Olympic Park and designed to catalyze the growth of the digital and creative industries. iCITY aspires to be a global hub for innovation, education, and enterprise, boasting cutting-edge digital infrastructure and encouraging collaboration among local organizations and community stakeholders. Through these initiatives, smart City London aims to use technology's revolutionary potential to build a more livable, sustainable, and inclusive urban environment for its citizens, as well as to stimulate global economic growth and innovation. (See Appendix – Catalogue 1).

— **BARCELONA, SPAIN**

Barcelona, along with New York City and Amsterdam, is working to incorporate the rule of law, human rights, and democratic ideals into the development of future technologies and artificial intelligence through projects such as the City Coalition for Digital Rights. Barcelona envisions itself as a forerunner in supporting ethical, transparent, and responsible innovation, with the goal of leading the global movement for technological sovereignty. In the Barcelona Digital City Plan (2015-2019), the city states its commitment to moving away from a surveillance capitalism model and toward one in which residents own and control their data. The strategy emphasizes the importance of technology serving people rather than the other way around, with an emphasis on developing a smart model for public services like transportation, housing, healthcare, and education. Barcelona sees itself as a laboratory for democracy and sustainability, using data while protecting privacy and individual information self-determination, and emphasizing solidarity, social cooperation, and collective rights. To achieve these objectives, Barcelona advocates for a number of public policy actions, including establishing itself as a global reference point for commons and collaborative production, halting privatization and promoting remunicipalization of urban infrastructures, lowering the cost of basic services, instituting a citizen's basic income, and favoring collaborative organizations over centralized state or market solutions.

The city's digital transformation prioritizes transparency, engagement, and effective government by leveraging open-source software, open budgeting, and progressive web applications. Barcelona intends to democratize urban technology by solving critical social and environmental issues such as affordable housing and climate change through programs like as City OS and Superblocks, which empower inhabitants and encourage green, citizen-centric places.

Furthermore, Barcelona has committed to a new social data agreement through projects such as BCN Data Commons and the Municipal Data Office, which ensure that data is managed ethically and responsibly for the benefit of all residents. The city also encourages digital innovation by assisting digital enterprises and entrepreneurs, as well as encouraging inclusive and open technology that supports alternative economic models such as platform cooperatives and the circular economy. Barcelona is also known as the city of wi-fi network, and it leads as another smart city due to its unique approach to smart urban developments. As it is generally known, Barcelona has a wifi network that covers the entire city, for free. This approach directly aligns with urban innovation, technology integration, accessibility and inclusivity, and environmental sustainability. Gascó-Hernandez (2018) in his research also showcase that Barcelona's aim towards better practices was twofold: use of new technologies to foster economic growth and improve the well-being of its citizens. Barcelona successfully achieved this practice by including international positioning, international cooperation, and 22 smart local programs implemented primarily by public-private partnerships (Gascó-Hernandez, 2018).

Respectively, Barcelona thrives in urban connectivity, citizen-centric solutions, and sustainable urban development, all key concepts of a smart city. According to Mora and Bolici (2016) the first documents describing the Barcelona smart city strategy were drafted between late 2010 and mid-2011. In the same article, Mora and Bolici (2016) explain that Barcelona had two objectives when doing the smart city strategies. The first one is the development of a new city model in which ICTs are used "to provide the city with technological infrastructures [and services] of high added value for Barcelona" (Buscher and Doody, 2013) "to acquire the global leadership on the development of smart cities" (Ajuntament de Barcelona, 2012f), which are considered a "driving force behind a new urban service economy" (Buscher and Doody, 2013). With this being said, we can say that Barcelona successfully enhanced urban connectively by providing technological infrastructure, such as the Barcelona Wi-Fi that covers all city. In addition, the city of Barcelona initiated many projects to support urban development, same as Barcelona Wi-Fi. For example, they initiated the project to develop a new model for the management of services, relationships and interactions with citizens based on the principles of e-government (Conesa, 2009), different pilot projects developed by both the private municipal company 22@ Barcelona and the Municipal Institute of Information Technology (IMI). Another project that is pivotal to the people of Barcelona, is the smart lighting systems in different parts of the city, such as the Poblenou district. These systems use sensors and intelligent controls to change lighting levels whether there are pedestrians walking or not, coupled with weather conditions, and time of the day. By optimizing energy usage and reducing light pollution, smart lighting enhances safety, sustainability, and overall urban experience. (See Appendix – Catalogue 1).

— **MILAN, ITALY**

Milan has made a decision to solve pressing societal issues by implementing policies that are focused on energy, sustainable mobility, and a smart agenda. Milan is to become more robust, intelligent, sustainable, and circular as a result of these projects. The Sustainable Energy Action Plan (PAES) and Smart City Guidelines are two of the strategic frameworks that the municipality has put in place to promote energy transition and smart city development. Milan has also implemented specialized measures to promote mobility while reducing pollution and energy consumption, such as the Sustainable Urban Mobility Plan (PUMS).

A research conducted by Cassinadria, Gambarini, Nocerino & Scopelliti (2019) “Sharing cities: from vision to reality: A People, place and platform approach to implement Milan’s smart city strategy” highlight that in accordance with its smart city vision, Milan has started testing smart solutions in limited areas of the city with the goal of scaling them up citywide. One such endeavor is the Sharing Cities project, which is funded by the EU and aims to construct "smart" neighbourhoods with nearly zero emissions. Milan's smart district demonstration in the Porta Romana/Corvetto/Vettabbia area includes extensive building retrofits, the introduction of e-logistics, a digital social market, smart parking technology, and smart lampposts. This Sharing Cities project has a "People, Place, and Platform" strategy, concentrating on user-centric smart city services co-designed with residents, infrastructure solutions for low-energy districts, e-mobility, and an urban sharing platform based on public data. Furthermore, the authors say that the project is divided into six major pillars: deep building retrofit, shared e-mobility, smart lampposts, sustainable energy management service (SEMS), urban sharing platform (USP), and digital social market (DSM). Furthermore, this research also showcases Milan's efforts in the Shared e-Mobility pillar include implementing charging points, e-car sharing, e-bike sharing, smart parking, and e-logistics services to promote low-carbon mobility options. Accordingly, Milan’s Smart Lampposts initiative involves installing sensors on lampposts and establishing a LoRaWAN network for environmental and traffic flow monitoring. On the other hand, the Sustainable Energy Management System (SEMS) aims to optimize energy demand and supply across urban infrastructures, while the Urban Sharing Platform (USP) aggregates data from various sources to enable better city resource management. Lastly, the Digital Social Market (DSM) facilitates the exchange of goods and services among citizens, contributing to a more sustainable and connected community.

The City of Milan has developed an Adaptation Strategy for the post-coronavirus period, with an emphasis on the so-called "Phase 2" of lifestyle adaptations and the requirement for social separation, according to an official document provided by the city of Milan (2020). In addition to providing operational answers tailored to its unique circumstances, Milan hopes to add to the larger national and worldwide discussion on post-pandemic strategies, according to this official paper. The strategy utilized in this publication recognizes the significance of shifting to a "new normal" defined by existing virus control efforts and expected future calamities. In order to enable the safe resumption of everyday activities, it outlines scenarios for pre-lockdown containment, lockdown, post-lockdown containment, and the new normal. It emphasizes the significance of mapping infections, offering medical services, isolation measures, tracking strategies, immunity facilitation, and sanitation. The plan also emphasizes the necessity of focused interventions that take into account age groups, prior medical histories, job status, immune status, health issues, and economic circumstances. This document also addresses Milan's efforts to restore its social cohesion and economy while preserving public health in the face of ongoing pandemic-related worries. The plan emphasizes how important it is to safeguard and invest in people, maintain the city's production system, preserve vital services, and promote public investment. It demands that the city's schedule be changed to provide non-polluting transit, neighbourhood-focused services, and support for disadvantaged areas top priority. In an effort to encourage private investment and the recovery of the economy, Milan intends to expedite applications for public tenders. Milan aims to establish a strong and competitive presence in the post-pandemic environment through effective resource allocation and stakeholder engagement. In summary, Milan aims to become a smart city by introducing cutting-edge solutions in a variety of areas, including urban infrastructure, mobility, and energy efficiency. The ultimate objective is to improve the standard of living for Milan's citizens while addressing environmental concerns. (See Appendix – Catalogue 1).

— **VIENNA, AUSTRIA**

Vienna, one of the most forward-thinking cities, has applied an approach to smart city development that maintains a balance between top-down and bottom-up approaches (City of Vienna, 2012). As many researchers echo, Vienna’s interest in smart city development is mainly oriented towards smart transport, smart building and smart grid solutions for low-carbon and energy efficient urban environments, ultimately guiding the city’s urban transformation dynamics in the smart city domain (Hofstetter and Vogl 2011).

Vienna Smart City has launched its strategy in 2011. After it’s launch, after many coordination between stakeholders, the process of urbanizing Vienna into a smart city led to the “Smart City Wien Framework Strategy” in 2014 (City of Vienna, 2014), aimed at providing guidelines for the development of Smart City initiatives and projects. This strategy has three lines: “Quality of living”, “Resources” and “Innovation”, which structure specific associated topics and goals (Fernandez-Anez et al., 2018). Until now, Vienna’s framework strategy was directed to all target groups of the city: its citizens, businesses, non-profit institutions, and last but not least, the public sector itself (Adamuscin et al., 2016). With that in mind, Adamuscin’s research (2016) highlights that Vienna’s firstly focused on the resource preservation as they started to make Vienna a smart city. By preservation, Vienna reduced a lot of CO2 emission, and is aiming to dramatically reduce it by 2050, by modifications in sectors of energy, mobility, and infrastructure. The research further explains that Vienna already created a public private entity, called TINA Vienna, which co-develops smart city strategies and solutions for the city of Vienna. As we see, Vienna is positioned as a pioneer in the realm of smart city development, with a strategic focus on sustainability, innovation, and quality of life for its residents. A project that Vienna has implemented is the Citizen Solar Power Plant as its goal is to obtain 50% of their energy from renewables by the year of 2030 (Cohen, 2014). (See Appendix – Catalogue 1).

— **AMSTERDAM, NETHERLANDS**

Amsterdam has developed as a pioneering smart city, adopting cutting-edge technologies and tactics to address urban difficulties and improve citizens' quality of life. A recent research by Mora and Bolici (2017) named "How to Become a Smart City: Learning from Amsterdam" investigates the development process of smart city strategies, concentrating on the case of Amsterdam. The report combines the tasks completed during the execution of Amsterdam's smart city strategy into a detailed roadmap by conducting a descriptive analysis. This strategy aims to give a comprehensive understanding of the strategy's development process, so offering important insights for similar initiatives in other cities and establishing the groundwork for further comparative analysis. The expanding number of communities implementing smart city efforts is evidenced by the report's emphasis on the strategies' growing significance for global urban development.

In terms of Amsterdam's specific tactics, the research also establishes a framework for understanding how the city uses information and communication technology (ICTs) to address diverse urban difficulties and promote sustainable development. It also focuses on the development phase of Amsterdam's smart city strategy, the emphasis moves to executing real projects that introduce new ICT-based applications, services, devices, and infrastructures to the city. The Amsterdam Smart City Foundation coordinates and facilitates these projects. Project selection and implementation follow a defined process that begins with the examination of project ideas during the Concept Development phase. Ideas can come from both the foundation and outside sources, and they are assessed based on feasibility, costs, and potential CO2 reduction. In the same vein as planning, Mora and Bolici (2017) also say that communication is essential for sharing knowledge, encouraging collaboration, and promoting the Amsterdam smart city strategy. The Amsterdam Smart City Foundation conducts substantial knowledge-sharing efforts through conference events, papers, press releases, reports, newsletters, presentations, social media platforms, and dedicated internet portals. These activities seek to enlighten stakeholders, attract new partners, and increase public participation in smart city programs, emphasizing the need of open communication and collaboration in achieving Amsterdam's smart city goals. Another research conducted by Mancebo (2019) on "Smart City Strategies: time to involve people" analyzes how the Amsterdam plan reveals a deviation from Barcelona's grassroots approach. While Amsterdam tried to create a welcoming atmosphere for grassroots initiatives including local

SMEs, startups, and neighbourhood communities, the critical difficulties faced in the city were unexpectedly identical to those in Barcelona. Three important projects in Amsterdam were investigated: energy transition, smart mobility, and collaborative action for urban renewal via living labs.

In the energy transition domain, the Amsterdam Smart City (ASC) interactive platform primarily supported energy-related actions, such as the Klimaat Straat pilot project. Although Klimaat Straat was portrayed as a grassroots initiative, its users were locals and shopkeepers, and its backers included the Amsterdam city government and internet commercial operators. Due to partner disputes and legal restrictions, the project encountered problems and ultimately came to a stop. The smart transportation industry is also examined in the same report, with Amsterdam aiming to achieve a zero-traffic greenhouse gas emission target by 2025. Among the initiatives were efforts to facilitate the use of electric cars, promote car-sharing applications, and test innovative urban lighting powered by bicycle-mounted photovoltaic panels. Walkers, bicycles, and cars interacted as users, however there was a lack of coordination among these programs and limited engagement from locals. Lastly, Mancebo's (2019) research found that a greater participation of locals was involved in living lab initiatives like Groene Leven Lab and Hackable City. These initiatives encouraged eco-friendly urban living and involved locals in cooperative decision-making by utilizing interactive web platforms. Notwithstanding their objectives, the majority of the initiative's leaders were academics and architects, and the community didn't really get involved until the projects were designed. Although local community interaction was emphasized in Amsterdam's approach, the degree of participation varied throughout projects, with some being more inclusive than others. (See Appendix – Catalogue 1).

— **COPENHAGEN, DENMARK**

Copenhagen, renowned for its innovative approaches to sustainable urban development, is a shining example of a smart city. With a population of about 600,000, Copenhagen has to deal with contemporary issues like environmental degradation and transportation congestion. Nonetheless, the city has taken the initiative to create a more livable and ecologically friendly urban environment by leveraging technology and data-driven solutions. According to a 2016 research "Strategic Approach to Smart Cities: The Case of Copenhagen" by Gatski and Galhoczi, Copenhagen is among the best smart cities in Europe. With a population of about 600,000, Copenhagen faces challenges like flash floods, traffic jams, and mounting public pressure to maintain hygiene and health. According to this research, Copenhagen is one of 79 municipalities that make up the Greater Copenhagen region, which also encompasses Eastern Denmark and Skane in Southern Sweden. The region has a population of almost 4 million people. Together, the region's political and economic forces promote regional development and progress, including smart city projects.

Copenhagen's smart city efforts have been recognized, with honors including the European Commission's Green Capital Award in 2014 and the World Smart City Award for its pioneering use of big data. The city has big aspirations, seeking to become the world's first carbon-neutral capital by 2025 (Gatski and Galhoczi, 2016) An official document released by The Alternative (2017), a political program for the local elections in Copenhagen focuses on 17 Copenhagen goals for sustainable development with goal number 1 being no poverty, then zero hunger, good health and well-being, quality education, gender equality, greener and cleaner air, work-life balance, entrepreneurship, and finally, a city with a place for everybody. (See Appendix – Catalogue 1).

— **ZURICH, SWITZERLAND**

Nestled in the heart of Switzerland, Zurich is a beacon of innovation, sustainability, and quality of life, earning a spot among the world's premier smart cities. Zurich emerges as a dynamic city where tradition meets technology, and the promise of the future is enthusiastically embraced. Zurich City Council (2016) in an official document released in 2016 regarding the strategies that Zurich will be implementing until 2035. According to this document, Zurich intends to maintain its successful growth while stressing sustainability. This includes policies that promote sustainable urban growth, resource-efficient energy models, and environmentally friendly housing and transportation. In addition, the city is devoted to long-term planning, aligning its actions with overarching plans such as the "Zurich 2025 Strategies" and, more recently, the "Zurich Strategies 2035" to ensure continuing success in the face of evolving problems. Besides long-term planning, Zurich values collaboration across politics, business, culture, and society. They seek to establish strategic objectives that promote vigorous democratic exchange and serve as the foundation for municipal policies, ensuring that all segments of society participate in the city's growth.

This document also describes Zurich's strategy for maintaining and enhancing its standing as a top business location, which includes offering welcoming business environments, a diversified industrial base, and skilled labor. This entails supporting vital sectors including technology, banking, the creative industries, and the health sciences. Moreover, the document highlights Zurich' high quality of life, which includes factors such as fiscal stability, diverse housing options, sustainable mobility solutions, safety, social diversity, youth opportunities, healthcare quality, and a vibrant cultural scene. Last but not least, the city is committed to environmental sustainability. Its goals include true-cost pricing, the generation of renewable energy, the creation of a 2000-Watt Society, and the acquisition of digital infrastructure to facilitate participation in and activities related to environmental sustainability.

Zurich's Smart City Strategy is described in another official document published by the Zurich City Council (2018). It emphasizes the need of using innovation and technology to address the problems brought on by urbanization. In accordance with this statement, Zurich seeks to connect its endeavors with the "Zurich Strategies 2035," which include lowering resource use and maintaining or improving quality of life. Zurich's plan is centered around three primary areas, as highlighted in the official document: smart participation, digital city initiatives, and integrated public mobility. These areas are guided by the principles of user-centric development, collaboration, data privacy, and innovation. Among the initiatives are raising stakeholder participation in urban developments, modernizing city administration procedures, and increasing public transportation services. Zurich aims to establish itself as a Smart City, improving sustainability and the standard of living for its citizens in the face of urbanization and technological advancement, by embracing technology and encouraging cooperation. (See Appendix – Catalogue 1).

— **LUXEMBOURG**

Luxembourg, a nation nestled in the heart of Europe, is at a crossroads in the age of globalization and technological upheaval, just as many other European cities. The terrain is continually changing, bringing both possibilities and problems that necessitate strategic planning and agility. An official document released by Deloitte Luxembourg named "Luxembourg towards a smart nation" explains Luxembourg's journey to smartness and how it is marked by a number of problems resulting from its integration into the global economy. According to research, Luxembourg, a small landlocked country, is under strain from both economic globalization and increased international regulation. The authors believe that these challenges decrease the nation's margin of maneuver, necessitating creative ways to long-term competitiveness and sustainability.

The research further explains Luxembourg's ability to welcome technological disruption while cultivating an innovative atmosphere is key to its quest for smartness. According to the authors of the research, the nation's economic environment is changing dramatically, thanks to digitalization and the growth of new businesses. They also highlight the use of data, often known as the new oil, is at the heart of this transformation, altering sectors throughout the economy. However, they say that the benefits of technological innovation are not guaranteed; they require strategic planning and proactive steps to be fully realized. (See Appendix – Catalogue 1).

— **ZAGREB, CROATIA**

The Zagreb Smart City Strategy, an official document released by the city of Zagreb, is a coordinated attempt by Croatia's capital city to harness the power of technology and innovation for the benefit of its citizens. Zagreb's Mayor Milan Bandić launched a strategy in October 2016 to improve efficiency and connectivity over the next decade. Fundamentally, the plan aims to use cutting-edge technologies like Big Data and the Internet of Things (IoT) in important areas including governance, education, transportation, energy, and the economy. Zagreb aims to create a more sustainable and responsive urban environment by integrating these clever solutions smoothly through the establishment of a strong ICT infrastructure. According to this document, a wide range of stakeholders are involved in the strategy formulation process, including officials from several city departments, organizations, and agencies as well as Zagreb Holding Ltd., the business in charge of providing public services in the city. Furthermore, working together with Croatia's top ICT businesses guarantees that the approach is based on the most recent knowledge and market research. The Zagreb Smart City Strategy, which takes a comprehensive approach to improving everyone's quality of life, lays out specific goals and top priorities for the ensuing ten years. Through the alignment of technical breakthroughs with the long-term vision of the city, Zagreb hopes to fulfill its potential as an urban hub that is more robust and smarter. (See Appendix – Catalogue 1).

— **GOTHENBURG, SWEDEN**

The official document (2012) from the City of Gothenburg outlines a multidimensional strategy to becoming a smart city that is embodied in the concept for RiverCity Gothenburg. According to this document, the idea of inclusivity and accessibility is fundamental to this goal, guaranteeing that every individual, regardless of background or circumstances, may benefit from smart city projects. In addition to a significant emphasis on sustainable urban development, this dedication to social fairness makes use of natural features like rivers and water bodies to promote resource efficiency and environmental consciousness. Furthermore, a hallmark of smart cities aiming for comprehensive urban redevelopment is their nuanced approach that embraces innovation while respecting tradition. This is highlighted by the incorporation of historical heritage into the city's transformation.

In the same line, this document explains the interactions with a wide range of stakeholders, including as academic institutions, international specialists, and municipal officials, emphasizes a dedication to utilizing group knowledge for efficient urban planning and execution. The collaborative culture and strong leadership exhibited by the City Council and Executive Board establish the foundation for well-coordinated initiatives and strong governance institutions that are essential to advancing the agenda of smart cities. By implementing these programs, RiverCity Gothenburg hopes to establish a reputation as a vibrant, diverse, and sustainable urban hub that uses innovation and technology to improve living conditions for all of its citizens.

From this document released we can see the shift of RiverCity Gothenburg from vision to implementation and how it highlights a shared understanding of the city's priorities, which include social cohesion, environmental sustainability, and connection. In order to bridge gaps across the river and promote a sense of unity and belonging among its citizens, the vision highlights the necessity of physically and socially uniting the city. Moreover, the city seeks to prevent social and physical segregation by encouraging inclusivity and community involvement in its development process. Examples of these initiatives include giving priority to pedestrian-friendly infrastructure and lively gathering areas. The vision also emphasizes the need of accepting water as a fundamental aspect of urban life, with a focus on developing a dynamic waterfront area that addresses the effects of climate change while improving the visual and recreational appeal of the city. (See Appendix – Catalogue 1).

— **LJUBLJANA, SLOVENIA**

A recent document released by the European Commission (2016) on the report of future cities, focusing on Ljubljana, Slovenia showcases the impressive shift that Ljubljana has undergone toward sustainability and intelligent urban planning is evidence of its dedication to environmental protection and the welfare of its residents. This document highlights that the city has changed dramatically over the last ten years, going from a transportation system centered on cars to one that prioritizes public transportation, bike networks, and pedestrian-friendly infrastructure. Notably, this move toward sustainable transportation is symbolized by the alteration of the traffic regime on Slovenska Street, the main thoroughfare. Furthermore, Ljubljana has shown progress in rehabilitating brownfield sites and protecting green spaces, exemplifying a comprehensive approach to urban planning that strikes a balance between environmental preservation and urban growth.

In addition, this document highlights how Ljubljana has made tremendous progress in waste management and catastrophe resilience in addition to improvements in green space management and transportation. The city has demonstrated its dedication to ecologically friendly resource management by pledging to meet a zero-waste target. Furthermore, Ljubljana has shown leadership in sharing its knowledge and approaches for dealing with natural disasters, as seen by its collaboration with the Balkan Region during a recent flooding crisis. The achievements of Ljubljana during its tenure as the 2016 European Green Capital serve as a model for other municipalities seeking to enhance their sustainability and resilience. This award emphasizes the city's leadership in smart governance and sustainable urban development, setting a benchmark for helping people and cities around the world find practical solutions to pressing urban issues.

Another document released by the City of Ljubljana (2016) celebrates Ljubljana's 2016 European Green Capital title, the statement emphasizes Mayor Zoran Janković's visionary leadership in developing the city into an innovative, sustainable, and green urban hub. It highlights how this designation will help the city's branding, tourism, and reputation and it shows that the dedication of Mayor Janković to guaranteeing an excellent standard of living for every inhabitant via many sustainability initiatives and approaches is recognized.

This document also examines the lessons learned during Ljubljana's green year, with a focus on community involvement, environmental consciousness, and the city's dedication to sustainability. It emphasizes how crucial it is to get locals involved in city projects and to instill a sense of environmental responsibility and ownership. In her reflection on the European Green Capital project's success, Tjaša Ficko, the deputy mayor, highlights the city's commitment to integrating inhabitants of all ages and implementing sustainable practices. The documents also end with an appeal for Ljubljana and other cities around the world to maintain their commitment to sustainability and environmental stewardship. (See Appendix – Catalogue 1).

4.4 WHAT DO WE KNOW OR CAN WE KNOW FROM STRATEGIES? (SIMILARITIES AND DIFFERENCES)

Paris, London, Barcelona, Milan, Vienna, Amsterdam, Copenhagen, Zurich, Gothenburg, and Ljubljana all have smart city strategies that use creative methods to solve urban problems and raise living standards. A common commitment to environmental sustainability, embodied in projects ranging from waste management plans to green infrastructure development and renewable energy projects, lies at the heart of these policies. As a result of a larger trend towards digital transformation in urban governance, every city understands the significance of utilizing digital technology to boost efficiency, engage citizens, and improve municipal services.

Furthermore, a recurrent feature in all of these techniques is community participation, which highlights the role that stakeholders and residents play in the conception and execution of smart city projects. In addition to highlighting the value of inclusive government, this participatory method shows a commitment to making sure that local communities' needs and goals are met by urban development initiatives. Although these strategies' general objectives coincide, each city's strategy is customized to fit its own circumstances, taking into account elements like topography, population density, current economic conditions, and infrastructure. As a result, different cities prioritize different things. For example, some prioritize sustainable mobility, while others prioritize energy efficiency or social inclusion. Moreover, variations in governance models, regulatory frameworks, and policy approaches are present and show the various institutional, political, and cultural contexts in which these tactics are applied. Despite these differences, every city is dedicated to using smart city efforts to improve the general quality of life for its citizens. In conclusion, there is a global trend towards more sustainable, inclusive, and technologically advanced urban environments, and while the smart city strategies of Paris, London, Barcelona, Milan, Vienna, Amsterdam, Copenhagen, Zurich, Gothenburg, and Ljubljana show both similarities and differences, they collectively represent this movement.

4.5 COMPARATIVE ANALYSIS OF STRATEGIES (LARGE SIZED CITIES, MEDIUM-SIZED CITIES, SMALL SIZED CITIES)

4.5.1 Large Sized Cities

In this part of the research, we concentrate on large-scale projects from Paris, London, Barcelona, Vienna and Milan that showcase a variety of initiatives designed to promote creativity, sustainability, public participation, and digital transformation in urban settings.

Paris first concentrates on initiatives involving citizen participation and cooperation. Paris focuses on promoting public innovation and co-creating with creative partners in order to encourage citizen engagement and collaborative ventures. The city council and residents can communicate with each other in both directions thanks to programs like the Transparency Mailbox and Progressive online applications, which promote moral principles and civic engagement. Paris, on the other hand, also prioritizes digital services and infrastructure. Paris is developing the infrastructure needed to enable digital services, making them widely accessible, and maximizing the use of data to drive public action. As demonstrated by initiatives like the Open Data Policy Act II and the development of data governance frameworks, Paris is dedicated to leveraging technology to improve urban living. These programs are coupled with others aimed at constructing a robust infrastructure for data processing and storage, which will facilitate the city's adoption of the Internet of Things (IoT). Resilience and sustainability are two other areas of focus. Paris aspires to complete its energy transition, construct smart networks and systems, and sustainably expand the metropolitan region. Paris places a strong emphasis on environmental resilience and sustainability, as seen in initiatives like the city's energy transition and sustainable urban development projects.

In addition, initiatives like "Digital School" and "Werkstadt Junges Wien" demonstrate Vienna's dedication to giving its children access to digital opportunities and skills. Programs like "Expansion of Photovoltaic Capacity," which is propelling the city's ambitions for renewable energy and helping to generate clean energy, and "Brise," a digital construction permission system, highlight Vienna's efforts to promote smart infrastructure and renewable energy. Projects like "RemiHub" and "Repair not Replace" demonstrate the city's commitment to the circular economy. “Repair not Replace” is a platform that uses cargo bikes for urban deliveries in support of climate-friendly logistics, and “RemiHub” is a network that promotes sustainable consumerism by encouraging the repair of things rather than their replacement.

London, Barcelona, Vienna and Milan are setting the standard for addressing urban difficulties using technology, data, and citizen participation. With that being said, London's programs emphasize teamwork, digital innovation, and sustainable mobility; while open data is being used to stimulate innovation and entrepreneurship through initiatives such as the London Datastore and the Smart London Innovation Challenge. On the other hand, Milan's projects are intended to improve environmental sustainability, digital infrastructure, and urban mobility. Projects like as "Strade Aperte," BikeMi, and Open WiFi demonstrate Milan's commitment to making the city more accessible, connected, and sustainable. Milan is likewise dedicated to promoting efficiency and innovation in city management.

To summarize, these cities are setting the bar for addressing urban difficulties using technology, data, and citizen participation. They are home to innovative, sustainable, and community-focused projects that are changing the way people live and work in cities.

4.5.2 Medium Sized Cities

The projects in medium-sized cities like, Amsterdam, Copenhagen, and Zagreb are examined in this section; they offer fascinating insights into the variety of initiatives meant to foster sustainability, innovation, and community involvement. These initiatives show the cities' dedication to addressing modern problems and encouraging responsible and inclusive urban growth.

On the other hand, the projects and initiatives in Amsterdam span a wide range of topics, from sustainable energy management to urban design and inclusive smart city development. We see that sustainable energy and the environment projects lead Amsterdam, such as Equinox, Clean Mobil Energy, and the Local Inclusive Future Energy (LIFE) City platform. With the help of these projects, an intelligent energy infrastructure that can both satisfy the needs of an expanding urban population and lower carbon footprints will be built. In addition, initiatives like the Circular Economy Course and CEDaCI highlight attempts to spread circular economy principles, decrease waste, and enhance resource efficiency. Amsterdam also focuses on Community Engagement and Education, for example initiatives like Urban Street Forest, My Clean City, and the Smart Citizens Lab engage citizens in environmental conservation efforts, promoting awareness, education, and citizen science. Specifically, the Green Living Lab and Rooftop Revolution provide spaces for experimentation and education on sustainable living practices, integrating nature into urban environments.

Across the cities studied, sustainability emerges as a key theme in smart city efforts. Initiatives like garbage recycling programs in Zagreb, Similar to this, Zagreb's Open Data Initiatives promote an inventive atmosphere where developers can obtain public data, encouraging openness and creativity and hastening the development of smart cities. These initiatives are prime examples of how tiny communities are utilizing technology to close the communication gap between citizens and city officials. These programs connect individuals who are capable of developing smart city solutions with the data required to generate and support them, encouraging an innovative and entrepreneurial culture.

Copenhagen is a leader in environmental sustainability and data-driven urban governance, focusing on leveraging data to enhance city services, while projects like People and Flows, BEE, C.in-City, and Enerbrain optimize energy use in buildings and offer real-time carbon emission monitoring in

Copenhagen. For example, the Copenhagen Solutions Lab encourages cross-departmental collaboration and innovation.

Amsterdam, Copenhagen, and Zagreb show how medium-sized towns may embrace a comprehensive strategy for smart city development through these projects. These cities are developing more resilient, efficient, and livable urban settings that can serve as models for communities of all sizes by fusing sustainability, technological innovation, and citizen participation. Smart technology has been successfully integrated by all cities into their urban designs, addressing local and global concerns while prioritizing sustainability, inclusion, and long-term growth.

4.5.3 Small Sized Cities

Smaller cities are rapidly understanding the value of implementing smart city programs to address urban difficulties and improve overall livability. Having that in mind, this chapter then explores a number of smart city projects implemented in small cities, with a particular emphasis on initiatives in Luxembourg, Zurich, Gothenburg, and Ljubljana, as it will analyze these projects to uncover similar themes, techniques, and implications for smart city development in small urban contexts.

Across the cities studied, sustainability emerges as a key theme in smart city efforts. Initiatives like green urban planning in Ljubljana, and energy-efficient district heating systems in Gothenburg showcase their commitment to environmental stewardship and resource efficiency. In contrast to the EU average of 12%, Gothenburg's district heating system, for instance, uses waste and recycled heat to heat 90% of the city's buildings. To further highlight their commitment to sustainability, Ljubljana's waste management system incorporates rainwater and biodegradable detergents for street cleaning.

Zurich focuses on mobility and transportation innovation, with projects like Pikmi and ZüriMobil improving urban mobility through on-demand services, seamless transportation networking, and public transportation electrification. On the other hand, the LoRa Network facilitates energy-efficient communication between city infrastructure and IoT sensors. Zurich also focuses on energy efficiency and sustainability, using renewable energy sources and promoting sustainable mobility options. Digitalization and citizen engagement are also key, with projects like Twin, HoloPlanning, and Urban Geoportal using digital technologies to visualize, collaborate, and plan cities.

On the other hand, digitalization also significantly improves urban governance and service delivery. The use of digital technology and open data projects promotes data-driven decision-making, innovation, and transparency. For example, 3D city modeling is used by the Digital Twin project ("Min Stad") in Gothenburg to enhance urban planning, include the public in decision-making, and illustrate the effects of upcoming changes. Another significant city the digitalization space is Luxembourg. Advanced indoor air quality prediction software is available for the design and maintenance of healthy buildings through the nation's Octopus Lab project. Another important component of small cities' clever strategy is citizen participation. For example, Gothenburg's Smart Map initiative fosters community among its citizens. Similar to this, the Urbana smart city card in Ljubljana makes it easier to access city services like public transportation and libraries, improving user convenience and promoting involvement in urban activities. These small cities and their projects show that smart city policies can be just as ambitious and significant as those in larger cities, despite their differences in size.

4.6 CONCLUSION: FROM STRATEGIC INTENT TO IMPLEMENTABLE SMART CITY VISIONS

Finally, examining smart-city strategies in a variety of urban contexts - from the megacities of Paris and London to the smaller cities of Luxembourg and Ljubljana - reveals a global movement toward more sustainable, inclusive, and technologically advanced urban environments. While each city's approach is unique to its specific circumstances, common themes such as environmental sustainability, digital transformation, and citizen engagement appear consistently across strategies.

Large cities such as Paris, London, Barcelona, Vienna, and Milan demonstrate a strong focus on incorporating cutting edge digital infrastructure, encouraging sustainable urban development, and augmenting citizen involvement via cooperative platforms and open governance. These cities take advantage of their substantial resources and worldwide clout to carry out audacious initiatives that function as role models for urban innovation. On the other hand, medium size cities that emphasize both technology advancements and sustainability are, Amsterdam, Copenhagen, and Zagreb. Their tactics frequently involve cutting-edge initiatives in renewable energy, smart infrastructure, and community involvement; these projects demonstrate a sophisticated approach to the development of smart cities that places equal emphasis on innovation and inclusivity. Finally, smaller cities like Luxembourg, Zurich, Gothenburg, and Ljubljana show a remarkable ability to carry out smart city projects that improve livability and successfully handle urban challenges. These cities frequently use innovative and scalable approaches to promote an innovative and responsive culture in urban management, such as open data initiatives and digital twins.

Despite variations in priorities and methodologies, all cities studied share a commitment to leveraging smart city strategies to improve the quality of life for their residents. Their initiatives to advance social inclusion, energy efficiency, sustainable mobility, and environmental stewardship clearly demonstrate this commitment. Furthermore, the participatory aspect of these approaches emphasizes how crucial stakeholder involvement is in determining the course of urban futures. Ultimately, comparative analysis of the smart-city strategies implemented by these cities highlights the significance of customized methods that take into account local circumstances while conforming to international sustainability objectives. The knowledge gathered from these strategies can guide and inspire future urban development initiatives as urban areas grow and change, ensuring that cities everywhere become more inclusive, sustainable, and intelligent places to live.

SMART CITY CRITERIA

Photography 5
Harbour Promeande, Oslo
Author: Tord Baklund, 2018.

5. SMART CITY CRITERIA

5.1 CURRENT STATE OF CRITERIA IN SMART-CITIES

In the era of rapid urbanization and technological advancement, the concept of smart cities has emerged as a promising solution to address the complex challenges faced by modern urban environments. Many authors from different part of the world (Purnomo, Meyliana, Prabowo, 2016) contest that smart cities leverage technology and data-driven approaches to enhance the quality of life, sustainability, and efficiency of urban systems. Examining how these ideas might be implemented globally while honoring regional settings and social systems is crucial as urbanization picks up speed on a global scale. As reported, half of the world's population is currently residing in cities, and it is expected that this number will rise to 70% by 2050 (Colldahl and Kelemen, 2013).

However, the term "smart city" is diverse and multifaceted, with various definitions proposed by scholars. Some, like Lombardi et al. (2012), emphasize the role of information and communication technology (ICT) in shaping smart cities and defines a smart-city as "the application of information and communications technology (ICT) with their effects on human capital/education, social and relational capital, and environmental issues", or innovation, such as Zygiaris (2013) who defines a smart-city as "a smart city is understood as a certain intellectual ability that addresses several innovative socio-technical and socioeconomic aspects of growth". These disparate definitions demonstrate the wide range of applications for smart cities, but they also point to the absence of common standards within disciplines and geographical areas. Similarly, Caragliu et al. (2011) focuses on sustainability as the main factor in a smart-city and defines the smart city as cities "that have a high quality of life, those that pursue sustainable economic development through investments in human and social capital and traditional and modern communications infrastructure and manage natural resources through participatory policies. On the other hand, other studies focus on quality of life as the main focus on smart-cities. Authors as Lazaroiu and Roscia (2012), Giffinger et al. (2007), Nam and Pardo (2011), collectively, describe "smart cities" as places an emphasis on using technology and sustainable practices to enhance the quality of life for its citizens. This definition emphasizes how important it is to think about smart cities not just as centers of technological innovation, but also as ecosystems where technology elevates human experiences. They place a strong emphasis on designing spaces that are welcoming, alluring, and safe while being ready to face the difficulties brought on by societal, economic, and environmental trends that are occurring globally. According to their research, smart cities are distinguished by their proactive approaches to a range of issues, including the economics, governance, transportation, environment, and quality of life.

As we notice, the notion of smart cities continues to evolve; thus, it becomes imperative to critically examine the criteria used to assess and categorize them. Cities can more closely align themselves with the long-term goals of sustainability and inclusion by iteratively improving these standards. Such analysis is crucial to comprehending the dynamic environment of smart city development and guaranteeing that evaluation frameworks appropriately represent the complex aspects of smart cities in improving urban life and tackling modern issues. A recent research conducted by Shokouhi, Naghibi, Alizadeh, Ahmadi (2016) on "Evaluation of Smart City Criteria in Ahvaz City, Iran" studies six indicators that evaluate smartness, such as smart economy, smart people, smart governance, smart mobility, smart environment, and smart living. Their analysis indicates that public participation is a key component of smart city creation, and smart government plays a critical role in this regard. This highlights how crucial it is to have government systems that support citizen empowerment, awareness, and participation in urban decision-making. Even the most cutting-edge technologies could fall short of meeting the actual demands of the public in the absence of robust citizen interaction.

Having all these information in mind, this research chapter then delves into the current state of criteria in smart cities, with a particular focus on several key aspects. Firstly, it explores the framework established by the European Union (EU) for categorizing smart cities into different levels, providing insights into the varying degrees of technological integration and urban development across European municipalities. A recent report by the EU defines a smart city as a "city seeking to address public issues via ICT-based solutions on the basis of a multi-stakeholder, municipally based partnership" (2014). In order to guarantee that smart city programs are inclusive and collaborative rather than merely top-down, a multi-stakeholder strategy is essential. This paper investigates how Smart City efforts correspond with the goals of city innovation, development plans, and Europe 2020 aims. It offers three motivations for implementing Smart City strategies: recruiting businesses, fixing weaknesses, and exploiting local strengths. Secondly, this research chapter delves into the criteria set forth by the European Investment Bank (EIB), a significant player in financing urban development projects, to evaluate the smartness of cities. In the beginning of early urban environment efforts, EIB made the environment one of its priorities in 1984; however, as the shift of urban efforts changes, EIB has expanded its eligibility requirements to include funding for programs pertaining to urban redevelopment, economic adjustment, and revitalization across the European Community.

This research chapter explores the criteria landscape in smart cities, examining various sets of criteria used by various stakeholders such as government agencies, academic institutions, and industry organizations. Secondly, it conducts a comparative analysis of these criteria, identifying similarities, differences, strengths, and weaknesses. The chapter also investigates the need for new criteria or the exclusion of existing ones to better capture the multifaceted nature of smart cities and align with emerging trends and priorities. The goal is to draw meaningful conclusions for city planning by synthesizing insights from the analysis of criteria frameworks, identifying best practices, challenges, and areas for refinement, contributing to the ongoing dialogue on assessing and fostering smart city development in the 21st century.

Cities utilize smart city standards to analyze their progress toward becoming more sustainable and intelligent. These standards address a wide range of issues, including social justice, economic dynamism, environmental sustainability, technology integration, efficient government, and public participation, which are reflected in smart mobility, smart environment, smart people, smart governance, and smart living. As a result, they provide a framework for urban planners, policymakers, investors, and other stakeholders to examine the efficacy and impact of smart city projects.

Lombardi et al (2012) in his research “Modelling the smart city performance” discusses the dimensions of a smart city and the related aspects of urban life. These dimensions clarify the core tenets of the smart city criterion, as seen in Table 1. These include smart mobility, which optimizes logistics and infrastructure for seamless transportation; smart environment, which prioritizes efficiency and sustainability; smart people, who foster education and human capital development; smart governance, which embraces e-democracy for transparent and participatory decision-making; and smart living, which ensures security and improves overall quality of life.

Table 9.0. Dimensions of a smart-city and related aspects of urban life (adapted by Lombardi et al., 2012).

Dimension of a smart city	Related aspect of urban life
Smart economy	Industry
Smart people	Education
Smart governance	E-democracy
Smart mobility	Logistics & Infrastructure
Smart environment	Efficiency & Sustainability
Smart living	Security & Quality

This classification of smart city criteria is consistent with that proposed by Tregua (2015) et al., who define SCs as having three components: environmental (smart environment and smart mobility), social (smart people, smart lifestyle, and smart management), and economic (smart economy). Similarly, Ruhlandt's (2018) research stresses the relevance of smart technology and smart governance, in line with Marchetti et al.'s (2019) findings that social and human capital, smart governance, and competitiveness are the most essential variables for categorizing smart cities.

Tahir and Abdul Malek's (2016) paper on "The main criteria in the development of smart cities determined using analytical method" employs the Analytical Hierarchy Process (AHP) to assign weightage to each aspect deemed necessary for its development. The findings of this research indicate that smart environment and smart transportation are the two most significant components in the successful construction of a smart city. This is consistent with prior research by Monfaredzadeh and

Bernardi (2015), who describe smart environment as sustainability in resource management, the absence of pollution, and the attractiveness of the natural surroundings. According to Kumar (2019), the solution to a smart environment is smart living that protects the ecosystem, as humans are an integral part of the environment. Kumar's 2019 research "Smart Environment for Smart People" suggests that individuals adopt sustainable lifestyles and activities that prioritize environmental conservation, resource efficiency, and sustainability. He agrees that cities can enhance resource management, reduce pollution, and improve inhabitants' overall quality of life by combining data analytics and IoT devices with sustainable living habits. Kumar (2019) also emphasizes the importance of community involvement and cooperation in moving forward with strategic environmental projects, as well as participatory decision-making procedures involving a variety of stakeholders. He believes that cities may create resilient and habitable environments that benefit both current and future generations by instilling a culture of environmental understanding and responsibility.

Similarly, the research by Govada, Rodgers, Cheng, and Chung (2019) highlight the urgent need for cities to adopt sustainable development to address global warming and climate change. Cities are major emitters of greenhouse gases, and a comprehensive urban development strategy incorporating resilience, sustainability, and technology is crucial. The authors propose a six-category framework for smart city development: smart living, smart environment, smart mobility, smart infrastructure, smart governance, and smart economy. They argue that technology should not replace sustainability and resilience, but rather enhance these concepts through effective decision-making and community involvement.

Likewise, Govada et al. (2019) emphasize the importance of environmentally conscious urban planning, green infrastructure, and sustainable resource management in achieving a healthy balance between ecological preservation and urban growth. They emphasize the promotion of responsible behavior and sustainable living practices through public education, community involvement, and government leadership. Smart mobility, a key factor in the development of smart cities, is emphasized by Tahir and Abdul Malek (2016). It focuses on leveraging information and communication technologies (ICT) to optimize transportation systems, reduce congestion, and improve accessibility. Brčić, Slavulj, Šojat, and Jurak (2018) discuss the concept of smart mobility as a solution to urban issues like excessive private car use-related traffic jams, environmental contamination, and economic stagnation. They emphasize the importance of establishing Smart Mobility indicators to assess progress and efficacy in achieving sustainable urban mobility objectives. The research also provides examples of successful adoption of Smart Mobility systems in top EU nations, such as the Netherlands, to improve road safety, streamline traffic flow, and reduce environmental impact.

Smart governance is crucial for smart cities, as it maintains responsiveness, accountability, and openness in municipal operations (Razaghi and Finger, 2018; Lopes, 2017; Pereira, Parycek, Falco, and

Kleinhans, 2018). Digitalization of government services increases citizens' happiness and faith in governance systems. Razaghi and Finger (2018) emphasize the importance of governance in the shift to smart cities, arguing that urban infrastructures must change due to the integration of information and communication technology (ICT). Traditional governance methods have historically been successful in improving urban life, but they are inadequate for tackling the complexity of urban sociotechnical systems. Technological advancements, particularly in ICTs, can remedy these deficiencies by offering improved tools for managing urban complexity. Three attributes of ICTs that facilitate intelligent governance include data accessibility, novel data processing technologies, and emergence of communication channels and citizen engagement. They argue that significant changes in governance and management processes are required due to technological breakthroughs and shifting sociopolitical cultures that promote greater public engagement. Smart governance for smart cities is envisioned as a strategy that uses data and citizen involvement to efficiently manage urban complexity without relying on reductionist methods.

Smart cities, as defined by Giffinger et al. (2007), are characterized by effective governance, self-decisive, independent, and aware citizens who play a significant role in shaping their communities. Smart governance, as highlighted by Lopes's (2017) research, includes political participation, citizen services, and efficient municipal administration. It is crucial for promoting creativity, innovation, economic growth, and sustainability. Both studies emphasize the importance of citizen participation and efficient government in the development and prosperity of Smart Cities. They emphasize the need for governance frameworks that empower people, use technology, encourage teamwork, ensure accountability and transparency, and address contemporary city issues.

Smart governance and smart economics are crucial components of smart cities, combining advanced technologies with digital infrastructure to boost competitiveness, encourage entrepreneurship, and accelerate economic growth. Kumar and Dahiya's research highlight the essential characteristics of a "Smart City Economy," emphasizing the importance of economic identity, academic innovation, originality, creativity, and a variety of economic options. They emphasize the importance of sustainable growth, national brands, and smart investments in city assets. They argue that cities are essential drivers of economic progress, with wealth generated more in larger cities. They also discuss the development of smart cities, which are digitally networked systems powered by ICTs and sensors, producing vast amounts of data for immediate decision-making. Understanding smart cities is essential for conducting research on smart economics in urban settings.

Bonte's 2018 paper "Role of Smart Cities for Economic Development" emphasizes the importance of smart cities in promoting economic development. The benefits of smart cities include cost savings, livability, safety, and security, which indirectly influence other aspects like cost savings, security, and livability. Public investments, open data policies, and structural smart urban economy growth significantly increase GDP growth. Bonte emphasizes the need to strike a balance between economic demands and the welfare of the populace, admonishing excessive rivalry among cities. On the other hand, Kumar (2020) highlights the importance of smart living and smart people in smart cities. He emphasizes the importance of developing urban settings that value cultural heritage, safety, and top-notch amenities. Kumar also highlights the importance of cultural adaptation in successful application of new technologies. Finally, in smart cities, smart people value human growth, education, and fostering a culture of lifelong learning among city dwellers. To promote innovation and attract skilled labor, Kumar (2020) recommends incorporating colleges and universities into all facets of urban life. He also emphasizes the value of E-democracy and community involvement in efficient governance and decision-making.

As we see, the literature highlights the complexity of urban development and the importance of holistic planning. This chapter suggests that smart city standards serve as guidelines for communities to improve intelligence, livability, and sustainability, while these standards reflect the interdependence of social, economic, environmental, and technological factors in urban ecosystems. As noted, research shows that sustainability, resilience, citizen involvement, and technological innovation are crucial for the development of smart cities. Thus, this chapter believes that the incorporation of technology, data analytics, and digital infrastructure in economic development policies demonstrates the potential of smart cities for equitable growth, employment generation, and global competitiveness. In conclusion, smart city standards emphasize sustainability, diversity, creativity, and citizen-centered government, enabling cities to navigate urbanization challenges and build resilient, equitable, and successful communities for current and future generations.

5.2 EU SMART CITIES – LEVELS

Over the years, the European Union (EU) has been working nonstop to come up with a plan for its metropolitan areas that will enable "smart" urban expansion. The EU is not the only international organization and think tank that supports an ICT-driven, networked model of development.

A research conducted by Sulich, Rutkowska, and Rothe (2018) offers a thorough analysis of the idea of smart cities and their applicability to solving urban problems. It highlights the need to improve inhabitants' quality of life by identifying issues like poor air quality and transportation conditions in quickly increasing cities. The concept of Smart Cities is defined as using digital hardware and sensor-equipped infrastructure to enable advancements in energy consumption, mobility, transportation, mobility, environment, and safety.

Correia, Marques, and Teixeira (2022) analysis on “State-of-the-Art of Smart Cities in the European Union” provides insightful information about the development and difficulties faced by European smart city programs. The authors start out by tracing the history of smart cities back to the late 1990s, emphasizing how technology corporations' interests first drove the focus on technological solutions. This emphasizes how early smart city efforts were historically biased toward technology-driven approaches, frequently without a clear strategic objective. The authors accurately note how the literature on smart cities has proliferated since 2010, which has coincided with the European Commission's increasing focus and funding. In the same vein, the European Comission defines a smart city as "a place where traditional networks and services are made more efficient with the use of digital solutions for the benefit of its inhabitants and business". Throughout Europe, smart city projects proliferated during this time, with Barcelona and other prominent cities emerging as early adopters of cutting-edge technologies. But as the writers point out, some communities have taken a top-down strategy that raises questions about giving technology precedence over social issues and strategic planning.

As Correia, Marques, and Teixeira (2022) have pointed out, the examination of the 'State-of-the-Art of Smart Cities in the European Union' illuminates the past prejudices and current difficulties that European smart city initiatives confront, especially when they are still in the early phases and rely heavily on technology. Simultaneously, an official European Union document from 2014 provides a thorough analysis of the different factors that impact the development and uptake of smart city projects. It highlights the vital role that citizen engagement, intercity cooperation, and the private sector play in promoting the successful growth and dissemination of smart city initiatives.

Similarly, a research published by the European Parliament (2013) explores the thorough examination carried out by the European Parliament on the frequency, distribution, and attributes of smart cities throughout the member states of the European Union (EU). The research holds significant importance in comprehending the dynamic terrain of smart city advancement in Europe and provides valuable perspectives that can guide policy determinations and strategic planning for forthcoming smart city endeavors. In terms of methodology, the analysis makes use of information gathered from multiple sources, such as databases and reports maintained by the European Parliament. The sample comprises EU-28 cities with a minimum population of 100,000, and smart city attributes are determined according to predetermined standards. The distribution of smart cities across various size categories, nations, and maturity levels is examined using statistical approaches.

This model identifies six core dimensions of a smart city:

— Smart Economy, Smart Mobility, Smart Environment, Smart People, Smart Living, Smart Governance.

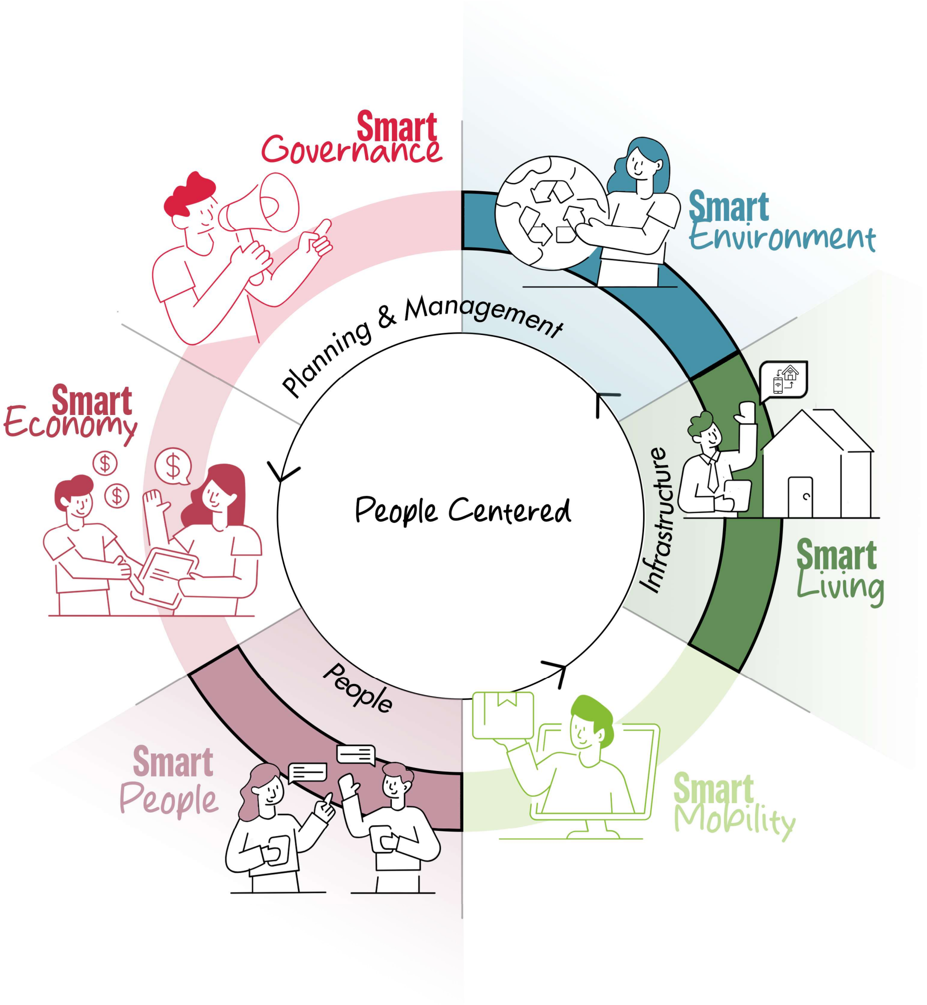


illustration 5.0.
Smart City Dimensions vs Our Research Focus
(Smart Environment, Smart People and Smart Living)
Author: Dashnor Kadiri, 2025[6].

According to this research, over half (51%) of the EU-28 cities meet at least one requirement to be classified as smart cities, indicating a notable prevalence of smart cities throughout Europe. The broad implementation of smart city programs demonstrates the increasing awareness of the need for creative ways to deal with urban problems and improve quality of life. The majority of the EU-28's member states are home to smart cities, which come in varied sizes. Although smart city efforts are more common in smaller cities, the UK, Spain, and Italy have the highest total number of smart cities. Notably, Italy, Austria, Denmark, Norway, Sweden, Estonia, and Slovenia have the most percentage of smart cities.

[6] Base illustration source:
IBM SMARTER CITIES | Data Model Prototype (Accessed: 29 May 2025)

Building upon these insights, another research conducted by Russo, Rindone, and Panuccio (2014) provides further depth into the European Union's ongoing efforts to define and implement strategies for smart city development at the EU level. On this article, the authors talk about the EU's continued attempts to create a strategy for the growth of its metropolitan regions, with a focus on the construction of smart cities powered by information and communication technology (ICT). It emphasizes that other international organizations and think tanks promote comparable development approaches, proving that the EU is not alone in supporting them. The paper then outlines the main actions made in the EU's smart city approach, making reference to the Europe 2020 vision and its signature projects meant to promote inclusive, sustainable, and intelligent growth. It goes on to talk about the European Innovation Partnership for Smart Cities and Communities (EIP-SCC), which fosters interdisciplinary cooperation and creative ideas to advance the energy, transportation, and ICT sectors. Lastly, the paper discusses that to achieve a triple bottom line gain for Europe—a higher standard of living for its population, more competitiveness for its industry and SMEs, and more sustainable energy, transportation, and ICT systems and infrastructures—the European Union is investing in research and innovation and creating laws for smart cities.

The integration of these diverse research, in summary, emphasizes the complexity of smart city development in Europe and emphasizes the role that technology, public participation, and strategic planning play in developing sustainable urban settings. Policymakers and urban planners can direct smart city programs toward inclusive and environmentally sustainable growth by utilizing the information gleaned from these investigations.

5.3 EIB BANK – LEVELS

In this part of the chapter, we will explore the European Investment Bank's (EIB) complex strategy for promoting smart and circular cities. As we discussed in the introduction, EIB is a key factor in funding urban development projects and their activities go beyond providing financial support as they also include strategic interventions meant to address complex urban concerns and promote sustainable urbanization.

As we know, the 28 Member States of the European Union control the European Investment Bank (EIB), which serves as the organization's financial arm. It was established in 1958 and now has operations in over 130 countries, including the EU. Since then, the European Investment Bank (EIB) is the world's largest transnational lender and borrower, and the only IFI that is held politically responsible by the European Union.

However, one might ask why does EIB finance smart cities. From their notable projects and released documents, we can see that the European Investment Bank (EIB) is actively supporting the progress of smart city aims and objectives throughout Europe by means of a combination of creative funding instruments, technical assistance programs, and cooperative partnerships. The recent research released by the EIB discusses various reasons why smart cities are financed by the European Investment Bank. First off, this research says that cities are becoming centers of competition, trade, and upscale services as their economies and populations continue to expand. But major obstacles like pollution, financial restraints, and social isolation come along with this progress (Hodžić and Arnautović, 2019). Thus, according to this research, making investments in smart cities makes it possible to effectively handle these issues and promote urban development that is sustainable. Secondly, there are disparities in competitiveness since medium-income cities, in particular, have not profited from agglomeration economies to the same extent as capitals. In these cities, wise investments may open up new value chains, improve infrastructure, and spur economic growth.

Thirdly, the aftermath of the 2008 financial crisis has constrained public investment, impacting municipal levels. Then, this article explains that due to financial constraints, a lot of communities have had to reduce spending and put basic maintenance ahead of innovation. This gap is intended to be filled by the EIB's funding for smart cities, which offers financial and technical support to help towns take advantage of their special assets and close infrastructural shortages. Furthermore, there exists a substantial unexplored potential for growth and development in cities located in Central and Eastern Europe (CEE). Thus, smart city initiatives may close current infrastructure gaps and unleash creative potential with EIB financing, spurring regional economic growth and development.

As we can see, the European Investment Bank (EIB) invests smart cities to support sustainable urban development, tackle urban issues, encourage innovation, and propel economic growth in Europe and beyond. This commitment is reflected in the comprehensive approach taken by the EIB to support smart city initiatives. The same document released by EIB provides a comprehensive approach that includes a range of urban initiatives targeted at improving infrastructure, mobility, water and waste management, and municipal services, the European Investment Bank (EIB) promotes smart cities. The three main tenets of all EIB-financed smart city programs are innovation, inclusion, and integration, regardless of project diversity.

Illustration 6.0. explains the smart city approach and in what sectors does EIB focus on. This illustration, adopted by EIB document showcases intelligent solutions into practice, such intelligent transportation systems, alternative fuel cars, and smart energy meters, among others. As we can see from the illustration, the foundation of smart city initiatives financed by the EIB is inclusion. Stakeholder participation and good governance procedures enable decisions about project design and execution to be made while taking into account the needs and viewpoints of many populations. By encouraging ownership and accountability, this participatory method produces more socially just and sustainable results.

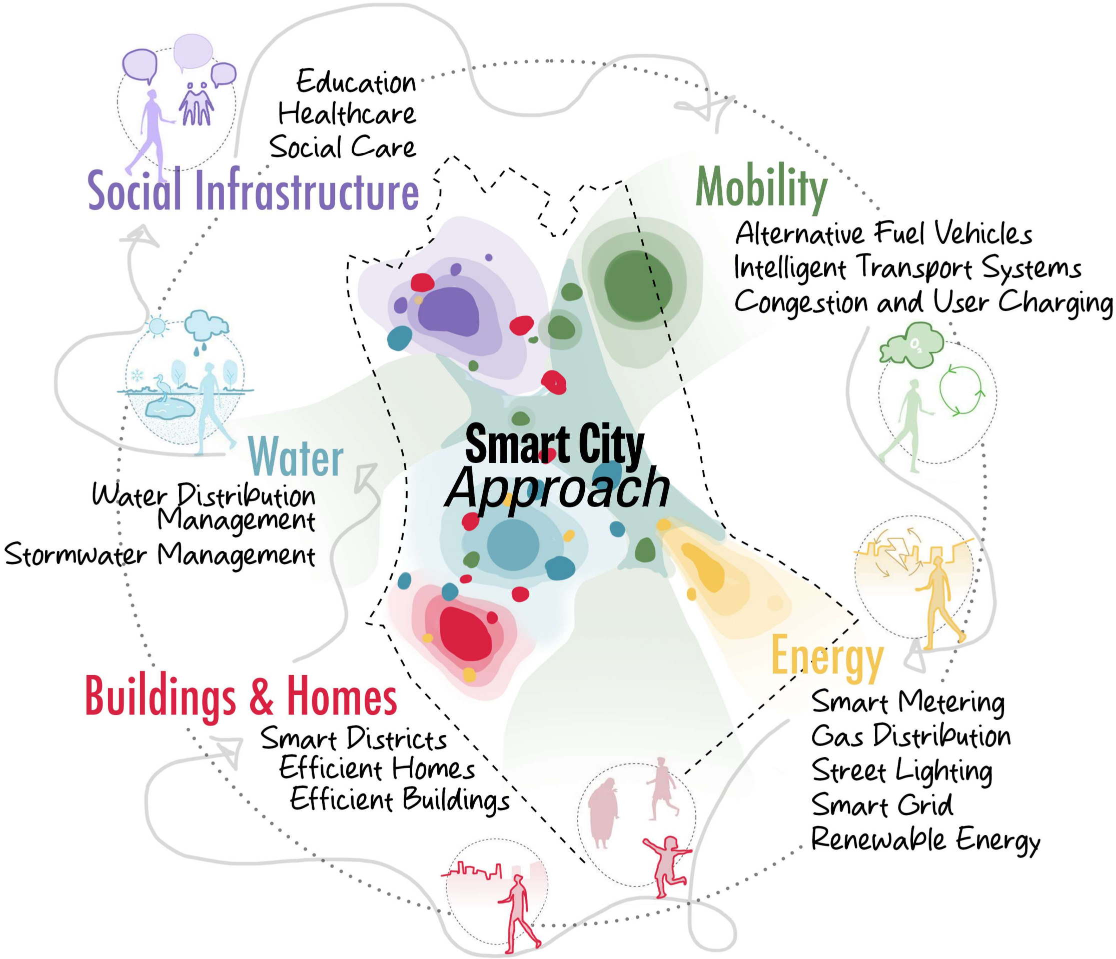


illustration 6.0.

Smart City Approach

Author: Dashnor Kadiri, 2025[7].

Another essential component of the EIB's strategy for smart cities is integration. Interventions in smart cities are designed and carried out in a comprehensive manner, incorporating solutions from a variety of industries, including public services, energy, housing, mobility, and water management. By ensuring coherence and synergy across various activities, this planning-led strategy maximizes the impact and efficacy of solving urban concerns.

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[7] Base illustration source: [20180619_brussels_Pierre_Emmanuel_Noel.pdf]() (Accessed: 29 May 2025)

Since we explained why EIB finances smart cities, according to the official article and fact sheet released by the EIB, now this chapter discusses how the EIB plains to support further smart city goals. In that regard, the European Investment Bank (authors Prof. Greg Clark, Dr. Tim Moonen, and Jake Nunley) published a report in 2019 that provides insight into the organization's endeavors to further smart city goals and tackle urban issues. According to this report, in order to maximize smart investment prospects, the EIB's approach entails utilizing its vast experience in smart city efforts to incorporate new technology into current assets and infrastructure. This strategic change seeks to maximize the potential of big data and artificial intelligence while fostering intelligent system integration and interoperability.

Moreover, this document shows that the EIB pledged to provide a sizeable financial package of $105 billion to support smart and sustainable urban development projects until 2021, with a sizeable share designated for investment within the EU, in the wake of the Habitat III Conference in 2016. Furthermore, the JASPERS program—which concentrates on offering technical help to cities and highlights sectors like research, innovation, ICT access, education, and healthcare—boosted the EIB's commitment to supporting investments in smart cities. In addition, the EIB's involvement in the circular economy is now essential to its urban projects. In addition, to encourage the application of circular economy principles in urban development projects, the European Investment Bank (EIB) has created a Circular Cities Funding Guide as part of the EU Urban Agenda's Circular Economy Partnership. Thus, the EIB has also increased its involvement in brownfield rehabilitation and urban property development as a result of realizing that significant interventions are necessary to properly solve urban difficulties. This report shows us a notable example of this widened focus which can be seen in Portugal, where the EIB is working with both public and private partners to create a long-term funding source for urban renewal and rehabilitation initiatives. In line with the overarching objective of modernizing Europe's building stock, this program seeks to fulfill housing needs, renovate structures for commercial use, and advance a more comprehensive green buildings approach. Moreover, the EIB's commitment to promoting sustainable urban development is demonstrated by its backing of strategic multi-sector investment plans for cities such as Lisbon and the Andalusian area of Spain. As we can see, the EIB continues to be a crucial financial and expertise partner as Europe's cities develop, advancing smart urbanization and tackling integrated challenges with sophisticated investment tools. This official document discusses also another component of the European Investment Bank's (EIB) agenda for sustainable urban development which is climate action in cities. According to the authors, the EIB has a long history of combating climate change and has led the way in funding projects for brownfield site remediation, renewable energy, public transportation, and pollution control. But the authors point out that the Bank's climate action programs are growing to include more goals, such strengthening civic security, encouraging citizen participation in environmental stewardship, and boosting resilience. Thus, the EIB has committed to allocating a minimum of 25% of its yearly financing to climate-related projects in accordance with its climate objectives; in recent years, it has routinely surpassed this target.

Additionally, this report discusses how the EIB actively participates in cutting-edge financing instruments like green bonds and equity investments to support climate change initiatives, meaning that its involvement goes beyond simply financing large-scale projects. This EIB report (2019) shows the commitment to promote climate action at the municipal level which is demonstrated by its noteworthy relationship with the Global Covenant of Mayors, which makes it easier to finance urban climate projects globally.

Apart from the official documents released by the EIB and European Commission, Hodžić and Arnautović (2019) in their research "The financing incentives for smart cities and importance for local government" talk about the crucial problem of funding smart city projects and point out the substantial financial outlays necessary to see them through to completion. They stress that because of the negative consequences of the debt crisis, many cities do not have adequate access to funds, which highlights the necessity of appealing financial instruments to support the low-carbon transition. The authors stress the need of industry-city cooperation in advancing the smart transition and call for a change to a demand-driven, needs-led approach. They point out that the expanding smart cities industry has a lot of promise to help ease the burden on public coffers. They do, however, emphasize how crucial it is to use creative business strategies to foster an atmosphere that is favorable for investors. Furthermore, Hodžić and Arnautović (2019) draw attention to the growing awareness of international organizations and the private sector, emphasizing the necessity of ongoing efforts to strengthen their funding and financial incentive contributions. The authors also go over the initiatives taken by the European Commission to address these issues through cooperative investment plans and rules pertaining to the 2014–2020 programming term. Within the framework of the European Cohesion Policy, they specifically mention financial instruments like the European Local Energy Assistance (ELENA), the Risk Sharing Finance Facility (RSFF), and the Joint European Support for Sustainable Investment in City Areas (JESSICA) as important incentives for smart cities. They offer thorough explanations of every incentive, stressing how each one helps to advance environmental objectives and urban development initiatives. Overall, Hodžić and Arnautović (2019) stress how crucial it is to diversify funding sources and develop creative economic models in order to support the growth and success of European smart cities.

In conclusion, the European Investment Bank (EIB) assumes a diverse function in the advancement of smart and circular cities by using its financial capabilities and tactical interventions to tackle intricate urban issues and promote sustainable urban growth. The European Investment Bank (EIB) has made a financial commitment to smart city financing because it understands how important it is to solve urgent urban problems, advance sustainable development, foster innovation, and accelerate economic growth in Europe and beyond. The EIB works to promote the advancement of smart city goals by means of creative financial mechanisms, technical assistance programs, and cooperative collaborations.

5.4 OTHERS SETS OF SMART CITY CRITERIA

As we analyzed the official documents released by EU, European Commission, and European Investment Bank (EIB), among other academic articles, on their work on the advancement of smart city criteria, this part now will focus on other sets which are also pivotal, such as the United Nations Sustainable Development Goals (SDGs) and the International Standards Organization (ISO) Standards. A comprehensive framework for tackling urgent global issues such as poverty, inequality, climate change, environmental degradation, and others is offered by the Sustainable Development Goals (SDGs). Cities can make sure that their efforts contribute to larger global efforts to achieve sustainable development by matching smart city programs with specific SDGs. Furthermore, including International Standards Organization (ISO) Standards into the smart city criterion assessment process provides a methodical way to gauge the success and efficiency of smart city projects. The ISO standards pertaining to smart cities offer direction on a number of topics, such as resilience, data management, governance, and environmental sustainability. Following these guidelines can aid in guaranteeing uniformity, compatibility, and excellence in the execution of smart city initiatives.

The Sustainable Development Goals (SDGs) are a set of 17 interconnected goals adopted by all United Nations Member States in 2015 as part of the 2030 Agenda for Sustainable Development. SDGs include: no poverty, zero hunger, good health and well-being, quality education, gender equality, clean water and sanitation, affordable and clean energy, decent work and economic growth, industry, innovation, and infrastructure, reduced inequality, sustainable cities and communities, responsible consumption and production, climate action, life below water, life on land, peace, justice, and strong institutions, and lastly partnerships for the goals. In the same vein, different authors claim that the Sustainable Development Goals (SDGs) provides a comprehensive framework for addressing global challenges, including those related to urbanization and sustainable development (Schwarz-Herion, 2020; Blasi, Gnzaroli, and De Nooni, 2022). For example, the article "Smartening sustainable development in cities: Strengthening the theoretical linkage between smart cities and SDGs" by Blasi, Ganzaroli, De Noni (2022) presents a comprehensive analysis of the relationship between smart cities and the United Nations Sustainable Development Goals (SDGs). The authors argue that smart technologies have the potential to contribute significantly to achieving the SDGs by 2030, particularly in urban areas where the scale and critical mass can accelerate progress. Their research uses a mixed-method approach, combining qualitative analysis of a subset of publications with quantitative analysis of literature using keywords relevant to SDGs and smart cities. The results show that although there is a growing body of literature on the topic, research on the intersection of sustainability and smart cities is still in its early stages.

One of the main conclusions is that there is little connection between SDG 11 (Sustainable Cities and Communities) and smart city projects. Common concepts including sustainability, resource management, governance, innovation, and collaboration are identified by the authors; nevertheless, they point out that there are differences in their interpretation between the literature on smart cities and the SDGs. In addition, the research highlights the necessity of closer cooperation between the literature on smart cities and the Sustainable Development Goals (SDGs) in order to tackle important problems like poverty, social inclusion, equity, and the effects of urbanization on sustainability. It implies that knowledge from both disciplines can help develop better strategies for accomplishing the SDGs in metropolitan settings. Similarly, a recent research conducted by Schwarz-Herion (2020) on "The Role of Smart Cities for the Realization of the Sustainable Development Goals" explores the intersection between smart cities and sustainable development goals (SDGs), emphasizing the importance of aligning smart city initiatives with the principles of sustainability across economic, social, environmental, and cultural aspects. In this regard, Schwarz-Herion (2020) firstly defines smart sustainable cities as innovative urban environments that utilize information and communication technologies (ICTs) to enhance quality of life, efficiency of urban operations, and competitiveness while ensuring sustainability across various dimensions such as economic, social, environmental, and cultural aspects. His article echoes the relevance of smart cities to the SDGs, particularly in addressing the needs of present and future generations without compromising their ability to meet their own needs. The 17 SDGs from the 2030 Agenda for Sustainable Development serve as a framework for guiding countries in eradicating poverty, reducing inequalities, tackling climate change, and promoting sustainable development in all its dimensions.

In addition, the author highlights that smart city represent a commitment to sustainable urban development and are motivated by a variety of ideals that correspond with particular Sustainable Development Goals (SDGs). These visions according to him include social well-being (SDG 3), environmental sustainability (SDGs 12 and 13), technical innovation (SDG 9), economic growth (SDG 8), and efficient government (SDG 16). The author claims that such alignment emphasizes how diverse smart city projects are, with the purpose of addressing intricate urban issues and furthering the more general objectives of sustainable development. Thus, he says that to guarantee alignment with the SDGs, it is imperative to stress the significance of converting these visions into specific actions and results.

Furthermore, Schwarz-Herion (2020) says that although every SDG has some bearing on the goal and vision of smart cities, SDG 11 (Sustainable Cities and Communities) is especially important. He says this as according to him, this goal, which closely aligns with the goals of smart city projects, highlights the necessity of establishing inclusive, safe, resilient, and sustainable urban environments. He adds that the development of smart cities is also greatly influenced by other SDGs, including SDG 6 (Clean Water and Sanitation), SDG 7 (Affordable and Clean Energy), SDG 8 (Decent Work and Economic Growth), and SDG 9 (Industry, Innovation, and Infrastructure). Finally, the author claims that in order to promote wise and sustainable urban development, it is imperative that these goals address key elements of urban life, such as robust infrastructure, economic possibilities, sustainable energy solutions, and access to basic services.

As we discussed the importance of the 17 SDGs from the 2030 Agenda for Sustainable Development, we will now also talk about the International Standards Organization (ISO) Standards and its relevance to smart cities. ISO is an independent, non-governmental worldwide organization that is made up of 164 national standards bodies. Each nation's standards body—such as Ghana Standards Authority (GSA) in Ghana and Bureau de Normalisation (NBN) in Belgium—works closely with ISO to reduce variations in technical definitions. Numerous domains, such as information technology security, energy management, quality management, environmental management, health and safety, and food safety, employ ISO standards

A recent research from Lai et al. (2020) on "A review of technical standards for smart cities" explains more on the correlation between the ISO standards. The authors claim that the organization is actively involved in both national and international debates around smart cities. They mention one example, the United Nations Sustainable Development Goals Taskforce, which is led by the ISO Technical Management Board. According to them, it is pivotal to review how ISO standards relate to the Sustainable Development Goals and assess the significance of the Goals for ISO, which will be resulting in the creation of a database that companies and organizations can use to identify standards that are helpful in promoting the Goals, develop guidelines for committees on how to proactively identify the appropriate partnerships, including the United Nations and other international organizations; and make recommendations regarding which ISO organizations should engage in standards promotion to support the Goals. In the same vein, the research research conducted by Ruso, Horvat, and Maričić (2019) explores how international standards affect the growth of smart cities and regions. The authors claim that what is driving global interest in smart cities is the need for sustainable urban development. The authors also offer diverse definitions of smart cities that highlight how technology and sustainability can be combined to improve economic development, standard of living, and environmental results. They point out that one major actor in creating standards for smart city efforts is the International Organization for Standardization (ISO), which covers topics like smart buildings, cars, city lighting, and management systems.

The purpose of their research "Do international standards influence the development of smart regions and cities" examines two hypotheses regarding how international standards affect the development of smart cities. The first hypothesis compares EU and non-EU nations in terms of the degree of smart cities and the quantity of certificates associated with smart and sustainable cities. The second hypothesis looks at how international standards can help with the development of smart cities. The methodology includes statistical analyses to evaluate the relationship between international standards and indicators of smart city development, such as correlation analysis, nonparametric testing, parametric tests, and structural equation modeling (SEM). The analysis reveals a number of noteworthy conclusions. First off, the authors claim that according to their research, quantity of certificates pertaining to international standards varies across EU and non-EU nations. They discuss that EU nations often issue more ISO 9001 certificates, whilst non-EU nations typically issue more ISO 14001 and ISO 27001 certificates. Secondly, the research finds that the values of the City Prosperity Initiative (CPI) dimensions are statistically higher in EU countries compared to non-EU countries, indicating a higher level of smart city development in EU regions. Secondly, the correlation research demonstrates that, especially in non-EU nations, international norms significantly affect CPI dimensions. Productivity, infrastructure development, and quality of life indicators are positively connected with standards like ISO 9001, ISO 14001, ISO 27001, and ISO 50001. The findings imply that, particularly in nations going through transition, international norms have a significant impact on how smart cities and regions evolve. The research concludes that international standards have a positive effect on the growth of smart cities and regions and it emphasizes how crucial it is to acknowledge global norms as significant determinants of policy for sustainable urban development. Another research conducted by Estevez et al.'s (2021) emphasizes as well how crucial ISO standards are for directing the creation of smart and sustainable cities. The authors emphasize how these standards, in conjunction with those from other international organizations like the ITU, IEC, and ETSI, offer a structure for certification and implementation that guarantees cost-effectiveness, compatibility, and safety. Notably, the EU implements multiple ISO standards for smart cities, including those related to resilience, open data, infrastructure performance, and universal accessibility. Additionally, the research highlights the tangible ways in which ISO standards—like ISO 50001 for energy management and ISO 39001 for road traffic safety management—address urban issues and advance sustainability in order to positively impact the development of smart cities. These standards support the larger objectives of smart sustainable cities by providing an organized method for increasing mobility, lowering energy use, and improving environmental performance. The report promotes ISO standards as essential parts of smart city programs and regulations, offering a strong framework for execution, oversight, and assessment. The research underscores the significance of ISO standards in molding the course of smart sustainable city development, guaranteeing that technological progress is efficiently utilized to tackle societal demands and ecological issues.

In conclusion, the framework for smart city criteria gives a comprehensive strategy to tackling complex urban difficulties through the combination of United Nations Sustainable Development Goals (SDGs) and International Standards Organization (ISO) standards.

5.1.4. Comparison of criteria

It is clear from comparing the criteria in EU and EIB levels that the emphasis moves from the financing and actual implementation of smart city projects to a more comprehensive analysis of their compliance with international standards and global sustainability goals. **The strategies and activities of the European Union (EU) and the European Investment Bank (EIB) concerning the creation and funding of smart cities are the main focus of sections EU and EIB levels.** These sections go into detail about the precise steps that these organizations have taken to provide financial, technological, and strategic assistance for smart city initiatives. They stress how crucial it is to use technology-driven strategies, include citizens, and collaborate across disciplines in order to achieve the objectives of sustainable urban development. The practical components of smart city development, including finance sources, project execution, and stakeholder roles, are the main topics of discussion in these sections.

When these criteria are compared, it is clear that although sections of EU smart cities levels and EIB offer a thorough analysis of the practical aspects of developing smart cities at the regional level, sections of SDGs and ISO standards present a more comprehensive view of the global framework and regulations governing smart city initiatives. The contrast emphasizes how crucial it is to take into account both global frameworks and localized strategies when designing and executing smart city initiatives in order to guarantee their efficacy, sustainability, and compatibility with more general development objectives.

However, now the question rises whether we need new criteria or exclude some. The growth of smart cities is contingent upon a range factors, including shifting objectives, new problems, and technological and intellectual advancements. It is imperative that criterion creation and assessment use a dynamic and adaptive approach in order to guarantee that smart city efforts adequately tackle the intricate and interrelated problems that metropolitan regions face globally.

5.5 METHODOLOGY OVERVIEW

This research adopts six dimensions in the smart city framework by its figure, such as Smart governance, Smart Economy, Smart People, Smart Mobility, Smart Living, and a Smart Environment.

However, as the research is focused specifically on architecture and urban design, it analyzes the three dimensions: Smart Environment, Smart People and Smart Living. They are most considered with spatial planning and sustainability, quality of life and citizen engagement, which coincide with the objectives of architectural innovation and urban development. Assessment of cities had been realized on the basis of initiatives and characteristics present in these three areas.

Data source: The dataset used for the analysis refers to a comprehensive smart-city performance dataset that evaluates cities, based on six main dimensions: Smart Economy, Smart Mobility, Smart

Environment, Smart People, Smart Living, and Smart Governance. The six parameters, as originally specified by Giffinger et al., provide a widely accepted framework for smart city evaluation. In this dataset, each city receives a rank for each category based on various quantitative indicators and benchmarks. This multidimensional approach gives a more complete picture one hears the buttocks of how each city performs in select areas of "smartness."

Selection Criterion: According to the above data, a simple filter was introduced to select cities of interest. Any city that qualified for receiving a position within the top five in at least one of the three prioritized categories, that is, Smart Environment, Smart Living, and Smart People, is chosen for further analysis. In practice, this means that if a city is, for example, 2nd in Smart Environment or 4th in Smart Living (even if it wasn't top five in the other categories), it may enter the group. The cities emerging from this selection are, hence, those that shine brightly in at least one of the critical areas of interest. By concentrating on top-five achievers, we would be able to spotlight cities that excel in those domains when it comes to sustainability, quality of life, and human capital excellence.

Selecting Cities Based on Smart City Performance: We selected those cities that are ranked in the top five in at least one of three key smart city categories: Smart Environment, Smart People, and Smart Living. These categories were chosen since they directly affect key areas of urban sustainability, livability, and human capital development.

High rankings in Smart Environment reflect a strong framework for sustainability and environmental stewardship (i.e., climate policies, pollution, resource management).

Leadership in Smart People denotes a strong endowment of human and social capital - inclusive of educated and engaged populations as well as the social coherence and cohesion with which they engage. Finally, an excellent ranking in Smart Living indicates the existence of one of the highest standards of living for residents, encompassing health, safety, housing, and cultural vibrancy
By focusing on these three spheres, we make sure that the selected cities are recognized for their sustainable quality of life and talent training- the very foundation for a city's long-term smart growth and innovation capacity.

Below is table that combines two main frameworks used to assess smart cities: the European Smart Cities (EU) characteristics and the European Investment Bank (EIB) criteria. Since this research is focused on urban planning and neighbourhood level, our comparison focuses on the three dimensions that connects most directly to physical changes of real-life outcomes: Smart Environment (Sen), Smart Living (Sli) and Smart People (Spe). Each row shows the criterion and which source it comes from (EU or EIB). (See Appendix – Catalogue 2).

Table 10.0. EU & EIB characteristics for Smart Environment, Smart People, and Smart Living derived from database of EU[8] smart cities program and EIB[9] (European Investment Bank)

ASSOCIATIONS	FOCUS	EU/EIB	CRITERIA
EU EUROPEAN SMART CITIES *CHARACTRISTCS*	SMART PEOPLE (Spe) / SMART LIVING (Sli) / SMART ENVIRONMENT (Sen)	EIB	(Spe) Technology and learning methods.
		EU	(Spe) Flexibility
		EU	(Spe) Cosmopolitanism/Open-mindedness Participation in public life
		EIB	(Spe) Creative networks.
		EIB	(Spe) Measures and platforms for employment.
		EIB	(Spe) Home-based work and workplace flexibilization.
		EIB	(Spe) ICT-enabled bottom-up initiatives.
		EIB	(Spe) Community and urban life information spread and sharing
		EIB	(Spe) Human rights watch.
		EIB	(Sen) Environmental monitoring (Natural resources, ecosystem, biodiversity)
		EIB	(Sen) Network monitoring.
		EU	(Sen) Pollution
		EU	(Sen) Environmental protection
		EIB	(Sen) Real time information and visualization tools
		EIB	(Sen) Smart grids.
		EIB	(Sen) Renewable energy.
		EIB	(Sen) Energy efficiency in buildings.
		EIB	(Sen) Energy efficiency in public devices.
		EU	(Sen) Citizen involvement in energy efficiency measures.
EIB EUROPEAN INVESTMENT BANK SMART CITIES *CHARACTRISTCS*		EIB	(Sen) Urban planning in new developments.
		EIB	(Sen) Participation in urban management and planning
		EIB	(Sen) Sustainability in new buildings.
		EIB	(Sen) Natural resources protection.
		EIB	(Sen) Ecosystem's protection.
		EIB	(Sen) Biodiversity protection.

[8] Available at: european smart cities (Accessed: 25 April 2025)
[9] Available at: 2017 - 0131 Ascimer Deliverable 3 Governance and Implementation of Smart City Projects in The Mediterranean Region | PDF | Governance | Infrastructure (Accessed: 25 April 2025)

	EIB	(Sen) Involvement in sustainable measures in buildings and urban spaces
	EIB	(Sli) Promoting healthier lifestyle and well-being
	EIB	(Sli) Improve access to healthcare.
	EU	(Sli) Housing quality
	EU	(Sli) Education facilities
	EIB	(Sli) Urban security.
	EU	Sli Touristic attractivity
	EIB	Sli Security services online.
	EIB	Sli Digital security
	EIB	Sli Measures to solve environmental factors.
	EIB	Sli Urban labs and SC centers
	EIB	Sli Integration and connection of uses in public space.
	EIB	Sli Adaptation of public space to users.

Comparative performance: The top five rankings in a category reflect how a city performed in comparison with all other cities under that dimension. In other words, being among the top five means that such cities are the ones performing among the top five in the world (or among the surveyed group of cities) in that particular dimension of smart city development. Such ranking would mean exemplary performance in that dimension. The selection criteria, therefore, inherently identifies cities that have demonstrated excellence in critical areas, evidenced in high comparative standings. Through this process, we can ensure that the cities we have chosen are not simply random selections but rather justified using data-driven evidence as leaders in the smart city characteristics most closely linked to urban success in sustainability.

5.6. CRITIC

The concept of "smart cities" has gained significant attention, with businesses, governments, and urban planners promoting technological solutions to urban problems. However, critics argue that this emphasis on technology may lead to unexpected problems if the social and human aspects are neglected. Rem Koolhaas, a renowned architect, criticizes the smart city paradigm for overusing technology, disregarding human-centered design, and the potential shortcomings of certain projects. He believes that smart cities often overlook essential elements like public space, culture, and human connection, and that cities that prioritize infrastructure over human experience risk being criticized for being "stupid." Koolhaas also emphasizes the need to address the social, political, and cultural complexity of urban living.

Koolhaas (2020) envisions a future where cities can transition from a hyper-urbanized, technology-driven paradigm to a more adaptable, organic approach that caters to citizens' needs. However, the conflict between technological determinism and the need for flexibility, inclusivity, and human-centeredness is a common criticism of smart cities. Gensler (2020) advocates for a human-centered approach, emphasizing the importance of creating spaces that promote wellbeing, creativity, and human interaction. The technocratic approach to urban planning, relying on data, sensors, and algorithms, is criticized for often overlooking the more fundamental issues urban settings face. The Sidewalk Labs project in Toronto, for example, failed due to privacy, governance, and public involvement issues. A Technology Review (2022) assessment of smart city initiatives highlights that many fails to consider the political, economic, and social realities of contemporary metropolitan contexts, and that technology alone cannot address problems like social fragmentation, housing shortages, or poverty.

Alexander (2019) critiques the "A Pattern Language" work, arguing that cities should develop naturally rather than adopt strict, top-down structures. He argues that smart cities often lack flexibility and sensitivity to local circumstances, which are essential for their development. The "one-size-fits-all" nature of smart city frameworks has been criticized for ignoring the complexity of cities and the need for tailored solutions. Some argue that smarter cities use technology to enhance human-centered behaviors, rather than replace them. This balance between technology's benefits and maintaining social, cultural, and economic development is crucial for urban planners and policymakers. The criticism also calls for a more comprehensive, human-centered approach to urban development, prioritizing inclusion, adaptability, and the social and cultural aspects of urban life. Thus, this chapter concludes with the belief that cities are not just sites for technology experimentation, but projects aiming to create smart cities should prioritize inclusion, adaptability, and the social and cultural aspects of urban life.

5.7 OVERVIEW OF LITERATURE AND CONCLUSIONS FOR CITY PLANNING: FROM FRAGMENTED INDICATORS TO STRUCTURED SMART CITY CRITERIA

This chapter explored the concept of smart cities, highlighting their complexity and dynamic nature. It examines the various frameworks and perspectives used by stakeholders, such as the European Union (EU), the European Investment Bank (EIB), the United Nations Sustainable Development Goals (SDGs), and the International Standards Organization (ISO). With that in mind, the chapter emphasizes the interdependence of technological innovation, sustainability, and urban quality of life in smart cities. The EU's approach emphasizes ICT-based solutions, multi-stakeholder collaborations, and alignment with development plans like Europe 2020 targets. The EIB also provides funding for smart city initiatives, prioritizing sustainable urban development. The chapter concludes that a synthesis of perspectives from various criteria frameworks provides significant direction for urban planning and policy formulation. It emphasizes the need to modify criteria frameworks in response to new goals, trends, and changing urban population demands. The chapter also holds practical implications for architects, legislators, urban planners, and other stakeholders involved in defining the future of cities.

PROJECTS / NEIGHBOURHOODS – BOTTOM-UP APPROACH

Photography 6
Emergency vehicles will have access to Merwede's center, but not cars.
Author: Marco Broekman, 2020.

6. PROJECTS / NEIGHBOURHOODS – BOTTOM-UP APPROACH

6.1. INTRODUCTION

The neighbourhood has been described as an important element in the discourse on smart cities. As we build on this recognition, the concepts connected to smart cities are being implemented into neighbourhoods of many cities and are essential principles of smart urban development.
Until now, we have looked at smart neighbourhoods concepts and what makes a neighbourhood smart. As many authors suggest, a smart neighbourhood is defined as a newly developed urban plan where the traditional urban plans are transformed into urban ones with a focus on technology, innovative governance, sustainability efforts, and resident engagement. With that being said, these smart districts will include in their plans integrated digital infrastructure, comprising decentralized renewable energy sources with storage capabilities, electric vehicles (EV) and their charging stations, as well as sensor-equipped public amenities, all managed through data systems.
Beyond technological frameworks, smart neighbourhoods include sustainable urban design features, such as energy-efficient buildings, climate-resilient landscaping, and accessibility. In addition to these, smart neighbourhoods also implement new governance frameworks and social initiatives such as smart governance and smart living. By implementing smart living and smart governance, smart neighbourhoods utilize digital technologies in order to enhance public service efficiency and foster citizen involvement, ultimately improving the overall quality of life.
While we discuss smart neighbourhoods, it is important to note that the development of such districts typically includes the collaboration of various stakeholders, such as municipal authorities, private technology companies, local residents, and, on occasion, academic or research institutions. This collaborative strategy has resulted in an increasing trend of cities establishing smart neighbourhoods which on a smaller scale include better mobility systems and other initiatives, before implementing the whole program.

Based on this research, this chapter then will analyze the evolution of urban planning in the context of smart neighbourhoods by exploring how smart principles are applied to solve urban challenges and improve the quality of life as smart neighbourhoods use advanced digital technologies, data analytics, and sustainable practices to respond to the challenges of modern urban life.

It is essential to recognize that the concept of a smart neighbourhood does not have a one-size-fits-all application, as these neighbourhoods, like cities, take on a variety of forms that are specifically designed to meet the unique requirements and needs of their residents. With that being said, some smart neighbourhoods are completely new, and some are redeveloped, meaning a former airfield or even a former prison is turned into a smart neighbourhood. Because of this diversity, smart neighbourhoods can take many different forms, as some are big in number, even in population and jobs they create, or small. For example, one city may set out to build a cutting-edge town near the city, while others might focus to transform a forgotten place, or a former industrial zone, into a vibrant community living. The unique circumstances surrounding each case resulted in distinct outcomes. This is further evidenced by comparative studies, which reveal that even among seemingly similar smart districts, such as those facing coastal flooding and with comparable technological capabilities, each city has developed unique smart neighbourhood strategies that are tailored to their local strengths, weaknesses, and goals.

In light of these considerations, it becomes evident that different districts may adopt varying priorities when it comes to urban development; for instance, one district might focus on enhancing climate resilience by incorporating flood-proof designs in its waterfront redevelopment projects, while another district could place a greater emphasis on achieving energy independence or developing solutions for digital mobility. Also, the goals of these projects can be very different; some projects see themselves as places for testing new ideas, putting a lot of money into trying out new pilot projects, while others may take a slower approach by adding smart technologies to larger city improvement plans. Moreover, there are notable differences in the models, with some being top-down public-private partnerships and others employing bottom-up or incremental strategies. Much of this advanced neighbourhood development is an ongoing process characterized by experimentation and adaptation. Smart neighbourhoods manifest in diverse forms but share a unified aim of incorporating technology and sustainability into urban living.

Through the analysis of various neighbourhoods, including Aspern Seestadt in Vienna, Nordhavn in Copenhagen, Merwede in Utrecht, Nieuw Zuid in Antwerp, Clichy-Batignolles in Paris, Schumacher Quarter in Berlin, Milano Innovation District in Milan, Brainport in Eindhoven, Überseeinsel in Bremen, Bajes Kwartier in Amsterdam, Knoop XL in Eindhoven, Freiham North in Munich, Tirana Riverside in Tirana, Oberbillwerder in Hamburg, Am Sandhaus in Berlin-Buch, Madrid Nuevo Norte in Madrid, Smíchov City in Prague, Kolkajen in Stockholm, Pihlajaniemi in Turku, and Gredelj in Zagreb, the reseaerch will analyze how smart urban planning principles are implemented and their impact on solving urban problems. (See Appendix – Research Catalogue 4).

To better understand these implementations, it is essential to first explore the core principles that define smart neighbourhoods, such as smart environment, smart living, smart mobility, smart governance, smart people, and smart economy. These principles aim to create compact, walkable communities with green spaces, efficient public transportation, and buildings that use renewable energy; ultimately, they strive to improve social inclusion and ensure that technological advancements benefit all residents.

Building on this conceptual foundation, the following chapter shifts the focus from theory to practice, examining how these principles are applied in various urban contexts. This chapter will highlight the differences and similarities in their approaches to smart urban planning by comparing case studies from the selected neighbourhoods. To effectively frame this comparison, the chapter will begin with an overview of the analytical approach. Firstly, this chapter will examine the specific criteria and indicators used in each project, such as proximity and walkability, green space distribution, energy efficiency, and community engagement, among other indicators. Secondly, the comparative analysis will provide insights into best practices and potential pitfalls in the development of smart neighbourhoods.

Conclusively, the transition from traditional urban planning to smart neighbourhoods signifies a significant change in the development of resilient and sustainable cities. By fostering active community participation and integrating smart technologies, these neighbourhoods address contemporary urban challenges and improve the quality of life for their residents. Consequently, the objective of this research is to illuminate the innovative strategies and strategies that render smart neighbourhoods a viable model for future urban development.

6.2 POSITIVE ASPECTS OF SMART NEIGHBOURHOODS

Smart neighbourhood projects have one goal in mind: to improve urban living and to create a community where the residents benefit from environmental sustainability, improved mobility, digital innovation, and participatory governance, among other smart principles. Although every neighbourhood is different due to its transformative process, there are still common themes that emerge when exploring these neighbourhoods.

With this in mind, this research delves into the primary advantages associated with smart communities, systematically categorizing them into thematic areas and detailing some of the most important global examples.

– **Environmental Sustainability and Energy Efficiency**

Since the traditional urban forms mostly focused on infrastructure, there was little to no attention to environmental sustainability and energy efficiency. With that being said, when exploring the neighbourhoods, we see an increase in environmental sustainability and energy efficiency in their projects, such as reducing carbon footprints, conserving resources, and implementing green infrastructure. In the same vein, smart districts often use smart grids that work on a district-wide scale, as well as renewable energy sources like geothermal heat pumps and photovoltaic panels, to make the most of the energy they use. The emergence of "positive energy districts" is a notable example of this forward-thinking approach. These districts are designed to generate more energy than they consume on-site by harnessing local renewable resources and constructing energy-efficient buildings.

The combined effects of various initiatives contribute to notable environmental benefits, such as a decrease in carbon dioxide emissions, improved air quality, and the development of more resilient communities. There are many examples of such initiatives, including the Merwede district in Utrecht, Netherlands. This district is focusing on building solar-panel-equipped roofs and the country's largest subterranean thermal energy storage tank, all in order to foster a sustainable, low-carbon neighbourhood. Furthermore, many smart neighbourhoods have recognized the value of incorporating green spaces and urban nature, including parks, green roofs, and tree-lined streets, which contribute to air filtration and urban cooling. In conclusion, smart neighbourhoods show that cities can change with the times while still working toward climate goals.

– Mobility and Accessibility

Until recently, almost all people relied on personal vehicles to function in everyday life. In smart neighbourhoods, the promotion of environmentally friendly transportation options and the reduction of their reliance on vehicles are becoming increasingly important in commercial districts too, as many of these smart neighbourhoods are aiming to create transit-oriented, walkable communities inspired by the 15-minute city concept.

This concept enables residents to fulfill their daily requirements by cycling or walking, thereby eliminating the need to travel long distances. For instance, Nordhavn in Copenhagen is currently undergoing a transformation into a 5-minute city. This initiative ensures that every residence is within a five-minute walk of essential amenities, workplaces, and transportation options, thereby encouraging the use of public transit and walking over driving. In addition to promoting walkability over driving, many of these neighbourhoods are also working towards their cycling infrastructure by establishing pedestrian-friendly spaces and enhancing transit connections.

For example, one of Europe's largest planned car-free districts, Utrecht's Merwede neighbourhood is distinguished by its limited parking, one shared car for every three households. The plan of Merwede includes that the residents will depend on efficient public transit systems, mobility hubs that are equipped with shared electric vehicles, and extensive bike trails to connect their community to the city and surrounding areas. This initiative not only improves safety and accessibility for individuals of all ages, but also reduces traffic emissions and energy consumption.

The integration of smart technologies further improves mobility through real-time information and electrified transport options. Effective charging systems for electric vehicles, sensor-based parking, and smart traffic management - similar to those implemented in Barcelona - are essential components of smart city projects. Smart neighbourhoods facilitate sustainable and equitable mobility by prioritizing pedestrians, cyclists, and public transit, thereby simplifying the process of movement for all.

– Digital Innovation and Smart Infrastructure

In addition to mobility and accessibility, smart neighbourhoods also use digital innovation and smart infrastructure to improve residents' quality of life. In fact, with technology being an important smart principle, these neighbourhoods rely on a strong ICT infrastructure that includes high-speed connectivity, IoT sensor networks, and integrated data platforms that enable a wide range of smart applications. Building on this foundation, they use real-time data collection and analytics to effectively monitor and manage critical aspects such as energy consumption, water usage, traffic flow, and public safety. To support this level of integration and responsiveness, centralized urban-wide data platforms

play an important role in consolidating these disparate data streams, allowing for the development of innovative digital services.
In these neighbourhoods, residents benefit from various digital services and applications designed to make urban living easier, such as local e-governance portals for online service requests and budget participation, smart-parking applications, and community portals. While many might assume that digital services are used only for basic usage, some smart neighbourhoods have even tested telemedicine hubs, e-learning centers, and digital marketplaces to encourage local sharing economies. For example, the Berlin's Tegel quarter project is establishing a comprehensive data platform to support smart services from the outset, which means that is fostering a smarter and more progressive neighbourhood.
As noted, smart neighbourhoods are cultivating innovation ecosystems that support tech - startups and pilot new solutions, eventually providing citizens with some of the most advanced urban services available. Importantly, the technology is not used as a promotional tool, but rather to address real-world problems such as energy waste and traffic congestion, as well as to make urban systems more resilient and reactive.

- **Participatory Governance and Community Engagement**

Successful smart neighbourhoods prioritize community engagement and participatory governance, as they confirm that including the residents in planning and decision-making processes is pivotal for these neighbourhoods to be successful.
Since the planning process of the smart neighbourhoods adopts a more bottom-up approach, it is important for the smart neighbourhoods to promote local values and trust among community members. Moreover, co-designing innovative solutions with users frequently results in enhanced acceptance and creativity, whether it pertains to a user-developed application or public spaces adorned with artwork by local artists that adapts according to community engagement. Through the promotion of individual ownership and the enhancement of digital literacy, participatory governance in smart neighbourhoods ensures that technological innovation generates genuine social value and empowerment.

- **Enhanced Quality of Life**

As we can see, smart neighbourhoods are focused on enhancing the quality of life for their residents through the integration of sustainable practices, so they can enjoy cleaner air, safer streets, and greater flexibility. For example, smart neighbourhoods enhance public health and well-being by reducing traffic and pollution and increasing green spaces. This is very important to the residents, as such sustainable living elevates the livability in such neighbourhoods.

To gain a clearer understanding of the model's practical application, it is beneficial to examine specific examples that exemplify these principles. First of all, it’s important to mention that a smart neighbourhood model is multidimensional; thus, it addresses different urban challenges, such as environmental, social, or economic. An example of a neighbourhood would be Aspern Seestadt or

Nordhavn, both smart neighbourhoods. Nordhavn, for instance focuses on a livability addressing multiple urban challenges environmental, social, and economic - simultaneously to create more livable and interconnected cities. In smart neighbourhoods such as Vienna's Aspern Seestadt and Copenhagen's Nordhavn, urban planners have emphasized resident welfare in conjunction with technological and environmental progress. Nordhavn epitomizes a philosophy focused on improving quality of life, meaning that a community can achieve high sustainability and technological advancement while maintaining comfort and social engagement. Both these neighbourhoods, along with other smart ones, share that, with thoughtful implementation, urban development can lead to cities that are more sustainable, connected, and enjoyable to live in.

6.3 NEGATIVE ASPECTS AND CHALLENGES OF SMART NEIGHBOURHOODS

As we have seen until now, there are numerous positive aspects that the smart neighbourhoods provide to the residents but also the community in general. However, there are also numerous negative aspects of smart neighbourhoods that are often overlooked. In many cases, the implementation of smart city initiatives at the neighbourhood level has been linked with various negative aspects, as noted by urban planners and community advocates, such as digital exclusion and the risk of inequity, socio-spatial inequalities and gentrification, and data privacy and surveillance concerns, among others, in addition to the concerns regarding privacy, governance, and an over-reliance on technology-driven solutions.

To have a balance between the positive and negative aspects, such challenges to the society by smart neighbourhoods should be examined. Thus, the following chapter looks deeply into the primary negative aspects of smart neighbourhoods, by theme, and reinforces them with one or more illustrative examples or pieces of evidence.

– Digital Exclusion and the Risk of Inequity

A major issue about smart neighbourhoods is the possibility of exclusion of some communities, which in long term can only worsen the current digital divide. As we already know, there is already a digital gap between people who have access to modern information and communication technology and those who do not, based on age, educational level, socioeconomic status, etc. This divide can worsen considering that the smart neighbourhoods employ advanced digital services and high-tech infrastructure associated with these projects are primarily designed for individuals who are already tech-savvy and well-connected.

With these facts being said, low-income families, the elderly, and other vulnerable groups can be part of the digital divide. Furthermore, this division is further deepened by the fact that the digital conveniences provided by smart neighbourhoods frequently appeal to educated people, resulting in a global concentration of wealth and resources.

As we see, smart neighbourhoods come with negative consequences as well. For example, people in the smart neighbourhoods who lack smartphones or reliable internet access are effectively disconnected from essential services if a neighbourhood's mobility or e-government services are heavily dependent on smartphone applications, which we have seen that they mostly are. This situation only serves to exacerbate the "digital divide" in terms of urban resources. Unfortunately, these marginalized groups are frequently overlooked in the development of smart city policies, as their unique needs and capabilities are not accounted for when crafting digital initiatives. Therefore, research suggests that smart city initiatives that lack an inclusive approach tend to benefit those who are already familiar with technology and are well-educated, thereby exacerbating digital inequalities in information and communication technology (ICT) access and outcomes for disadvantaged citizens.

In our opinion, smart neighbourhoods that lack intentional inclusion strategies are at risk of fostering a situation in which the technologically proficient become even more advanced, while others experience a reduction in access to resources and opportunities. Thus, I believe that by addressing this divide, cities must invest in education, ensure affordable access, and explore alternative service delivery methods, and by doing so, they can ensure that smart initiatives genuinely benefit all residents.

- **Socio-spatial Inequalities and Gentrification**

In line with digital exclusion and the risk of inequity, socio-spatial inequalities and gentrification present another negative aspect of the smart neighbourhoods. A major concern is that smart neighbourhoods usually serve elite populations, those who are well-educated, etc., which worsens urban inequalities. As we know, smart neighbourhoods usually promote high-end initiatives such as innovation districts, technology hubs, or eco-districts, which may result in elevated property values and living expenses in the area. A concerning outcome of developing a new smart neighbourhood is its potential evolution into an exclusive enclave that becomes financially inaccessible for lower-income residents, either abruptly or progressively. The phenomenon of gentrification presents a significant challenge; the influx of capital and affluent newcomers can displace established communities, transforming the area into a refuge for the middle and upper classes. In this context, recent analyses have highlighted concerns that smart city projects, if not executed thoughtfully, could exacerbate gentrification and further marginalize impoverished populations. Indeed, there is a risk that the smart neighbourhoods movement may overlay existing segregation with a veneer of technology or even reinforce urban inequalities, a situation referred to as e-gentrification.

- **Data Privacy and Surveillance Concerns**

The people who live in these smart neighbourhoods echo that privacy and surveillance concerns are the biggest two negative aspects of living in such neighbourhoods. Considering the fact that smart neighbourhoods rely on data-driven technologies, such as sensors, cameras, and smartphones, to gather extensive information to enhance urban systems, it is almost impossible to say that smart neighbourhoods do not possess a risk of data privacy or surveillance concerns.

However, this reliance raises critical ethical and privacy questions:

- **Who is responsible for data collection?**
- **How is this data utilized? and**
- **What measures are in place to protect residents' personal information?**

During the early stages of smart city initiatives, residents were frequently regarded solely as data sources for urban platforms, resulting in concerns about consent and privacy. Compounding these concerns, the swift advancement of smart neighbourhood technologies often surpasses existing privacy regulations. At the same time, private technology firms, which are pivotal in these initiatives, frequently assert ownership of the data, which further diminishes public transparency and oversight.

In response to these challenges, there have been demands for more comprehensive data governance frameworks, including data trusts and the adoption of privacy-by-design principles in smart districts. The ethical and privacy implications of these issues are widely recognized, underscoring concerns regarding the increasing quantification of citizenship as data points. As we see, privacy emerges as a negative aspect, and I highly believe that smart neighbourhoods must establish strong privacy protections and community governance to safeguard against the erosion of personal data.

- **Overly Technocentric Planning**

In addition to data privacy and surveillance concerns, smart neighbourhood projects have also been criticized for their overly technocentric planning. This means that many of the initiatives being implemented in smart neighbourhoods favor technology and data over human-centric planning. This, then, suggests that the people who live in such a smart neighbourhood cannot be deemed smart if its technology fails to meet the needs of its inhabitants.

As we have seen, technology is overly used in the planning of the neighbourhoods. We also must admit that it is because of the technology that this redevelopment of urban plans is made possible. However, it is important to include a more humane, hypothesis-driven methodologies in planning smart cities, as this would mean that people's real needs and well-being is a priority, or, as research suggests, smart neighbourhoods should make sure that technology serves communities rather than the other way around.

As a conclusion, for smart neighbourhoods to not have these problems, there should be a balance between digital innovation and rational urban planning principles, incorporating the insights of local residents while maintaining a realistic perspective on the capabilities and limitations of technology.

6.4 CRITERIA AND PROCESS FOR SELECTING NEIGHBOURHOODS

This research used a purposive, multi-stage case selection design to select in-depth analysis of twenty smart neighbourhoods (from an original pool of ~200). Since the number of possible cases was high, a systematic way of searching was implemented until the sample was reduced according to the objectives of the research. The process was intended to address various urban contexts as well as themes within the smart urbanism spectrum, in addition to being pragmatic in responding to criteria of practice (in terms of recency and data availability). (See Appendix – Research Catalogue 3).

The selection of these >200 neighbourhoods was based on specific criteria: geographical diversity throughout Europe, various neighbourhood categories (brownfield, greenfield, suburb, rural, mixed-use, or historic or preservation districts), different sizes and populations, and varying smart objectives such as environmental sustainability, innovation, social inclusion, and quality of life. Additionally, neighbourhoods with sufficient and reliable data about their smart programs were prioritized.

1. **The research first presents a long list gathering >200 candidate neighbourhoods in Europe.** The original pool was designed to ensure diversity with respect to urban setting and possible relevance to smart urbanism. With that being said, it includes an extensive range of urban typologies, such as new developments in greenfield sites, regenerated brownfield areas, established suburbs, rural towns, and even historical city quarters. The selection was done to represent different scales and urban morphologies. The research also attempted to achieve thematic diversity, so the conceptual framework would cover various smart urbanism aims (e.g., energy-saving eco-districts, digitally smart quarters, socially smart neighbourhoods etc.). All the candidates in the first set were found to have some type of smart program or innovation initiative in their development, which makes them part of the sample.

2. Chronological Refinement (100 cases) – In the preliminary refinement phase, the research categorized the 200+ cases by date of development in order to limit the review to only the most relevant to current conditions of smart urbanism. With this being said, only the neighbourhoods that were built, heavily rebuilt, or in progress of built between 2005 and 2023 remained in the pool. This 2005–2023 date range correlates with the time when formal smart city and smart urbanism agendas became more salient, most notably across Europe, and as such, the application of this criterion sampling filter guaranteed that all the cases selected presented the new trends and technologies for smart urban development. This way, projects developed outside this time period (such as earlier ones from the 1990s) or more recent plans (which are undergoing the planning process) were ruled out in order to focus the analysis on similar (post-2005) implementations of smart urban paradigms. As a result of this test, the list was reduced to an estimated 100 neighbourhoods that did meet the historical eligibility test.

3. Thematic and Data Screening (20 Sites) – Subsequently, a second targeted screening was implemented in order to choose 20 neighbourhoods to further investigate. In this phase, cases were selected in order to cover a variety of themes, to represent different urban typologies, and to guarantee an adequate availability of data. Therefore, these neighbourhoods have been intentionally selected to represent a wide variety of smart city themes. For instance, some of the cases emphasize environmental sustainability (such as positive-energy or carbon-neutral districts), while others emphasize digital innovation and ICT infrastructure, social inclusion, or governance reforms. This guarantees that the final set of 20 cases does fairness to the diversity of smart urbanism as a category, rather than focusing on one aspect of it. (See Appendix – Research Catalogue 3).

The research methodically balanced the sample by urban context, encompassing large metropolitan districts, medium-sized city neighbourhoods, and smaller towns to represent various scales and environments. Importantly, data availability was chosen as an inclusion criterion: neighbourhoods in which we did not find enough documentation or available information were removed at this stage. Cases were selected based on the abundance of available data, specifically instances where substantial publicly accessible information existed in the form of project reports, academic publications, official websites, or open data portals, facilitating comprehensive analysis.

Finally, the research also removed redundant cases caused by an overlap with repeated characteristics. For example, if several invasive propositions or features were presented in very similar ways by several or many neighbourhoods, only 1 or 2 examples of each category were retained to prevent duplication. Thus, the twenty neighbourhoods left fulfill all of the mentioned criteria - varying in theme and typology, well - documented, and clearly exemplifying the variety in smart urban development practices.

To conclude, such an elaborate selection workflow guarantees that the 20 neighbourhoods this research selected, represent a wide and varied sample of smart urbanism in Europe and can be feasibly studied due to data availability and recency. This methodology aligns with established qualitative sampling frameworks; specifically, we employed a blend of criterion sampling (with explicit inclusion criteria regarding time frame and data sufficiency) and purposeful maximum variation sampling to encompass a range of contexts and themes.

6.5 COMPARATIVE ANALYSIS OF THE 20 NEIGHBOURHOODS

This section of the research presents a comparative analysis of 20 smart neighbourhoods, chosen based on criteria including sustainability, transportation, green spaces, energy efficiency, and community engagement, among other smart principles. With that being said, the following analysis aims to identify trends, similarities, and differences among these neighbourhoods, thereby offering a thorough understanding of the efficacy of various smart urban planning strategies.

The objective of this chapter is to research these twenty neighbourhoods in-depth by contrasting smart initiatives with traditional urban planning principles. To achieve this, this chapter will demonstrate the substantial transition from traditional urban planning methods to smart urban planning by analyzing the integration of advanced technologies, sustainable methodologies, and data-driven decision-making in these neighbourhoods.

Ultimately, this analysis will address critical questions that are vital for understanding the evolution of urban planning in the context of smart neighbourhoods:

- **What has changed in urban planning from being smart?**
- **Have smart people changed the way smart neighbourhoods are planned?**
- **What problems do smart neighbourhoods solve?**

By closely researching these neighbourhoods, this research will also highlight potential negative consequences that urban planners should consider while illustrating best practices that have emerged across different contexts. This includes examining how each neighbourhood incorporates green spaces, promotes walkability, enhances energy efficiency, and fosters a sense of community. By making this comparison, the research will be able to identify common themes and distinctive strategies that either help or hinder smart urban development.

6.5 OVERVIEW OF SELECTED NEIGHBOURHOODS

6.5.1 ASPERN SEESTADT (VIENNA, AUSTRIA)

Aspern Seestadt is one of the first smart neighbourhoods in Europe and is located in Vienna, Austria. With over 240 hectares and an investment of around 5 billion euros, this smart district of Vienna is one remarkable urban plan in which around 9,400 currently reside, with the aspiration to reach over 25,000 by 2030. Besides population, Aspern Seestadt is also offering around 4,000 employment opportunities, and by 2030, this district is hoping to generate an additional 20,000 jobs. As we can see, Aspern Seestadt is positioning Vienna as one of the most advanced smart neighbourhoods. To support this, the neighbourhood of Aspern Seestadt also received the price "Best Smart Project" in 2016 by World Smart City Awards. Previously an airfield, the planners of Aspern Seestadt saw a huge potential for the neighbourhood to be transformed into a smart neighbourhood, with a focus on sustainability, urban mobility solutions, and energy-efficient living.

— **Changes in Urban Planning from Being Smart**

Aspern Seestadt is an example that transformed the traditional methods of urban planning into a smart approach. Since Aspern Seestadt was once an airfield, it mostly focused on the construction of physical infrastructures rather than providing more integrated approaches. With that being said, due to this transformation, Aspern Seestadt embraces a full-scale model by prioritizing community engagement, sustainability, and cutting-edge technology. One notable initiative is the implementation of smart grids and advanced information and communication technology (ICT). By employing such principles, Aspern Seestadt is offering better communication between buildings and utilities, paving the way for more efficient and responsive energy distribution. With this being said, Aspern Seestadt now is an example of smart buildings that optimize energy consumption, show sustainability, and enhance urban management. As mentioned, sustainability is another cornerstone of Aspern Seestadt's design. The smart district of Aspern includes ecological principles in its planning, including sustainable stormwater management systems, green spaces, and green roofs. This emphasis on environmental sustainability enhances urban aesthetics and strengthens climate resilience through the integration of renewable resources. In addition to improving the community's resilience to climate impacts, the emphasis on effective stormwater solutions and extensive green spaces has also significantly improved the quality of the environment.

In the same vein, Aspern Seestadt also echoes its commitment to community engagement. As the neighbourhood includes many mixed-used buildings such as residential, commercial, and recreational spaces, this encourages the residents of Aspern to voice their concerns in the planning process and makes them feel a sense of ownership.

— **Influence of Smart People on Planning Smart Neighbourhoods**

The smart people of Aspern embrace and adapt to the cutting-edge technologies that are used in the neighbourhood. As Aspern Seestadt is highly influenced by the new technology, the residents, or the "smart people", are encouraged to participate in the decision-making process in order to make sure that their needs are met. Such collaboration between the residents of Aspern Seestadt and the planners of the neighbourhood showcases how much the neighbourhood is dedicated to user-centered innovation, where residents play a crucial role in the acceptance and usability of new technologies through participatory research. In addition, the residents are welcome to provide continuous constructive feedback to the planning committee. This is made possible by the continuous feedback mechanism, which enables the residents to actively participate in the creation of their surroundings. As a result, not only does this collaborative process improve the functionality of the neighbourhood, but it also fortifies community bonds.

— **Problems Solved by Smart Neighbourhoods**

Aspern Seestadt is a smart neighbourhood that is forward-thinking and effectively addresses urban challenges by integrating sustainable practices with innovative technology. Specifically, by emphasizing renewable energy and energy-efficient design, the community substantially reduces its carbon footprint, demonstrating a robust commitment to environmental sustainability. This environmental focus is further reinforced by sophisticated waste management systems that include recycling and waste-to-energy initiatives, which streamline resource use and reduce landfill reliance. In terms of transportation, Aspern Seestadt actively promotes alternative mobility solutions. By doing so and by promoting cycling, walking, and public transportation, the neighbourhood seeks to reduce dependence on private vehicles, thus mitigating traffic congestion. In addition, the incorporation of electric vehicle (EV) charging stations and car-sharing alternatives enhances this sustainable mobility framework, facilitating residents' adoption of eco-friendly transportation options. Beyond transportation, the neighbourhood features green spaces, parks, and recreational amenities that improve residents' quality of life and promote their overall well-being. Complementing these physical features, the integration of smart health services, including health monitoring systems and telemedicine, guarantees that quality healthcare is accessible to residents, which is essential for the well-being of the community. Lastly, the emphasis on green infrastructure, which encompasses environmental sustainability and biodiversity, is in accordance with the extensive green infrastructure of Aspern Seestadt.

— **Implementation of Smart Urban Planning Principles**

Aspern Seestadt exemplifies innovative urban planning, effectively embodying principles that promote a resilient, livable, and sustainable community. The neighbourhood's commitment to environmental sustainability is evident through its expansive green spaces, green roofs, and advanced stormwater management systems. This dedication enhances the aesthetic appeal and contributes to ecological balance. Through a concentration on mixed-use developments and high-quality housing, the concept of smart living is realized, with the intention of fostering community interaction and participation. This is consistent with Arnstein's framework on citizen engagement, as Aspern Seestadt actively encourages resident participation through community engagement initiatives and feedback mechanisms. These participatory methods empower residents by ensuring that their voices influence the development of their environment. Moreover, the design of Aspern Seestadt is fundamentally based on the principles of compact city planning. This planning approach is evident by prioritizing sustainable development, mixed land use, and high density. As a result, the project not only enhances social connectivity but also supports environmental and economic sustainability. Furthermore, in Aspern Seestadt, sustainable mobility is enhanced by infrastructure that supports electric vehicles, pedestrian pathways, cycling routes, and public transportation. This approach to transportation reflects a commitment to reducing carbon footprints and promoting healthier lifestyles. Additionally, the neighbourhood's governance model exemplifies smart governance through active resident participation and ongoing feedback loops, ensuring that community needs are continuously addressed.

Lastly, the economic growth of Aspern Seestadt is enhanced by innovation hubs and spaces that are specifically designed for high-tech industries and startups, thereby fostering a dynamic local economy. In addition to economic growth, the integration of educational facilities and social infrastructure promotes lifelong learning and community engagement. In summary, Aspern Seestadt implements numerous smart urban planning principles to establish a resilient, livable, and sustainable urban environment. These principles are summarized below.

Smart Environment: Aspern Seestadt is making major steps in biodiversity enhancement and environmental sustainability by incorporating extensive green spaces, green roofs, and cutting-edge stormwater management systems.

Smart Living: The housing units in Aspern exemplify modern sustainability standards, demonstrating a dedication to high-quality living. This area is designed with a mixed-use approach, fostering a vibrant community where residential, commercial, and recreational spaces harmoniously coexist. Furthermore, active community engagement initiatives ensure that the development aligns with the needs and desires of local residents, creating a more inclusive and responsive environment.

Smart People: Establishing robust social infrastructure and educational institutions is crucial for fostering an engaged and smart community. In Aspern Seestadt, a thriving community hinges on the promotion of social connections and continuous learning, both of which are facilitated by schools, kindergartens, and community centers.

Smart Mobility: Aspern Seestadt is a prime example of a progressive approach to urban mobility, as it prioritizes public transit, cycling, and walking as essential components of sustainable transportation. To support this vision, the area is designed with pedestrian-friendly zones and expansive bike lanes, which promote healthier lifestyles and reduce dependence on cars. Additionally, the integration of a robust public transportation network enhances accessibility and convenience for residents.

Smart governance: The governance model of Aspern Seestadt emphasizes the importance of engaging residents in the decision-making process. Community engagement tools and participatory research initiatives are integrated into the model to guarantee that residents have a say in the development of their surroundings. In addition to fostering a sense of ownership among community members, this approach also enables the development to be responsive and adaptable to their needs.

Smart Economy: The integration of innovation hubs, research centers, and environments tailored for high-tech startups within the neighbourhood fosters significant economic growth. This strategic development positions Aspern Seestadt as a pivotal hub for business and technological advancement.

6.5.2 NORDHAVN (COPENHAGEN, DENMARK)

Nordhavn is another example of a smart neighbourhood, which is set in the harbor area of Copenhagen, Denmark. With around 40,000 residents and only 5-minutes away from the city, the district of Nordhavn has undergone a remarkable transformation, as it used to be an industrial port prior to becoming one of the most vibrant communities to live in. With a focus on smart living and sustainability, the district is also known for its “5-minute city” philosophy, which indicates that all basic services are only 5 minutes away and are accessible by either walking or biking. In this way, Nordhavn is promoting sustainable transportation modes rather than the traditional use of personal cars. Moreover, Nordhavn focuses on sustainable ecosystem that integrates different smart principles such as mixed-use buildings, cutting-edge technology, transportation, etc. Ultimately, spanning approximately 200 hectares, this redevelopment project repurposes a former industrial port and transforms it into a mixed-use community with a focus on environmental sustainability, social diversity, and green mobility.

— **Changes in Urban Planning from Being Smart**

Nordhavn is an example of redevelopment in urban planning, transitioning from traditional methods that primarily focused on land use and infrastructure functionality. Instead Beyond traditional methods, this smart district embraces a holistic approach that prioritizes community engagement, sustainability, and technological innovation. For example, it integrates various energy systems, optimizes renewable energy utilization through the implementation of smart grids and advanced energy infrastructures, demonstrates a commitment to technology-driven urban management that improves energy distribution and control, and many other smart principles. Nordhavn's initiatives show that sustainability is central to its planning. We assert this because these initiatives utilize green and blue infrastructure, including permeable pavements, green roofs, and advanced water management systems, to enhance ecological connectivity and strengthen urban resilience. Additionally, Nordhavn also emphasizes renewable energy sources, such as solar and wind power, along with climate-responsive designs, underscoring a proactive approach to minimizing environmental impact. This extensive strategy redefines urban living and establishes a standard for future advancements in sustainable city planning.

— **Influence of Smart People on Planning Smart Neighbourhoods**

The involvement of local residents, often referred to as "smart people," is crucial for the evolution of Nordhavn. The project employs a participatory model that incorporates community insights into urban planning and technological advancements, prioritizing the needs and desires of its residents. This approach cultivates a collaborative atmosphere in which residents participate via public forums and feedback sessions, guaranteeing that innovations are customized to improve user experience and community approval. Moreover, this active participation improves the functionality of new technologies and cultivates a stronger sense of ownership among community members. For instance, the Energy Lab Nordhavn initiative exemplifies such engagement by incorporating local feedback in the development of smart energy solutions, ensuring that these systems are both practical and aligned with the community's requirements. Ultimately, this collaborative framework not only drives innovation but also involves local residents in testing and providing feedback on smart energy technologies and systems.

- **Problems Solved by Smart Neighbourhoods**

Nordhavn exemplifies a forward-thinking approach to urban development, prioritizing environmental sustainability and community well-being. Its design integrates renewable energy sources and energy-efficient construction methods to significantly reduce carbon emissions, reflecting a commitment to ecological responsibility. The project also tackles transportation challenges by promoting sustainable options such as walking, cycling, and public transit, which not only diminishes reliance on cars but also alleviates traffic congestion. Furthermore, Nordhavn enhances the quality of life for residents by incorporating ample green spaces and water features that encourage outdoor activities and foster social connections. This focus on recreational areas is crucial for community engagement and mental well-being. Additionally, the inclusion of educational institutions and advanced health services underscores a holistic approach to urban living, emphasizing lifelong learning and the overall well-being of the residents.

- **Implementation of Smart Urban Planning Principles**

Below are presented the ways Nordhavn implements several smart urban planning principles to create a sustainable and livable environment and how these urban innovations are linked with smart dimensions.

Smart Environment: The urban planning guidelines for Nordhavn, which were established in 2021, underscore the significance of incorporating comprehensive green and blue infrastructure, such as permeable pavements, green roofs, and effective water management systems. In addition to bolstering ecological connectivity, these components also improve the resilience of urban environments. Furthermore, the utilization of renewable energy sources, such as solar panels and wind turbines, is a significant factor in Nordhavn.

Smart Living: Nordhavn's approach to smart living is fundamentally anchored in three pivotal aspects: fostering community involvement, promoting mixed-use spaces, and ensuring the availability of high-quality housing. By prioritizing these elements, Nordhavn enhances social interactions among residents and tailors the development to align with their specific needs and preferences.

Smart People: Investing in social infrastructure, educational resources, and community-building efforts is essential for fostering a culture of lifelong learning within a community. Such initiatives are pivotal in cultivating an informed and actively engaged populace. This engagement is not just beneficial but crucial for the development of the community.

Smart Mobility: The project prioritizes the development of robust public transit systems, extensive bike lanes, and walkable streets, emphasizing the significance of sustainable transportation options. In the same vein, it acknowledges the importance of promoting clean energy transportation, which is why it includes the development of smart charging stations and infrastructure for electric vehicles.

Smart governance: Smart governance thrives on the principle of engaging residents in the planning stages, facilitated by open forums and avenues for feedback. This approach ensures that community development aligns closely with the actual needs and desires of the people it affects. By prioritizing active participation, smart governance not only fosters transparency but also cultivates a sense of ownership among residents.

Smart Economy: Nordhavn's economic growth is significantly bolstered by its array of research centers and innovation hubs, which are specifically designed to support high-tech industries. These facilities not only promote technological advancements but also encourage business development, positioning Nordhavn as a key player in sustainable economic practices.

6.5.3 MERWEDE (UTRECHT, NETHERLANDS)

Merwede is another smart neighbourhood located in Utrecht, the Netherlands, and is a pioneering car-free neighbourhood that prioritizes pedestrians and cyclists; in this way, it fosters a sustainable lifestyle for its 12,000 residents. The goal of this smart neighbourhood is to establish a healthier community by emphasizing the reduction of resource consumption and waste. Thus, the plan of Merwede includes plenty of green spaces and ensures that essential services are easily accessible by foot or bike.

— **Changes in Urban Planning from Being Smart**

Throughout the years, Merwede's urban planning has undergone a notable transformation by adopting smart principles that prioritize pedestrians, cyclists, and public transport over the traditional transportation methods such as cars. Merwede has achieved a significant milestone by limiting the number of parking spaces to three per ten households. This change is intended to promote shared mobility options, such as bike and car sharing. This method is consistent with a more general trend in urban design that is designed to cultivate sustainable and walkable communities. In addition, the incorporation of green spaces improves the well-being of residents by improving the visual appeal and environmental quality of the area.

— **Influence of Smart People on Planning Smart Neighbourhoods**

The success of Merwede is built upon the active engagement of its residents, who proactively adopt new technologies, as their involvement is essential for the proper coordination of urban planning with the needs of the community. Furthermore, in order to foster sustainable practices, Merwede emphasizes participatory design and feedback, which allows residents to influence development. such as shared transportation and cycling, and fostering ownership. This collaborative approach is key to the neighbourhood's smart initiatives.

— **Problems Solved by Smart Neighbourhoods**

Merwede addresses urban challenges through the implementation of sustainable practices and innovative technologies, with a focus on reducing traffic congestion and carbon emissions. Merwede's plan includes promoting alternative modes of transportation and reducing car usage, with the goal of improving air quality and lowering the smart neighbourhood's carbon footprint. In the social aspect, Merwede emphasizes inclusive public spaces that encourage community interaction and accessibility. It is designed to ensure that essential services are conveniently located, thereby reducing the length of commutes and fostering a sense of community.

— **Implementation of Smart Urban Planning Principles in Merwede**

Merwede successfully applies smart urban planning principles to create a sustainable and vibrant community. Below are presented principles and their specific implementations in Merwede.

Smart Environment: The neighbourhood features ample green areas, green roofs, and effective stormwater management, all aimed at promoting sustainability.

Smart Living: The development aims to create sustainable housing that meets modern standards. By incorporating mixed-use spaces, it creates a vibrant community with easy access to essential services and amenities.

Smart People: In Merwede, educational facilities and community activities encourage resident involvement and continuous learning; thus, the plan of this smart neighbourhood includes strong social infrastructure, which, as they believe, is key to creating an informed and active community.

Smart Mobility: The plan of Merwede focuses on cycling, walking, and public transport instead of private cars. This approach requires bike lanes, pedestrian-friendly areas, and efficient public transit systems.

Smart Governance: Community members use platforms that encourage participation and design, which allows for ongoing feedback to ensure that development meets their needs.

Smart Economy: Innovation hubs, research facilities, and high-tech startup spaces will be integrated to stimulate economic growth and establish Merwede as an innovation hub.

6.5.4 NIEUW ZUID (ANTWERP, BELGIUM)

Nieuw Zuid is a pioneering urban district in Antwerp, Belgium, covering 44 hectares and intended for approximately 5,000 inhabitants. The plan of Nieuw Zuid is to emphasize mixed-use development: blending residential, commercial, and recreational areas to foster a lively community. This project reflects Antwerp's dedication to sustainable urban planning, featuring ample green spaces, smart mobility options, and efficient energy management systems.

— **Changes in Urban Planning from Being Smart**

Nieuw Zuid's urban planning has evolved to incorporate smart principles, transitioning from traditional methods focused solely on infrastructure expansion. The neighbourhood of Nieuw Zuid, as seen in their initiatives, prioritizes sustainability, technology, and community involvement, with key features including energy-efficient buildings equipped with smart systems that monitor energy use. Additionally, Nieuw Zuid integrates extensive green infrastructure like green roofs and vertical gardens, enhancing both aesthetics and environmental health by improving air quality and supporting biodiversity. The planning also emphasizes climate resilience through renewable energy and adaptive designs, ensuring the area can respond effectively to environmental changes.

— **Influence of Smart People on Planning Smart Neighbourhoods**

The role of smart people in Nieuw Zuid's development has greatly influenced the neighbourhood's planning. The residents of Nieuw Zuid engage in decision-making through community platforms, and they make sure that their needs are met in order for them to feel a sense of ownership. As we have seen in other smart neighbourhoods as well, this participatory approach is vital for effectively implementing smart technologies and sustainable practices. Furthermore, the contributions from the residents have resulted in innovative solutions that address the community's needs. For instance, the neighbourhood promotes shared mobility services like car-sharing and bike-sharing to streamline traffic and reduce environmental impact.

— **Problems Solved by Smart Neighbourhoods**

Nieuw Zuid addresses urban challenges using innovative and sustainable development strategies, with a strong emphasis on environmental sustainability. The neighbourhood's energy-efficient buildings, renewable energy sources, and effective waste management systems are all designed to reduce its environmental footprint. On the other hand, smart grids and energy monitoring improve resource efficiency and reduce greenhouse gas emissions. Additionally, mobility is a key focus in this smart neighbourhood. The master plan emphasizes infrastructure for pedestrians and cyclists, promoting active transportation and decreasing dependence on cars. Public transportation is included in the Nieuw Zuid plan because it provides residents with convenient access while alleviating traffic congestion. These initiatives improve the quality of life by providing safe and sustainable transportation options.

— **Implementation of Smart Urban Planning Principles**

Nieuw Zuid effectively implements various smart urban planning principles to create a sustainable, livable, and resilient neighbourhood. The text below serves as an illustration of all principles.

Smart Environment: The neighbourhood's design incorporates green spaces and sustainable features like green roofs and stormwater management as these elements enhance biodiversity, air quality, and climate resilience.

Smart Living: Modern housing units in Nieuw Zuid are constructed with sustainability in mind, as it has the potential to cultivate vibrant communities. By integrating mixed-use spaces, residents have easy access to essential services and amenities, and by engaging the community in the development process helps ensure that projects align with their needs and preferences.

Smart People: In Nieuw Zuid, educational facilities, social infrastructure, and community-building activities foster resident engagement, lifelong learning, and social cohesion, enhancing the neighbourhood's success.

Smart Mobility: The focus of smart mobility in Nieuw Zuid is to promote sustainable mobility by prioritizing walking, cycling, and public transportation through well-designed infrastructure such as bike lanes and efficient transit systems.

Smart Governance: Residents engage in community platforms and feedback loops to ensure the neighbourhood adapts to their evolving needs.

Smart Economy: The integration of innovation hubs, research centers, and workspaces for startups and high-tech companies in Nieuw Zuid aims to foster economic growth and position the area as a center of innovation and technological advancement.

6.5.5 CLICHY-BATIGNOLLES (PARIS, FRANCE)

Located in the 17th arrondissement of Paris, Clichy-Batignolles is a significant urban renewal initiative that encompasses 54 hectares of repurposed railway land. Its objective is to cultivate a sustainable mixed-use neighbourhood. In addition to the integration of residential, commercial, and recreational spaces, this ambitious project seeks to generate 12,700 jobs and accommodate approximately 7,500 residents, thereby fostering a vibrant urban environment. With a strong emphasis on sustainability, innovation, and community involvement, Clichy-Batignolles stands as a pioneering example of smart urban planning in Paris, reflecting a forward-thinking approach to creating inclusive, resilient, and environmentally responsible neighbourhoods.

— **Changes in Urban Planning from Being Smart**

The incorporation of smart principles has profoundly altered urban planning in Clichy-Batignolles, shifting from a conventional emphasis on infrastructure and amenities to a paradigm that prioritizes sustainability and technology. The neighbourhood of Clichy-Batignolles features energy-efficient buildings, green spaces, and smart grids, designed to enhance energy efficiency and lower carbon emissions, reflecting a commitment to advanced environmental planning. Moreover, Clichy-Batignolles promotes a walkable and bike-friendly atmosphere, as it is its goal to decrease dependence on private cars while encouraging sustainable transportation options. The integration of public transit in the neighbourhood enhances accessibility to the city, thereby reducing traffic congestion.

— **Influence of Smart People on Planning Smart Neighbourhoods**

The involvement of residents, often referred to as "smart people," is crucial in shaping the Clichy-Batignolles smart neighbourhood, as their engagement guarantees that urban planning aligns with the actual needs and desires of the community. By incorporating public consultations, workshops, and feedback mechanisms, this smart neighbourhood not only empowers residents but also cultivates a strong sense of ownership and community involvement. As we have seen in other similar initiatives of smart neighbourhoods, this collaborative approach enables the development of innovative solutions that are specifically designed to meet the needs of the community.

— **Problems Solved by Smart Neighbourhoods**

Clichy-Batignolles exemplifies innovative and environmentally friendly urban planning that addresses a variety of city challenges. The neighbourhood prioritizes environmental sustainability, with energy-efficient buildings, renewable energy, and advanced waste management systems. Its design includes green roofs, parks, and efficient water management, which improves air quality and promotes urban biodiversity. Moreover, the project effectively addresses mobility concerns by fostering walking, cycling, and public transport use, which solves traffic jams and reduces toxic gas emissions. The integration of mixed-use developments, affordable housing, and communal spaces encourages social interaction and inclusivity, ultimately enriching the community's social inclusion.

— **Implementation of Smart Urban Planning Principles in Clichy-Batignolles**

Smart Environment: The Clichy-Batignolles neighbourhood enhances urban biodiversity and environmental sustainability through extensive green spaces, green roofs, sustainable water management systems, and the integration of renewable energy sources.

Smart People: Educational facilities and community activities in Clichy-Batignolles promote resident engagement, lifelong learning, and social cohesion.

Smart Living: The development features high-quality, sustainable housing units and mixed-use spaces that foster community engagement and provide essential services and amenities for residents.

Smart Mobility: Clichy-Batignolles promotes sustainable mobility options involves prioritizing walking, cycling, and public transportation through the development of infrastructure such as bicycle lanes, pedestrian paths, and efficient transit systems.

Smart Governance: In Clichy-Batignolles, residents engage in public consultations and workshops to ensure the neighbourhood evolves according to their changing needs.

Smart Economy: Clichy-Batignolles focuses on the integration of commercial spaces, offices, and local businesses, promoting economic growth and job creation in the neighbourhood.

6.5.6 SCHUMACHER QUARTIER (BERLIN, GERMANY)

Schumacher Quartier is another example of an urban redevelopment, set on the grounds of Berlin's former Tegel Airport. This smart neighbourhood is aiming to build houses to accommodate around 10,000 people while at the same time hoping to create around 5,000 job opportunities. Being a vibrant residential neighbourhood, Schumacher Quartier is making a huge step in terms of urban development, as, like other smart neighbourhoods, it is focusing on smart approaches such as sustainability, technology, and transportation. With a remarkable commitment to innovative urban regeneration, the former airport, now the smart district of Schumacher Quartier, plans to shift the traditional approach of city planning as it prioritizes sustainability, digital integration, and inclusive community living.

— **Changes in Urban Planning from Being Smart**

The transition to smart urban planning at Schumacher Quartier marks a significant shift in how we think about and design cities. As we already know, in the past, urban development usually focused on infrastructure rather than innovation and adaptability. Now, it's more than natural that smart neighbourhoods will prioritize innovation and adaptability, as these neighbourhoods are taking a more flexible and responsive approach in order to create a vibrant urban environment. With that being said, Schumacher Quartier is an example of transforming the traditional focus of infrastructure into, for example, the incorporation of renewable energy systems like solar panels and smart grids, which not only aligns with global trends toward energy efficiency but also fosters resilience in urban settings. By prioritizing such changes, Schumacher Quartier is setting a standard for future developments, demonstrating that cities can be both environmentally sustainable and highly functional.

— **Influence of Smart People on Planning Smart Neighbourhoods**

The smart people of Schumacher Quartier play an important role in the development of the neighbourhood. One of the reasons why Schumacher Quartier is this successful is because of its commitment to participatory planning, which invites residents to contribute their insights and feedback through various channels. Even from other initiatives such as those in Aspern Seestadt, Merwede, and others, we have noted that such an inclusive approach not only empowers individuals but also ensures that the urban design and technological solutions implemented truly resonate with the community's needs and aspirations. With this being said, we highly believe that this collaborative model is crucial in the smooth changing urban environment of today, as it acknowledges that the people residing in a space are the most adept at understanding its challenges and opportunities.

— **Problems Solved by Smart Neighbourhoods**

Since Schumacher Quartier is challenging the traditional norms of urban planning, along with other smart neighbourhoods, the district is tackling many challenges that are faced by modern cities, including environmental sustainability. With environmental sustainability, Schumacher Quartier is prioritizing renewable energy sources and constructing energy-efficient buildings in order to reduce the carbon footprint. Such progress is not just a trend but a necessary shift towards a more sustainable future, as urban areas are often major contributors to greenhouse gas emissions. Moreover, the integration of advanced waste management systems and urban agriculture initiatives plays a vital role in promoting sustainability. These systems not only encourage recycling but also encourage local food production.

— **Implementation of Smart Urban Planning Principles**

Schumacher Quartier employs various smart urban planning principles to establish a sustainable urban environment.

Smart Environment: Schumacher Quartier has employed extensive green roofs, urban agriculture, sustainable stormwater management, and climate-responsive designs.

Smart People: In Schumacher Quartier, educational institutions, social infrastructure, and community development initiatives promote resident involvement and continuous learning.

Smart Living: Schumacher Quartier features high-quality residential units, mixed-use developments, and community engagement initiatives.

Smart Mobility: Schumacher Quartier actively advocates for cycling, walking, public transportation, and electric vehicle infrastructure.

Smart Governance: In Schumacher Quartier, residents actively engage in planning processes, provide ongoing feedback, and participate in research initiatives.

Smart Economy: Schumacher Quartier encompasses innovation hubs, research centers, and facilities for startups and high-tech industries.

6.5.7 MILANO INNOVATION DISTRICT (MILAN, ITALY)

The Milano Innovation District (MIND) is another neighbourhood set in Milan, Italy, which also is transforming an old site, in this case the former Expo 2015, into a modern, sustainable living community with around 1 million square meters. The goal of MIND is not only to renovate the former Expo 2015 with new buildings but also to show that by using a mixed-use environment, including public spaces, retail, offices, and buildings, the new neighbourhood is dedicated to fostering a culture of innovation and sustainability.

— **Changes in Urban Planning from Being Smart**

MIND is also an example of transformation from the traditional approaches into more modern and technology-driven approach. As MIND aims to create an environment that fosters sustainable growth, the urban planning will likely change a lot, starting with many smart initiatives such as ICT infrastructure, smart transportation systems, and smart grids, among others. Such innovation means that resources can be used more efficiently, urban systems can be monitored in real-time, and ultimately, the quality of life for everyone in the area can be significantly enhanced. Moreover, MIND is leading the way in sustainable urban development as it includes green building and renewable energy solutions. In my view, this is a refreshing departure from the traditional urban planning mindset, as it emphasizes many smart principles, including smart living and smart people.

— **Influence of Smart People on Planning Smart Neighbourhoods**

As we have seen in other successful smart neighbourhoods, Milano Innovation District also focuses on the smart people or the residents of its neighbourhood in order to make sure that all changes made are in line with the community’s needs. In addition, the presence of educational and research institutions in MIND creates a vibrant culture of innovation and continuous learning, as it fosters collaboration across different sectors, leading to the co-creation of solutions that enhance the district's resilience and adaptability. By prioritizing human-centric design and participatory planning, MIND demonstrates how smart people can influence the successful implementation of smart urban planning principles.

— **Problems Solved by Smart Neighbourhoods**

By integrating sustainable practices and smart technologies, MIND addresses a variety of urban challenges. One of the primary concerns that is addressed is the sustainability of the environment. Furthermore, the district's commitment to energy-efficient buildings, renewable energy, and green spaces enhances urban resilience to climate change and reduces its carbon footprint. Lastly, smart waste management systems and water recycling initiatives help the district achieve its sustainability goals.

— **Implementation of Smart Urban Planning Principles**

Smart Environment: The integration of green spaces, renewable energy, sustainable building practices, smart grids, and real-time environmental monitoring promotes enhanced sustainability in MIND.

Smart People: In MIND, educational and research institutions foster continuous learning and community engagement, while collaborative initiatives across sectors promote innovation and resilience.

Smart Living: The design of high-quality residential and commercial spaces in MIND, incorporates smart building technologies for energy efficiency and comfort, while multifunctional public areas encourage social interaction.

Smart Mobility: The focus of MIND includes enhancing sustainable mobility through public transportation, cycling, walking, and the integration of intelligent transportation systems and EV charging stations.

Smart Governance: Active stakeholder engagement and participatory planning, along with continuous feedback mechanisms, are essential for ensuring that the district meets the needs of its residents in MIND.

Smart Economy: Milan is enhancing its status as a leading innovation hub by establishing innovation hubs, research centers, and spaces for start-ups and high-tech industries, which promotes economic growth.

6.5.8 BRAINPORT (EINDHOVEN, NETHERLANDS)

The new multi-faceted district of Brainport will focus on urbanity and welfare – two important principles of smart neighbourhoods. By offering many housing options, jobs, and shopping malls, as well as educational facilities, all in the heart of Eindhoven – the Brainport Smart District, will be the innovative living and working community where the urban greenery is carefully planned together. Set in Eindhoven, with over 80 hectares for growing food, with water storage, nature, and energy generation, Brainport stands in the intersection of innovation, sustainability, and quality of life – all these rooted in a shared aspiration of many industry leaders and visionary policymakers to transform the former industrial land into a dynamic ecosystem of progress, and as architects of Brainport say, it all emerged as a response to the challenges of the 21st century.

— **Changes in Urban Planning from Being Smart**

Ever since the inauguration of Brainport as a smart district, many initiatives got off the ground, each contributing to Brainport's strategy – to create a sustainable living for its residents. From the beginning, urban infrastructure has been the priority for Brainport's progress and that included smart transportation systems, intelligent energy management, and data-driven urban planning. Such developments have reduced emissions, and with that in mind, Brainport's urban mobility is more efficient and environmentally friendly. Secondly, energy-efficient buildings also had a great priority for Brainport in order to reduce energy consumption and enhance residents' comfort and ultimately, their sustainability. In addition to Brainport's priorities, many other projects were set up in Brainport, making Brainport stand as a living testament to the remarkable synergy between human ingenuity and technology-driven progress. As Brainport has an adaptable plan, the process and plan rely a lot on the community's feedback as this cooperation fosters a sense of ownership, promotes innovation, and makes sure that all new projects are aligned with the needs of the residents. With that being said, many needs assessments need to be conducted to understand the challenges and opportunities that the locals have. In addition to this, urban forms weave together harmoniously to create a comfortable environment for the community. As a result, Brainport is committed to balancing technological progress with nature's tranquility as parks, gardens, and green corridors interlace with the city.

— **Influence of Smart People on Planning Smart Neighbourhoods**

Engaging smart people, including residents and businesses, is essential for the planning and growth of the smart neighbourhood of Brainport, as their involvement in co-design ensures that the neighbourhood meets the actual needs of its residents. With this approach, Brainport ensures that their residents have a cohesive and resilient community. Moreover, as we have also seen from other case neighbourhoods, the collaboration among government, academia, industry, and citizens - known as the quadruple helix approach - enhances innovation and social inclusion. Thus, even in Brainport, the participatory process has led to a flexible urban environment that prioritizes the well-being and engagement of its citizens.

— **Problems Solved by Smart Neighbourhoods**

By integrating sustainable practices with smart technologies, Brainport prioritizes environmental sustainability by implementing circular economy principles, waste management solutions, and renewable energy to minimize carbon emissions and address urban challenges. In the same vein, the smart neighbourhood also promotes sustainable transportation with infrastructure for cycling, walking, and electric vehicles, alleviating mobility issues and enhancing air quality. Brainport also encourages community engagement by creating inclusive spaces such as public areas and community gardens, which promote social interaction and cohesion. This approach not only strengthens community ties but also effectively addresses social and environmental issues, resulting in a thriving urban environment.

— **Implementation of Smart Urban Planning Principles**

Smart Environment: Brainport promotes environmental sustainability through green spaces, sustainable stormwater management, renewable energy systems, and circular economy principles for resource efficiency.

Smart People: Brainport focuses on enhancing educational facilities, social infrastructure, and community-building initiatives to foster resident engagement and lifelong learning for a vibrant community.

Smart Living: Brainport's design prioritizes high-quality housing, mixed-use development, and community engagement to create a sustainable and high-quality living environment for its residents.

Smart Mobility: Brainport promotes sustainable transportation by encouraging cycling, walking, public transportation, and EV charging infrastructure to reduce reliance on private vehicles.

Smart Governance: To ensure that development meets community needs, Brainport's governance model prioritizes active resident involvement, ongoing feedback, and participatory research.

Smart Economy: The neighbourhood of Brainport encourages economic growth and technological innovation by incorporating innovation hubs, research centers, and space for startups and high-tech businesses.

6.5.9 ÜBERSEEINSEL (BREMEN, GERMANY)

Überseeinsel is a new neighbourhood set in Bremen, Germany. Formerly known as Kellogg-Areal, the new neighbourhood is focusing on reducing waste and resource use, as it is intended to be a sustainable neighbourhood with a diverse population. The neighbourhood has green areas, energy-efficient homes, and practical architecture influenced by the region's industrial past.

— **Changes in Urban Planning from Being Smart**

Überseeinsel represents a remarkable shift from the traditional urban planning of Kellogg-Areal to the new smart neighbourhood of Überseeinsel . With mixed-use buildings including residential, commercial, and industrial areas, the new neighbourhood focuses on sustainability, among other smart principles. The project incorporates smart technologies such as energy-efficient buildings and digital infrastructure, reflecting a forward-thinking approach to urban design that prioritizes sustainability. It also has plenty of green space and promotes environmentally friendly transportation options like cycling and walking paths, with the goal of lowering carbon emissions and improving residents' quality of life. This comprehensive strategy exemplifies an emerging trend toward sustainable urban development.

— **Influence of Smart People on Planning Smart Neighbourhoods**

Smart people play a vital role in shaping the Überseeinsel project, which emphasizes community involvement and participatory planning. By prioritizing the needs and preferences of residents in this neighbourhood, the project fosters regular feedback and engagement opportunities for citizens to influence decisions. Additionally, educational initiatives and social infrastructure are integrated to cultivate an informed and active community. These efforts encourage residents to participate in sustainable practices such as waste management and energy conservation, which are effectively integrated into the smart urban design process.

— **Problems Solved by Smart Neighbourhoods**

Smart neighbourhoods, such as Überseeinsel, address urban challenges by combining technology with environmentally friendly practices. As in other neighbourhoods, environmental sustainability is a key focus, with green roofs, advanced stormwater management, and renewable energy being used to reduce ecological footprints and increase resilience to climate change. Überseeinsel also promotes sustainable mobility by prioritizing pedestrian and bicycle infrastructure and providing access to efficient public transportation. This approach reduces reliance on automobiles, alleviates traffic congestion, and reduces carbon emissions.

— **Implementation of Smart Urban Planning Principles**

Smart Environment: The Überseeinsel neighbourhood features extensive green spaces, green roofs, sustainable stormwater management, and climate-responsive designs.

Smart People: The Überseeinsel neighbourhood features educational facilities, social infrastructure, and community-building activities that promote resident engagement and lifelong learning.

Smart Living: The Überseeinsel neighbourhood features high-quality housing units, mixed-use development, and community engagement initiatives.

Smart Mobility: The Überseeinsel neighbourhood is focused on promoting cycling, walking, public transport, and electric vehicle infrastructure.

Smart Governance: Residents of the Überseeinsel neighbourhood engage actively in planning processes through continuous feedback and participatory research initiatives.

Smart Economy: The Überseeinsel neighbourhood features the integration of innovation hubs, research centers, and spaces designed for startups and high-tech industries.

6.5.10 BAJES KWARTIER (AMSTERDAM, NETHERLANDS)

The makeover of the former Bijlmerbajes prison complex, designed by architect Jacoba Pot-Keegstra and finished in 1978, lies at the heart of Bajes Kwartier. This prison was made out of six towers linked by a central structure. During its height, it housed a slew of infamous criminals. However, as part of the Bajes Kwartier development project, the once-imposing prison experienced major alteration in recent years. The Bajes Kwartier project set out on a quest to revitalize the site by preserving the historical context of the former prison while incorporating modern design and green spaces. The construction design for the project includes roughly 70 gardens, emphasizing the integration of nature within the city. Bajes Kwartier hopes to become an exciting and appealing new neighbourhood rooted in the historical value of the former prison complex by paying homage to the past. The concept aspires to build a modern and forward-thinking area that effortlessly mixes the Bijlmerbajes' rich heritage with imaginative design elements and abundant natural spaces.

— **Changes in Urban Planning from Being Smart**

Bajes Kwartier aspires to be the most environmentally friendly city area in the Netherlands. In terms of energy, this district intends to build a smart grid system that maximizes renewable energy generation and distribution. This includes the installation of solar panels on rooftops, as well as the use of geothermal energy and new energy storage technology. Smart networks will enable for more efficient electricity management and distribution, maximizing energy usage and lowering total environmental impact. Because of the utilization of solar panels and other sustainable energy sources, the district is energy neutral. The district's 'thermal grid' transfers heat and cold.

Bajes Kwartier is being constructed circularly, with 98% of the materials from the existing jails being repurposed. Cell doors, for example, are utilized in bridges. Bajeskwartier is designed to be environmentally friendly and climate-adaptive. Progressive parties working on sustainability will continue to work on the city of the future here in the coming years. Bajes Kwartier's design emphasizes the establishment of green areas and the incorporation of nature into the urban fabric. These green spaces allow for relaxation, recreation, and community involvement. Around 70 individual gardens and common courtyards will be built, giving inhabitants throughout the district access to nature. The addition of green roofs and vertical gardens to buildings boosts the presence of greenery in the community. The Bajes Kwartier proposal places a premium on the utilization of water as a key feature of the urban landscape. Water features like ponds and canals are included in the plan not only for aesthetic reasons but also for water management and climate resilience. These water features contribute to biodiversity, improve the microclimate, and help to offset the effects of urban heat islands. In addition, the project is looking into implementing sustainable drainage systems to manage stormwater runoff and ensure effective water use.

— **Influence of Smart People on Planning Smart Neighbourhoods**

Smart citizens who engage with new technologies are essential for the development of Bajes Kwartier, as it's pivotal for this neighbourhood to have community interaction and participatory planning to align the project with residents' interests.

— **Problems Solved by Smart Neighbourhoods**

Smart neighbourhoods like Bajes Kwartier tackle urban challenges through advanced technologies and sustainable practices, and they focus on environmental sustainability by incorporating renewable energy, energy-efficient buildings, and waste management solutions. For example, initiatives like green roofs and urban agriculture enhance air quality and local food sources. On the other hand, the project also emphasizes mobility by prioritizing pedestrian and bike facilities, reducing reliance on private cars, and improving public transit. Additionally, mixed-use development and accessible public spaces foster social inclusion and community well-being, while smart health services and digital infrastructure enhance access to quality healthcare for residents.

— **Implementation of Smart Urban Planning Principles**

Smart Environment: Bajes Kwartier focuses on integrating green roofs, sustainable stormwater management, and renewable energy systems to promote environmental sustainability.

Smart People: Bajes Kwartier fosters a vibrant community through educational facilities, social infrastructure, and community-building activities that encourage resident engagement and lifelong learning.

Smart Living: Bajes Kwartier features high-quality housing units, mixed-use development, and community engagement initiatives that promote a sustainable environment and enhance residents' quality of life.

Smart Mobility: Bajes Kwartier promotes sustainable mobility by encouraging cycling, walking, public transport, and electric vehicle infrastructure to reduce reliance on private cars.

Smart Governance: Active resident participation and continuous feedback in planning processes ensure that development in Bajes Kwartier aligns with community needs.

Smart Economy: The integration of innovation hubs, research centers, and spaces for startups and high-tech industries in Bajes Kwartier promotes economic growth and technological innovation.

6.5.11 KNOOP XL (EINDHOVEN, NETHERLANDS)

Knoop XL is another smart neighbourhood set in Eindhoven, Netherlands, which is aiming to build a lively and diversified neighbourhood. With that being said, Knoop XL includes many mixed-use buildings, such as educational institutions, public areas, retail, office space, and a multi-phased redevelopment. Moreover, the project's architecture draws inspiration from the region's industrial past and emphasizes urban mobility, energy-efficient housing, and sustainability.

— **Changes in Urban Planning from Being Smart**

Knoop XL, like many other neighbourhoods, plans to significantly shift the old urban planning of the district by prioritizing sustainability and technology over traditional methods that often focused solely on infrastructure. The smart neighbourhood in Eindhoven integrates innovative technologies with eco-friendly practices, such as smart energy grids, green roofs, and renewable energy sources, in order to create a resilient urban space and to lower the neighbourhood's carbon footprint. Moreover, Knoop XL emphasizes a pedestrian-friendly structure that encourages walking, cycling, and the use of public transport, thereby reducing reliance on cars. This approach aligns with a broader movement in urban planning that we have also seen in other smart neighbourhoods, which seeks to develop more sustainable, interconnected, and accessible cities. This holistic vision of urban development is inspiring to me because it addresses not only environmental concerns but also improves residents' quality of life by fostering community and reducing traffic congestion.

— **Influence of Smart People on Planning Smart Neighbourhoods**

As in many neighbourhoods, the success of the Knoop XL neighbourhood lies in the involvement of engaged residents who are willing to embrace new technologies. From the projects in Knoop XL, we understand that the project is focused on community engagement and participatory planning - both very essential for ensuring that the development aligns with the actual needs and requirements of the people living there. Moreover, I highly believe that educational initiatives and social infrastructure play a significant role in nurturing an informed and active community. In Knoop XL, the collaboration among major Dutch cities and real estate developers highlights the importance of community centers, educational institutions, and cultural spaces. Ultimately, these elements not only facilitate lifelong learning but also encourage social interactions, ultimately leading to a more connected and vibrant neighbourhood.

— **Problems Solved by Smart Neighbourhoods**

Smart neighbourhoods like Knoop XL are successfully addressing urban challenges by integrating advanced technologies with sustainable practices. This indicates that by prioritizing environmental sustainability, Knoop XL and various other neighbourhoods seek to employ renewable energy, energy-efficient structures, and advanced waste management systems to reduce their ecological impact. Similarly, Leopold Quartier emphasizes sustainability through features like green roofs and urban farming. Additionally, Knoop XL is addressing mobility issues by prioritizing infrastructure for pedestrians and cyclists, which helps decrease reliance on cars and eases traffic. The smart neighbourhood of Knoop XL also is distinguished by strong public transportation options and facilities for electric vehicles, promoting a more sustainable approach to mobility. Overall, these developments reflect a thoughtful integration of sustainability and urban living.

— **Implementation of Smart Urban Planning Principles**

Smart Environment: Knoop XL emphasizes the integration of green roofs, sustainable stormwater management, and renewable energy systems to enhance environmental sustainability.

Smart People: Knoop XL illustrates the importance of educational institutions and communal activities in promoting resident involvement and continuous learning for a dynamic community.

Smart Living: Knoop XL is dedicated to the provision of high-quality housing, mixed-use development, and community engagement in order to improve the quality of life of residents in a sustainable environment.

Smart Mobility: Knoop XL encourages cycling, walking, public transportation, and electric vehicle infrastructure in order to reduce reliance on private cars and improve sustainable mobility.

Smart Governance: Knoop XL emphasizes the importance of active resident involvement and ongoing feedback in planning processes to ensure that the needs of the community are met.

Smart Economy: Knoop XL emphasizes the role of educational facilities and community activities in fostering resident engagement and lifelong learning in a thriving community.

6.5.12 FREIHAM NORTH (MUNICH, GERMANY)

Munich, Germany's Freiham North is a brand-new urban development project with retail, office, and public space. It is renowned for being sustainable, emphasizing the reduction of waste and resource consumption. By combining sustainable stormwater management with green construction, the district fosters biodiversity and a microclimate that is in balance.

— **Changes in Urban Planning from Being Smart**

Freiham North serves as a compelling example of the evolution in urban planning, shifting from traditional, segregated zoning to a more integrated, smart approach. In the past, urban design often divided spaces into distinct residential, commercial, and industrial areas, which could lead to inefficiencies and a lack of community cohesion. This innovative approach not only enhances the quality of life for residents by reducing commuting times and increasing walkability but also fosters stronger community interactions. Moreover, the integration of smart technologies and sustainable practices is a hallmark of Freiham North's development highlights the implementation of smart energy solutions, such as solar panels and energy-efficient buildings, aimed at optimizing energy use and reducing carbon footprints.

— **Influence of Smart People on Planning Smart Neighbourhoods**

The active participation of residents, commonly termed "smart people," is crucial in the development of Freiham North. Their involvement in the planning process guarantees the fulfillment of community needs and fosters the development of more user-friendly technological solutions. This plan underscores the significance of public forums and workshops, enabling residents to express their views and impact decisions, thereby customizing the neighbourhood to align more closely with their lifestyles and preferences. Moreover, the residents' commitment to sustainability is noteworthy, as by embracing sustainable living practices, they contribute significantly to the neighbourhood's environmental goals.

— **Problems Solved by Smart Neighbourhoods**

Freiham North stands out as a model for modern urban development by integrating smart design and sustainable practices to tackle pressing urban issues. One of the keys focuses of the project is environmental sustainability, as the neighbourhood is designed with green building standards, renewable energy sources, and ample green spaces, all aimed at minimizing environmental impact and enhancing urban biodiversity. This thoughtful approach not only benefits the environment but also creates a healthier living space for residents. Additionally, Freiham North prioritizes smart mobility strategies, as it incorporates extensive bike paths, pedestrian-friendly streets, and efficient public transport. This shift not only alleviates traffic congestion but also fosters a more connected and accessible community.

— **Implementation of Smart Urban Planning Principles**

Smart Environment: Freiham North features green buildings, renewable energy sources like solar panels, extensive green spaces, and sustainable water management systems.

Smart People: Freiham North incorporates educational facilities, social infrastructure, and initiatives that encourage sustainable living practices.

Smart Living: Freiham North offers high-quality, energy-efficient housing units, mixed-use developments, and community engagement initiatives.

Smart Mobility: Freiham North focuses on promoting cycling, walking, and public transportation while integrating smart mobility hubs.

Smart Governance: Freiham North emphasizes active resident involvement in planning through ongoing feedback and public consultations.

Smart Economy: Freiham North places emphasis on the development of commercial spaces and innovation hubs while providing support for local businesses and startups.

6.5.13 TIRANA RIVERSIDE (TIRANA, ALBANIA)

Tirana Riverside, located in the capital city of Albania, Tirana, is undergoing tremendous shifts in its urban forms in order to create a better, sustainable living space. This initiative, like many other smart neighbourhoods in Europe, uses different urban forms such as mixed-used buildings, pedestrian-friendly infrastructure, and as much green spaces as possible. By doing this, Tirana Riverside is ensuring its residents that they will live in a place that is lively, hospitable, but also diverse.

— **Changes in Urban Planning from Being Smart**

Unlike other cities in Albania, Tirana Riverside project is transitioning from traditional urban planning to dynamic and modern multi-functional spaces that can change based on the needs of the population. For this smart neighbourhood to achieve this standard, it was required an organized strategy that included different stages of urban planning, design, and of course, implementation—all by keeping smart growth, sustainable design, and the incorporation of green infrastructure in mind. In the same vein, the neighbourhood also encourages its citizens to use sustainable transportation options such as biking or even encourages walking. Furthermore, one of the most noticeable developments is the adoption of climate-responsive urban architecture, as Tirana Riverside usually has high urban heat, in order to reduce it, it is including green roofs, vertical forests, and many green spaces.

— **Influence of Smart People on Planning Smart Neighbourhoods**

As we know, smart people, or citizens who actively engage with and adapt to new technologies, have a significant impact on Tirana Riverside's design and growth. We say this because in smart neighbourhoods, it's expected to have many shifts in technology or infrastructure due to their adaptability. Thus, if the citizens of Tirana Riverside are taking part in meetings or providing constructive feedback, the project will try to stay consistent with the citizens needs and requirements. Furthermore, educational activities and social programs are also important for the growth of smart people in Tirana Riverside. These efforts provide residents with the information and skills necessary to prosper in a smart urban environment.

— **Problems Solved by Smart Neighbourhoods**

Like many other smart neighbourhoods, Tirana Riverside also solves many problems. First of all, the residential development of this neighbourhood includes various housing alternatives, such as apartments, townhouses, etc. By doing this, the project solves the problem of affordable housing units, as it aims to accommodate different income levels, and ultimately it shows that Tirana Riverside is focused on social inclusion. Secondly, Tirana Riverside has developed mixed-use buildings where many commercial spaces and offices, but also public facilities, strive together in order to provide everything that is needed for the residents of the neighbourhood. Thirdly, the project of Tirana Riverside also is aiming to revive the riverfront region and provide areas for use for the residents. With that in mind, the neighbourhood will have many recreational spaces for the residents to use, such as waterfront promenades, public parks, and other gathering areas. Last but not least, Tirana Riverside also provides sustainable transportation infrastructure, which prioritizes pedestrians and cyclists; thus, it provides sidewalks, bike lines, and many forms of public transportation. Like many other neighbourhoods, Tirana Riverside also tries to reduce the usage of personal cars and promote sustainable forms of transportation.

— **Implementation of Smart Urban Planning Principles**

Smart Environment: Tirana Riverside has included green roofs and different forms of forests and green spaces in order to make the life of its residents better.

Smart People: Social infrastructure, educational buildings, and many community-building activities are placed in Tirana Riverside in order to offer its residents a dynamic community.

Smart Living: High-quality, energy-efficient housing units, mixed-use developments, and community engagement initiatives to ensure residents enjoy a high quality of life in a sustainable environment.

Smart Mobility: Tirana Riverside offer sustainable options for mobility as it tries to reduce the usage of personal cars; thus, it promotes walking and cycling by offering many bike lanes and sidewalks.

Smart Governance: For Tirana Riverside to be successful, active resident participation is needed in order to ensure that all developments and changes are in line with community needs and requirements.

Smart Economy: Tirana Riverside offers mixed-use buildings in order for residents to have everything in one place but also to foster economic growth and technological innovation.

6.5.14 OBERBILLWERDER (HAMBURG, GERMANY)

Germany, known for its urban developments, has recently included Oberbillwerder as a smart neighbourhood. Oberbillwerder is located in Hamburg and is also known as the Connected City as it connects the nature and the city in its development plan. As many other smart neighbourhoods, Oberbillwerder also focuses on social, economic, and environmental sustainability in its project. The main goal of the project is to build a city of the future with cutting-edge architecture, modern transportation options, and resource management.

— **Changes in Urban Planning from Being Smart**

Oberbillwerder is a notable district in Hamburg that has made a huge transition from traditional principles to smart urban planning. Oberbillwerder did this as it combined innovative technologies with sustainable practices. Before becoming a smart neighbourhood, Oberbillwerder focused more on physical infrastructure such as buildings, with little to no attention to sustainability or technological integration. By making this transition, Oberbillwerder now uses smart technology, smart infrastructure, and sustainable urban environment in order to provide a better quality of life for its residents.

— **Influence of Smart People on Planning Smart Neighbourhoods**

Just like in other neighbourhoods, people of Oberbillwerder play an important role in the design and development of the neighbourhood. As the project includes community engagement, it's pivotal for the residents of Oberbillwerder to participate in the planning and development of the neighbourhood. As we have noted before, by participating in the development of the neighbourhood, this approach will give the residents a sense of ownership and will transform them into active residents, focused on the neighbourhood's growth. In line with this, Oberbillwerder also provides educational activities and social infrastructure which are pivotal for the residents of the neighbourhoods.

— **Problems Solved by Smart Neighbourhoods**

Smart neighbourhoods, such as Oberbillwerder, address a wide range of urban issues by combining innovative technologies and sustainable practices. For example, Oberbillwerder includes renewable energy sources, energy-efficient structures, and innovative waste management technologies—all in order to reduce environmental consequences. Oberbillwerder also addresses other essential topics such as mobility and transportation. As other neighbourhoods, Oberbillwerder tries to reduce the dependency on private cars so the neighbourhood does not have traffic. With this in mind, the neighbourhood focuses on providing pedestrian and bike infrastructure.

— **Implementation of Smart Urban Planning Principles**

Smart Environment: Oberbillwerder has integrated green roofs, green spaces, water management, and renewable energy systems.

Smart People: Oberbillwerder provides educational facilities, social infrastructure, and community-building activities that to promote community engagement.

Smart Living: Oberbillwerder has integrated high-quality, energy-efficient housing units to ensure residents enjoy a high quality of life in a sustainable environment.

Smart Mobility: Oberbillwerder promotes walking, cycling, and public transport and tries to reduce the usage of personal cars.

Smart Governance: Oberbillwerder has included the citizens in their planning process in order to have constructive feedback and to ensure that the needs of the community are met.

Smart Economy: Oberbillwerder includes innovation and commercial spaces and supports local businesses so they can have economic growth.

6.5.15 GREDELJ (ZAGREB, CROATIA)

Gredelj, once an abandoned industrial zone in Zagreb, is now transforming into a smart neighbourhood, which includes a 45-hectare area and is around a 15-minute walk from the city center. As this neighbourhood requires a deep restoration, the neighbourhood of Gredelj addresses one of Zagreb's most pressing urban issues: the divide between north and south.

— **Changes in Urban Planning from Being Smart**

Gredelj marks a huge transformation from an abandoned industrial zone into a smart neighbourhood. Although the change is drastic, the new smart neighbourhood will try to not lose the current spatial identity, as it is important for Gredelj to maintain its heritage. Although modern technology will be integrated, the neighbourhood of Gredeelk will try to regenerate the ex-industrial zone through cultural and social content. For instance, Gredelj will redevelop the Paromlin site into a new library, and in this way, it will increase the worth of the neighbourhood and maintain its heritage. As other neighbourhood, Gredelj will also combine smart technologies such as renewable energy sources, smart grids, and energy-efficient buildings with ecological practices in order to offer a better place to live for its residents.

— **Influence of Smart People on Planning Smart Neighbourhoods**

Gredelj plans to include its residents in the decision-making process of the neighbourhood, as it's pivotal for the residents to be active in the neighbourhood's growth. As other studies have shown, this participatory approach ensures that the needs of the residents are met, while at the same time it provides them with a sense of ownership. Educational activities and social infrastructure are critical to building a knowledgeable and active community; thus, Gredelj also plan to include educational facilities, community centers, and public places that encourage lifelong learning and social engagement.

— **Problems Solved by Smart Neighbourhoods**

The Gredelj neighbourhood solves numerous problems as it transforms the old industrial zone into a vibrant community. Beginning with the usage of cutting-edge technologies together with sustainable principles, Gredelj will provide a better life for its residents. Renewable energy sources, energy-efficient structures, and innovative waste management solutions are some of the initiatives used in Gredelj to reduce environmental effects.

— **Implementation of Smart Urban Planning Principles**

Smart Environment: Gredelj integrates green roofs, green spaces, sustainable water management, and renewable energy systems to enhance environmental sustainability and biodiversity.

Smart People: Gredelj provides educational facilities, social infrastructure, and community-building activities to promote resident engagement and lifelong learning.

Smart Living: Gredelj includes high-quality, energy-efficient housing units, mixed-use developments, and community engagement initiatives.

Smart Mobility: Gredelj promotes walking, cycling, and public transport and integrates smart mobility hubs and electric vehicle charging stations to support sustainable transportation options.

Smart Governance: Gredelj encourages its residents to participate in planning processes through participatory design workshops in order to make sure that their needs are met.

Smart Economy: Gredelj includes the development of commercial spaces, innovation hubs, and support for local businesses and startups to foster economic growth and technological innovation.

6.5.16 SMÍCHOV CITY (PRAGUE, CZECH REPUBLIC)

Once a railway station, now a redeveloped smart neighbourhood, Smíchov City is the new smart neighbourhood that lies in Prague. With 230 hectares to be used, the project aims to transform the railway station into a modern neighbourhood that echoes sustainability and citizen

— **Changes in Urban Planning from Being Smart**

Smíchov City's transition to a smart community involves a significant shift in urban planning principles. As the former railway station focused on the traditional urban planning on providing merely buildings and housing, the new neighbourhood will include cutting-edge technology and sustainable practices, in addition to exemplifying the trend toward data-driven urban administration. With urban planning concepts, such as utilizing advanced technologies for energy management, green buildings, and sustainable mobility solutions, Smíchov City will become one of the most renowned smart neighbourhoods of Prague.

— **Influence of Smart People on Planning Smart Neighbourhoods**

Smíchov City uses a bottom-up approach that instills a sense of responsibility in the residents of the neighbourhoods, which is a pivotal aspect in smart neighbourhoods. The community living in Smíchov City will have the opportunity to be included in the decision-making processes through the participatory platforts, which will make their voices heard. With this being said, residents can contribute to the constant improvement and refinement of the neighbourhood's smart systems by offering input on smart services and infrastructure.

— **Problems Solved by Smart Neighbourhoods**

Smíchov City, like many other smart neighbourhoods around Europe will use modern solutions to address urban challenges. For instance, it will use renewable energy sources and energy-efficient structures to lower the neighbourhood's carbon footprint. In addition to that, advanced waste management systems and sustainable water management methods will be used to contribute to environmental sustainability.

— **Implementation of Smart Urban Planning Principles**

Smart Environment: Smíchov City integrates green spaces, sustainable stormwater management, and climate-responsive designs.

Smart People: Smíchov City provides educational facilities, social infrastructure, and community-building activities to promote citizen engagement.

Smart Living: Smíchov City will provide high-quality housing, mixed-use development, and community engagement initiatives.

Smart Mobility: Smíchov City will encourage the residents to cycle, walk, or use public transportation in order to reduce the usage of personal cars.

Smart Governance: Smíchov City will include the residents in planning processes and continuous feedback loops.

Smart Economy: Smíchov City will provide innovation hubs, research centers, and spaces for startups and high-tech industries.

6.5.17 AM SANDHAUS (BERLIN-BUCH, GERMANY)

Berlin-Buch has a new smart neighbourhood, Am Sandhaus, which echoes sustainability practices and maintains the diversity of the surrounding landscape. The development plan calls for densely populated urban areas, large green areas, and peaceful neighbourhood coexistence. It seeks to promote biodiversity and give locals access to leisure activities.

— **Changes in Urban Planning from Being Smart**

As many other neighbourhoods, Am Sandhaus has to be transformed from a traditional to a smart urban neighrbohood. As the traditional planning focused on buildings and infrastructure, Am Sandhaus will focus more on sustainability or technological integration. With that being said, the neighbourhood combines cutting-edge technical solutions with sustainable practices to create a more robust and adaptable urban environment. In line with technolgy, the neighbourhood includes smart grids, renewable energy systems, and climate-responsive building designs, which ensure efficient resource usage and reduce environmental consequences.

— **Influence of Smart People on Planning Smart Neighbourhoods**

The role of smart people is crucial to the design and implementation of smart neighbourhoods such as Am Sandhaus. Am Sandhaus will encourage its residents to be involved in decision-making through public involvement projects, workshops, and feedback channels, as this participatory strategy ensures that the development meets the community's needs and preferences, generating a sense of ownership and cooperation among people.

— **Problems Solved by Smart Neighbourhoods**

Am Sandhaus' smart neighbourhood includes solving a variety of urban concerns. The first one, as in many other neighbourhoods, is to minimize reliance on personal vehicles, hence lowering traffic congestion and pollution. With this being said, Am Sandhaus will incorporate designated bike routes, pedestrian zones, and efficient public transportation connections, making it easy for the residents to choose sustainable modes of transportation. Secondly, Am Sandhaus focuses on providing energy-efficient buildings and renewable energy systems to reduce carbon emissions, which ultimately contributes to Berlin's climate goals. Last but not least, Am Sandhaus focuses on providing green spaces and ecological preservation zones in the neighbourhood to boost biodiversity and offer recreational activities.

— **Implementation of Smart Urban Planning Principles**

Smart Environment: Am Sandhaus integrates extensive green spaces, green roofs, and sustainable stormwater management systems.

Smart People: Am Sandhaus provides social infrastructure and educational facilities, which are crucial for fostering an informed and engaged community.

Smart Living: Am Sandhaus offers high-quality housing units that meet modern sustainability standards, and it promotes mixed-use development, combining residential, commercial, and recreational spaces to create a vibrant community.

Smart Mobility: Am Sandhaus offers sustainable mobility is prioritized through the provision of extensive bike paths, pedestrian zones, and efficient public transportation links.

Smart Governance: Am Sandhaus emphasizes active resident participation in planning processes.

Smart Economy: Am Sandhaus integrates innovation hubs, research facilities, and spaces for high-tech startups, promoting economic growth and establishing the neighbourhood as a hub for business and technology innovation.

6.5.18 KOLKAJEN (STOCKHOLM, SWEDEN)

Kolkajen, a new smart neighbourhood, is located in Stockholm, Sweden. With an emphasis on eco-friendly buildings, green areas, and sustainable public transportation, Kolkajen aims to be the neighbourhood that echoes social cohesion and environmental sustainability.

— **Changes in Urban Planning from Being Smart**

Looking back at how much Kolkajen has improved, we can notice various smart principles being implemented, such as accessibility, infrastructure, and even the essential services. In addition to smart principles of accessibility and infrastructure, the neighbourhood of Kolkajen has embraced digital innovation in public services, sustainable energy solutions, and community-centered planning. These initiatives make Kolkajen not just more livable but also forward-thinking neighbourhood.

— **Influence of Smart People on Planning Smart Neighbourhoods**

As in other neighbourhoods, the involvement of smart people has had a significant impact on the development and implementation of Kolkajen. As other studies also state, the participation of residents of smart neighbourhoods in the decision-making process guarantees that the development coincides with the community's needs and preferences, leading to more user-centered and approved urban solutions.

— **Problems Solved by Smart Neighbourhoods**

Smart neighbourhoods like Kolkajen address several urban concerns, including environmental sustainability, mobility, and community engagement. By integrating renewable energy sources, fostering sustainable transport, and incorporating inhabitants in planning processes, smart neighbourhoods produce more livable and resilient urban settings.

— **Implementation of Smart Urban Planning Principles**

Smart Environment: Kolkajen provides green spaces, green roofs, sustainable stormwater management, and climate-responsive designs.

Smart People: Kolkajen provides educational facilities, social infrastructure, and community-building activities that encourage resident engagement and lifelong learning.

Smart Living: Kolkajen includes high-quality housing units, mixed-use development, and community engagement initiatives.

Smart Mobility: Kolkajen encourages cycling, walking, public transport, and electric vehicle infrastructure.

Smart Governance: Active participation of residents in planning processes, continuous feedback loops, and participatory research initiatives.

Smart Economy: Integration of innovation hubs, research centers, and spaces for startups and high-tech industries.

6.5.19 PIHLAJANIEMI (TURKU, FINLAND)

A new smart neighbourhood is set in Turku, Finland. The Pihlajaniemi neighbourhood aims to build a new urban district for approximately 2,500 residents. The project of Pihlajaniemi focuses on carbon neutrality, which increases biodiversity, and integrates urban green spaces. Furthermore, the smart initiatives include stormwater parks and wetlands to manage heavy rainfall, contributing to Turku's goal of carbon neutrality by 2029.

— **Changes in Urban Planning from Being Smart**

The smart principles have had a considerable impact on Pihlajaniemi urban planning, shifting the focus away from traditional urban development and toward more integrated and sustainable alternatives. The use of green infrastructure, such as large green spaces and sustainable stormwater management systems, demonstrates a dedication to environmental sustainability. Furthermore, as noted by Ark (2022), the emphasis on walkability and cycling infrastructure indicates a shift toward less reliance on private vehicles, supporting healthier and more sustainable modes of transportation.

— **Influence of Smart People on Planning Smart Neighbourhoods**

The residents of Pihlajaniemi have influenced the development of the neighbourhood in a good way, as they're actively participating in the planning process. This participation guarantees that the development meets the people' wants and preferences, generating a sense of ownership and community. The design of public spaces and facilities promotes social contact and community activities, which are critical for establishing a cohesive and lively neighbourhood.

— **Problems Solved by Smart Neighbourhoods**

Pihlajaniemi's smart neighbourhood design solves a variety of urban concerns. The incorporation of green infrastructure and sustainable stormwater management technologies reduces flooding while increasing the neighbourhood's resilience to climate change. The emphasis on walkability and bicycle infrastructure minimizes automobile congestion while encouraging healthier lifestyles. Furthermore, the development of high-quality public spaces and social infrastructure promotes community building and enhances inhabitants' overall quality of life.

— **Implementation of Smart Urban Planning Principles**

Smart Environment: Pihlajaniemi includes large green spaces, sustainable stormwater management systems, and the incorporation of existing natural features into the urban landscape.

Smart People: Pihlajaniemi provides schools and community centers that are interwoven into the neighbourhood to encourage lifelong learning and community participation.

Smart Living: Pihlajaniemi includes high-quality building units centered on mixed-use development.

Smart Mobility: Pihlajaniemi puts emphasis on walkability and cycling, with designated bike lanes and pedestrian pathways.

Smart Governance: Pihlajaniemi promotes community interaction and ensures that public spaces and facilities meet the needs of its residents.

Smart Economy: Pihlajaniemi involves the creation of commercial edge zones and outdoor activity spaces helps to support local companies.

6.5.20 NUEVO NORTE (MADRID, SPAIN)

Nuevo Norte in Madrid, Spain, is a new smart neighbourhood that is focused on revitalizing an underdeveloped 230-hectare area, with the idea to transform it into a sustainable residential and business district. Nuevo Norte, otherwise known the former Operación Chamartín, is set to transform the area around Chamartín train station with housing, business centers, green spaces, and improved infrastructure. With this being said, the project's main focus will be to integrate the rail transport, thus emphasize public transport, sustainability, and the creation of a thriving public space.

— **Changes in Urban Planning from Being Smart**

The implementation of smart urban planning principles has resulted in significant changes to traditional urban development techniques in Nuevo Norte in Madrid. As we know, this area of Madrid was usually focused on increasing the city's infrastructure and housing capacity. However, the new smart neighbourhood of Nuevo Norte is using cutting-edge technology and sustainable practices to produce a more efficient and livable urban environment. Moreover, the neighbourhood is using smart grids, renewable energy sources, and ICT infrastructure, in order to make the neighbourhood as sustainable as possible.

— **Influence of Smart People on Planning Smart Neighbourhoods**

Smart people of Nuevo Norte play a pivotal part when it comes to the design and implementation of the neighbourhood. The planners of this are have concluded that they want the residents included in every step of the planning process, either via digital platforms or community workshops, as this will establish a sense of ownership and will ensure that the smart solutions deployed are user-friendly and effective

— **Problems Solved by Smart Neighbourhoods**

Smart districts, such as Madrid Nuevo Norte, address a variety of urban challenges with innovative and sustainable solutions. For example, the project's goal is to lower the urban heat island effect and enhance air quality by including substantial green spaces and climate-responsive designs. On the other hand, the neighbourhood also addresses transportation by promoting public transportation, cycling, and walking.

— **Implementation of Smart Urban Planning Principles**

Smart Environment: Nuevo Norte provides large green spaces, sustainable stormwater management, and climate-responsive designs are used to increase biodiversity and environmental sustainability.

Smart People: Nuevo Norte includes the development of educational facilities, social infrastructure, and community-building activities to foster lifelong learning and social cohesion.

Smart Living: Nuevo Norte offers high-quality housing units, mixed-use development, and community involvement programs.

Smart Mobility: Nuevo Norte prioritizes public transport, cycling, and walking, and includes infrastructure for electric vehicles to promote sustainable mobility.

Smart Governance: Nuevo Norte employs participatory planning processes, continuous feedback loops, and digital platforms to ensure active resident involvement and responsive governance.

Smart Economy: Nuevo Norte integrates innovation hubs, commercial spaces, and high-tech industries to drive economic growth and create job in the neighbourhood.

The following five tables (11.0–11.4) compare twenty European smart neighbourhoods across seven dimensions: (i) Urban transformation type, (ii) Size, (iii) Smart-city dimensions, (iv) Innovation strategies, (v) Unique features, (vi) Governance model, and (vii) Problems tackled.

Table 11.0. Comparative table - Aspern Seestadt (Vienna), Nordhavn (Copenhagen), Merwede (Utrecht), Nieuw Zuid (Antwerp).

Dimension	**1. Aspern Seestadt (Vienna, AT)**	**2. Nordhavn (Copenhagen, DK)**	**3. Merwede (Utrecht, NL)**	**4. Nieuw Zuid (Antwerp, BE)**
Urban Transformation Type (Before; After)	Former airfield to mixed-use lakeside district	Industrial port to waterfront city district	Industrial/depots to dense urban quarter	Brownfield on river quays to residential park district
Size (ha; projected population)	240 ha; ~20,000 residents	200 ha; ~40,000 residents (~40k jobs)	24.3 ha; ~12,000 residents	15 ha core; ~5,000 residents
Smart Urban Dimensions (focus)	Environment, Mobility, Living, People, Government, Economy transit-first, compact	All six; strong Environment & Mobility (5-min city)	Environment, Mobility, Living, car-free; health; circular energy	Environment, Living, Mobility, green-blue; district heat; low-car
Innovation Strategies	Metro built early; smart energy, cycling network; urban lab	Energy Lab grid; low-temp DH; new metro; cycling	Car-free plan; mobility hubs; aquifer TES; green/solar roofs	Biomass/solar energy; wadis; tram/bike-first
Unique Features / Concepts	‘City within a city’; lakeside park; high-density mixed-use	Blue-green canals; DGNB Platinum; five-minute city	One of NL’s largest car-free districts; ‘Coulisse City’	Vertical forest (Palazzo Verde); park-city character
Governance Model	City SPV (Wien 3420) + PPP; co-creation	Public development corporation (City & Port); phased PPPs	Multi-owner coalition + city; co-creation	Private developer + strict city sustainability benchmarks
Problems Tackled	Brownfield reuse; housing need; cut car use; climate targets	Harbor blight; housing/jobs balance; climate adaptation; traffic	Congestion/emissions; green deficit; compact growth	Post-industrial cleanup; flood resilience; livability; inclusion

Table 11.1. Comparative table - Clichy-Batignolles (Paris), Schumacher Quartier (Berlin), MIND – Milano Innovation District (Milan), Brainport Smart District (Helmond).

Dimension	**5. Clichy-Batignolles (Paris, FR)**	**6. Schumacher Quartier (Berlin, DE)**	**7. Milano Innovation District (Milan, IT)**	**8. Brainport Smart District (Helmond, NL)**
Urban Transformation Type (Before; After)	Rail freight yard to eco-district	Closed Tegel Airport land to timber, climate-neutral quarter	EXPO 2015 site to science & innovation campus district	Greenfield edge to living-lab neighbourhood
Size (ha; projected population)	54 ha; ~6,500–7,500 residents	46 ha core; ~10,000 residents	100–110 ha; ~3,000 residents	155 ha; ~4,500 residents
Smart Urban Dimensions (focus)	All six; strong Env & Gov (energy coop)	Environment, Mobility, Governance, timber; energy-sharing; car-free	Econ, Env, Mobility, Living, zero-carbon; One-Health	People, Economy, Environment, circular; participatory; data-commons
Innovation Strategies	Geothermal + PV; car-light; pneumatic waste; CoRDEES, energy	Digital low-temp thermal grid; hubs; sponge-city landscape	Smart grid; on-site renewables; electric shuttles; pavilion reuse	Citizen-controlled data; shared energy & mobility; productive landscape
Unique Features / Concepts	10 ha central park; 15-minute city; passive-house standards	Large-scale timber; 'energy marketplace'	Innovation ecosystem (hospital+university); digital twin	'World's smartest neighbourhood' ethos; flexible grid plan
Governance Model	City-led ZAC; multi-partner delivery	City-owned developer (Tegel Project) + charter co-creation	PPP (Arexpo + Lendlease) with KPI governance	Foundation/quadruple-helix governance
Problems Tackled	Carbon reduction; affordable housing; air quality; urban green	Post-airport reuse; housing shortage; car reliance; net-zero goals	Post-event legacy; economic diversification; sustainable mobility	Sprawl alternative; privacy-by-design; social cohesion; emissions

Table 11.2. Comparative table - Überseeinsel (Bremen), Bajes Kwartier (Amsterdam), Knoop XL (Eindhoven), Freiham North (Munich).

Dimension	**9. Überseeinsel (Bremen, DE)**	**10. Bajes Kwartier (Amsterdam, NL)**	**11. Knoop XL (Eindhoven, NL)**	**12. Freiham North (Munich, DE)**
Urban Transformation Type (Before; After)	Kellogg's factory peninsula to mixed quarter	Former prison complex to green car-free district	Underused station/office zone to vibrant mixed hub	Agricultural edge land to large mixed district
Size (ha; projected population)	41.5 ha; ~4,200 residents	7.5 ha; ~3,000 residents	55 ha; 6,500–7,500 homes	350 ha total; ~20,000 residents
Smart Urban Dimensions (focus)	Environment, Living, Mobility reuse; river resilience; car-light	Environment, Living, People circularity; health; gardens	Economy, Mobility, Environment TOD; digital planning; green river	Env, Living, Mobility Park-led; geothermal; transit-oriented
Innovation Strategies	Adaptive re-use (silos); district heat; mobility hub; green loop	98% material reuse; bio-digester; mobility hub; smart waste	Multimodal hub; MaaS; digital twin; circular construction	55 ha central park; S-Bahn/tram; energy-plus schools
Unique Features / Concepts	Landmark silo conversions; public waterfront	'Green Tower' vertical park/lab; 70+ gardens	Dommel river green spine; new civic station plaza	'New Garden City'; auto-free housing clusters
Governance Model	City-developer PPP with binding sustainability contract	City circular targets; consortium delivery	Multi-level public partnership + private developers	City-orchestrated; multiple developers & cooperatives
Problems Tackled	Brownfield cleanup; reconnect riverfront; modal shift	Embodied carbon; housing mix; open isolated site	Fragmentation; congestion; office/housing shortage; flood risk	Housing affordability; heat-island; sprawl containment

Table 11.3. Comparative table - Tirana Riverside (Tirana), Oberbillwerder (Hamburg), Gredelj (Zagreb), Smíchov City (Prague).

Dimension	**13. Tirana Riverside (Tirana, AL)**	**14. Oberbillwerder (Hamburg, DE)**	**15. Gredelj (Zagreb, HR)**	**16. Smíchov City (Prague, CZ)**
Urban Transformation Type (Before)	Flood-prone river edge & underused public land to smart green quarter	Farmland/greenfield to new city district	Railway factory & yard to central city extension	Rail freight yard to mixed-use downtown quarter
Size (ha; projected population)	29 ha; ~12,000 residents	118 ha; 6,000–7,000 homes (~15k people)	45–54 ha; several thousand homes/offices	20 ha; ~12,000 people (residents, workers)
Smart Urban Dimensions (focus)	Environment, Mobility, People urban forest; electric transit; 15-min	All six; strong Mobility & Living 5-minute city; Active City	Governance, Mobility, Environment reconnect city fabric; reuse heritage	Mobility, Living, Economy TOD around a multimodal hub
Innovation Strategies	1:1 tree-to-resident; solar on roofs; green spine; e-bus loop	Central Green Loop; mobility hubs; energy-smart local grid	Elevating rail; intermodal hub; adaptive reuse; new parks	Unified train+bus terminal; car-light grid; smart waste; district energy
Unique Features / Concepts	Polycentric 15-min layout; river park as floodplain	'Connected City' model; health/active design	Extend 'Green Horseshoe'; civic/cultural anchors	Largest brownfield regens in Prague; central linear park
Governance Model	Municipal leadership + PPPs; design review committee	IBA Hamburg public development; competitive dialogue	City-led with national rail & EBRD support	City-developer agreement; major public infra funding
Problems Tackled	Disaster resilience; informal growth; air quality; affordability	Housing need; flood; transport emissions; social mix	North-south divide; remediation; transit integration	Sprawl reduction; congestion; housing supply; cleanup

Table 11.4. Comparative table - Am Sandhaus (Berlin-Buch), Jägersro (Malmö), Pihlajaniemi (Turku), Madrid Nuevo Norte (Madrid).

Dimension	**Am Sandhaus (Berlin-Buch, DE)**	**Jägersro (Malmö, SE)**	**Pihlajaniemi (Turku, FI)**	**Madrid Nuevo Norte (Madrid, ES)**
Urban Transformation Type (Before)	Former military hospital campus + vacant land to new quarter	Horse racetrack to mixed neighbourhood	Coastal military barracks to climate-smart district	Chamartín rail yards & brownfields to urban extension
Size (ha; projected population)	57 ha; ~6,000–7,000 residents	46 ha; phased ~8,000 residents	30 ha; ~5,000 residents	323 ha; ~25,000 residents (+major employment)
Smart Urban Dimensions (focus)	Environment, People, Living sponge-city; health focus; 15-minute	Environment, Living, Mobility flexible; human-scale; soft mobility	Environment, Living, Mobility 'soft city'; biodiversity; car-light	Mobility, Econ, Governance, transit-oriented mega-project
Innovation Strategies	Wetland retention; geothermal potential; active mobility links	Shared-space streets; green-blue corridors; transit upgrade	Waterfront restoration; smart metering; cycling links; district heat	New multimodal hub; decked rail corridors; large parks; smart mobility
Unique Features / Concepts	'Living-lab' integrated planning; health district synergy	'Balanced city' on Malmö's edge; racetrack legacy	Public shoreline access; heritage barracks as community hub	One of Europe's largest regenerations; business district spine
Governance Model	Publicly led with housing companies	City-landowner partnership; flexible code	City–state (Senate Properties) partnership	Public-private consortium; long-horizon phasing
Problems Tackled	Affordable units; preserve nature; car-light edge growth	Urban expansion without sprawl; cloudburst resilience; inclusion	Carbon-neutral 2029 pathway; flood buffers; affordable homes	Reconnect districts; housing/jobs balance; sustainable growth

6.6 CONCLUSION: EVALUATION THE STRENGTHS AND LIMITATIONS OF SMART NEIGHBOURHOODS AND FRAMES A COMPARATIVE, CRITERIA- BASED APPROACH TO UNDERSTANDING BOTTOM-UP DEVELOPMENT

The in-depth analysis and comparison of the twenty smart neighbourhoods across Europe showcases a multifaceted integration of shared principles and numerous strategies in sustainable urban development.

For example, each neighbourhood, from Aspern Seestadt in Vienna to Nordhavn in Copenhagen, and Merwede in Utrecht to Nieuw Zuid in Antwerp, exemplifies the practical application of the smart city concept, frequently customized to suit its distinctive local context. Together, these examples demonstrate that smart urbanism is not a universal solution; rather, it is a dynamic process that can be customized to accommodate a variety of types, cultures, and scales of cities. This analysis highlighted the similarities and differences that distinguish them, such as typological variations, including closed versus open and core versus peripheral, and the overarching smart strategies—community engagement, sustainability, technology, and livability.

- **Shared Patterns in Smart Neighbourhoods**

The twenty neighbourhoods showcase a rich tapestry of geographical and cultural diversity; however, they all face a common challenge: the evident shortfalls in design and planning principles. Each initiative adopts a holistic approach, addressing various aspects such as smart environments, smart people, smart governance, smart living, and smart economy. These principles are realized in the following elements through the projects.

- **Sustainable Environment**

Each neighbourhood places a high priority on environmental sustainability, with a particular emphasis on climate-responsive design and green infrastructure. In addition to renewable energy systems, the neighbourhoods are distinguished by their innovative green and blue infrastructure, which includes water-resistant surfaces, green roofs, and parks, as well as its expansive green spaces. For example, Nordhavn serves as an illustration of this phenomenon, as it implements advanced water management strategies, water-resistant pavements, and green roofs to reinforce its urban resilience. Other initiatives, such as Tirana Riverside, demonstrate innovative designs, including green roofs and vertical forests, which mitigate heat islands and enhance biodiversity. This common environmental ethic embodies the fundamental smart neighbourhood value of reducing environmental burden while increasing resilience.

- **Smart mobility**

Smart neighbourhoods are shifting their focus away from traditional modes of transportation, such as personal cars, and are shifting towards more sustainable mobility options, such as walking, cycling, and comprehensive public transit. All the neighbourhoods encourage their citizens to use the public means of transportation, or, for example, Merwede takes another shift, as it intends to be nearly car-free in comparison to other neighbourhoods in the Netherlands, and this is achieved by significantly reducing the number of parking spaces, with only three spots per ten households. In the same vein, Nordhavn encourages active transportation by implementing pedestrian-friendly streets, wide bike lanes, and efficient public transit. The objective is to establish a "5-minute city," in which residents can effortlessly walk or bicycle to fulfill their daily needs. Furthermore, these neighbourhoods frequently feature electric car charging stations and shared vehicle programs to encourage low-emission transportation.

- **Community and Governance:**

Community participation and inclusive governance are pivotal aspects that we can see in all twenty neighbourhoods. The idea of community engagement is to include the residents in the decision-making process in order for them to enjoy living in these neighbourhoods, but also make sure that their needs are met. Such community engagement is achieved by using different methods such as digital constructive feedback, workshops, and town hall meetings, which guarantee that local voices are addressed in development decisions. One notable example is Nordhavn, where the public meetings foster a collaborative approach and the residents are part of the project development. In this way, the residents feel a sense of ownership over the initiatives. In a similar vein, Tirana Riverside implements participatory design workshops and immediate digital channels to involve citizens in governance, thereby guaranteeing that their input influences the results.

- **Smart living and People:**

All neighbourhoods emphasized the importance of people in their smart city agenda, as the neighbourhoods provide a better quality of life for them. By providing mixed-use and energy-efficient housing, in line with other urban forms, these neighbourhoods make sure that they're providing a neighbourhood which foster social diversity and inclusivity. For instance, Paris's Clichy-Batignolles and Munich's Freiham North integrate social housing with market-rate units to establish a dynamic, mixed community.

Furthermore, these neighbourhoods provide many public spaces, such as plazas, community centers, and parks, in order to foster social interaction and community life. In line with public spaces, these neighbourhoods also provide educational institutions, libraries, and innovation centers that facilitate learning and skill enhancement, ensuring residents are prepared to live in technology-driven neighbourhoods. In addition, health and well-being are emphasized through smart health services and proactive design principles that promote healthy lifestyles.

- **Technology Integration**

As this research analyzed each theme, it was evident that advanced technology and data are important factors in driving neighbourhood smartness. As we have noticed, every neighbourhood is furnished with advanced ICT infrastructure, such as ubiquitous connectivity, sensors, and data platforms, which are intended to enhance the efficiency of urban operations. One notable example of this integration is the smart energy grids located in Vienna’s Aspern Seestadt, where real-time data and advanced building systems synchronize local energy supply with demand. In a similar vein, the EnergyLab project in Nordhavn integrates thermal, electrical, and transport networks into a cohesive smart energy system.

Beyond energy systems, numerous initiatives are also integrating digital solutions to enhance mobility, such as apps for shared transportation and transit information, as well as environmental management tools like smart waste and smart water systems. Ultimately, this technology supports broader sustainability and community goals by optimizing resource use, reducing carbon emissions, and providing citizens with innovative services, including smart home systems and e-governance applications.

On the other hand, data-informed decision-making and pilot initiatives, commonly known as living labs, are widespread in numerous districts, including Aspern, Nordhavn, and Brainport Eindhoven. Despite the differences in physical planning, the utilization of information technology and innovation serves as a common criterion categorizing each as a smart neighbourhood.

– **Differences and Contextual Variations**

Since this research focused on different geographical parts of Europe, it is therefore expected that the twenty neighbourhoods have similarities but, at the same time, also showcase numerous differences, especially in the implementation of initiatives. These differences were mostly driven by either local context or objectives that included scale or type of development. These differences underscore that while the smart city principles are global, their realization is profoundly local:

– **Open vs. Closed Communities**

The differences here lie between open versus closed communities, meaning how inclusive, accessible, and participatory the neighbourhoods’s digital and physical systems are. For example, in Europe, numerous smart neighbourhoods aim to establish open communities, rejecting the notion of isolated exclusive zones; thus, numerous initiatives establish ambitious goals for social diversity while ensuring public access. For instance, Clichy-Batignolles dedicates many of its buildings for the low-income families who need affordable housing, and public spaces for them to engage with the broader community. In the same vein, Freiham North mixes housing with commercial and recreational facilities to foster a diverse resident base. Likewise, Tirana Riverside exemplifies this approach, as it prioritizes equitable access to public amenities and provides affordable housing options suitable for every family. As such, it’s important for the neighbourhoods to tackle issues of social inequality by offering affordable housing and easy access to services in order to create an inclusive community.

Another example of successful redevelopment is Gredelj in Zagreb, Croatia. Once a railway station, now a multifunctional neighbourhood, Gredelj promotes a compact and walkable urban environment as it prioritizes sustainable transportation options, green infrastructure, and mixed-use development. The area is equipped with advanced waste management solutions and smart energy systems, which improve the efficiency of services and the sustainability of the environment. Crucially, the project emphasizes social inclusion and participatory planning as it enables the smart people of Gredelj to participate in public meetings and workshops. In this way, Gredelj exemplifies a hybrid smart city model, technologically advanced yet deeply rooted in local culture and context, offering a compelling framework for post-industrial urban regeneration in the era of smart cities.

However, slight variations exist, especially when examining innovation-focused districts such as the Milano Innovation District (MIND) and Brainport. These areas often start with particular functions, like tech campuses and research centers, which can draw in a more exclusive demographic. However, they still prioritize community engagement by incorporating amenities and public spaces that are accessible to everyone. For instance, Brainport includes community gardens and social infrastructure designed to promote inclusivity.

In summary, we cannot regard any of the neighbourhoods we examined as isolated communities. In cities like Vienna, Paris, and Munich, where public sector involvement is strong, socio-economic strategies are implemented with strict criteria for social mixing and affordability. Conversely, districts propelled by private partnerships, which frequently possess significant legislative clout, may prioritize mixed-use developments and economic incentives.

– **Innovation Focus:**

Numerous projects are known in field of mobility, with Merwede serving as a notable example. Merwede set itself apart from other neighbourhoods due to its commitment to reducing reliance on cars, placing a strong emphasis on the needs of cyclists and pedestrians. In contrast to regions that merely dissuade automobile use, Merwede exemplifies the principle of sustainable mobility. In contrast, certain developments aim to serve as energy and technology testing grounds. Nordhavn, for instance, is transforming into a dynamic urban laboratory focused on smart energy solutions. This advanced infrastructure facilitates Copenhagen's ambition to emerge as a global leader in clean energy innovation.

Another remarkable example is Aspern Seestadt in Vienna, which features a smart grid and an energy management system developed under the Aspern Smart Research initiative. In these cases, the utilization of technology, including sensors, data analytics, and IoT systems, is notably widespread, as these neighbourhoods serve as living laboratories for the experimentation of smart technologies.

Moreover, ecological design is crucial in various urban developments. One example is the Tirana Riverside neighbourhood which integrates urban technological systems that address climate challenges, employing vertical landscaping and nature-based strategies to enhance heat management and air quality, very common in Mediterranean climates. Another example is Hamburg's Oberbillwerder, often referred to as the Connected City, where there is a significant focus on incorporating natural elements and water features into residential planning in order to establish a network of parks and lakes. Last but not least, these projects frequently incorporate biophilic design principles and demonstrate superior adaptability to climate change compared to others.

Community empowerment is a crucial element in some of these developments. For example, the Brainport Smart District (BSD) in the Netherlands stands out for its commitment to advanced infrastructure while prioritizing resident involvement. Here, community members actively participate in every stage of decision-making, utilizing participatory approaches that allow them to make changes in their neighbourhood as needed. This model goes beyond the typical public consultations found in many projects, as it demonstrates how innovative governance operates.

Finally, these smart neighbourhoods showcase numerous economic focuses: some function as innovation districts or economic centers (e.g., MIND in Milan, which emphasizes life sciences and technology enterprises; Nordhavn and Knoop XL, which accommodate research institutions), while others focus on local community enhancement by improving daily services for residents (such as Tirana Riverside or Gredelj). These differences influence potential lifestyle scenarios: high-tech campuses and start-up incubators for some versus local markets and antique shops for others—thereby impacting the social dynamics and vibrancy within each area.

However, these differences exemplify the varied strategies employed by the smart neighbourhoods to implement smartness in urban environments. As we see, each neighbourhood has their own distinct strategy to address particular neighbourhood-specific challenges and objectives. Consequently, the emphasis on certain aspects of smart development may vary as one aspect might focus heavily on technological infrastructure while another prioritizes social innovation. However, such variability does not negatively impact the overall dedication to a comprehensive smart city framework. Importantly, these variations present valuable learning opportunities: innovative practices from one neighbourhood (like Merwede's design promoting reduced car reliance or Nordhavn's integrated energy system) can serve as models for others, reinforcing the need to tailor smart strategies to local contexts instead of adopting them indiscriminately.

– **Synthesis of Smart Strategies and Livability**

Smart urban neighbourhoods thrive by blending technology, sustainability, and a focus on human-centered design, all aimed at improving the quality of life for residents. Research shows that the most successful communities are those that harmoniously integrate a variety of strategies to create a cohesive and livable environment. Key integrated strategies include:

– **Community Participation Strategy**

In the 20 neighbourhoods that were analyzed for the purpose of this research, we noted that engaging citizens in the neighbourhood's decision-making process is a pivotal component for success. As we have seen in all neighbourhoods, the residents, or the “smart people,” want to actively engage with other residents and planners of the neighbourhood, as this gives them a sense of ownership, and in return, it will establish trust between the planners and the residents.

– **Sustainability and Resilience**

Prior to smart neighbourhoods, cities usually focused on the traditional principles of building neighbourhoods based on infrastructure, with minimal consideration to environmental factors. Now, with the rise of smart neighbourhoods, environmental sustainability is the most important principle that serves as the foundation for all other smart strategies that are implemented to address urban and climate challenges. The initiatives of sustainability and resilience include green urbanism, combined with state-of-the-art technology, in order to develop solutions that are both innovative and effective. As we see, the principle of sustainability includes the design and development of urban areas that contain a number of high-performance buildings and living infrastructures.

At the same time, at a more localized level, the focus shifts to specific enhancements implemented in the buildings, such as deep energy retrofits and the installation of green roofs. As we have noted in the neighbourhoods, the strategies implemented are diverse, starting from passive systems that rely on natural ventilation and lighting to active solutions such as district energy systems and green power plants. In addition to energy systems and green power plants, the 20 smart neighbourhoods that were analyzed also focused on the integration of renewable energy sources, including solar, wind, and geothermal, into resilient urban designs that also include sustainable drainage systems and fiber optic networks. This comprehensive approach to sustainability results in neighbourhoods that are not only low in carbon emissions and resource-efficient but also promote health and overall livability.

– **Technology Integration:**

The rise of the smart neighbourhoods is made possible with the integration of technology, which effectively enhances environmental and social initiatives. In the neighbourhoods that this research analyzed, we noticed that they employ district-wide initiatives that help the neighbourhood become smart, such as smart grids and sensors, which monitor and optimize energy and water usage in real-time, and urban data platforms, which help manage traffic patterns, among others. This research also saw specific cases, such as Aspern Seestadt, which employs digital surveillance in all neighbourhoods to enhance real-time energy distribution.

This seamless integration of technology minimizes waste and energy shortages while enhancing responsiveness through functionalities such as smart lighting and real-time public transport updates—ultimately, these advancements enhance the quality of life for residents. As we can see, technology is intricately integrated into the city's framework, preserving its character and human scale while serving as an unobtrusive support system for sustainability and convenience. This approach confirms that successful technology in smart neighbourhoods prioritizes user needs while simultaneously striving for clear environmental.

- **Livability & Social Inclusion**:

In the 20 neighbourhoods that we analyzed, we have concluded that the primary goal of these smart neighbourhoods is to improve the livability of neighbourhoods as they transform them into more convenient and healthy places to live. In these neighbourhoods, we notice that by combining participatory governance, sustainable design, and cutting-edge technology, we can see immediate developments in the overall quality of life as the residents benefit from living closer to their workplaces and are encouraged to use public transportation, which reduces traffic congestion and pollution.

At the same time, numerous initiatives in these smart neighbourhoods focus on enhancing housing affordability and fostering social inclusion, which in the long term guarantees that the advantages of smart neighbourhoods are accessible to all residents. In line with this, these smart neighbourhoods thoughtfully integrate public spaces and educational institutions, as part of their strategic efforts to create not just high-tech areas but genuinely family-friendly communities that cater to both elderly and young professionals. This human-centered approach utilizes technology and innovation as tools to improve living conditions, aligning with the original vision of smart cities.

Finally, insights from research on 20 European smart neighbourhoods reveal that, while each case is unique, a common thread runs through them: successful urban development relies on a cohesive strategy. Smart environments, mobility, governance, people, and living are interconnected principles. The neighbourhoods of the future can only develop successfully when these elements collaborate, customized to the local context, resulting in sustainable and inclusive communities.

In summary, city officials and local leaders need a clear vision for urban policy, followed by the formulation of relevant policy implications grounded in New Smart Models (NSM). As we have noted, sustainable design and citizen engagement, among other smart principles provide a foundational framework, while variances in methodology underscore the importance of adaptable and context-sensitive planning. However, it’s important to note that none of these areas attained perfection; instead, by learning from both positive and negative aspects of smart neighbourhoods, urban planners and community leaders can refine their strategies for developing smart cities.

Finally, this research emphasized that the fundamental nature of a smart neighbourhood resides not only in the optimization of technological tools but also in the seamless integration of these systems within human communities and ecosystems. These 20 neighbourhoods show again that they thrive on openness, adaptability, and a commitment to enhancing human well-being. Last but not least, this research explored diverse practical examples, which served as an encouraging indication for the future, suggesting that achieving smart and sustainable urban environments is attainable if we embrace comprehensive approaches to connecting people, places, and technology.

6.7 RESEARCH CASES – URBAN PLANNING AND SMART PROGRAM

6.7.1 Criteria for detailed case research selection

This research adopts a multiple - case study approach. From an initial list of twenty European smart neighbourhoods, five were chosen through a two - step purposive method that merges criterion sampling (sufficiency of data, project maturity, and program scope across various domains) with maximum-variation sampling (considering geography, scale, governance structures, and thematic focus). Cases lacking sufficient public documentation or featuring overly limited pilots were omitted; near - duplicates were eliminated to prevent overlap. The final five serve as rich sources of information that exemplify different models of smart urbanism. (See Appendix – Research Catalogue 3).

The primary evidence comprises official master plans, design and infrastructure documents, reports on sustainability and certification, implementation dashboards, and policy tools. Secondary evidence is made up of academic case studies and independent assessments. The research is based on systematic document analysis; where applicable, datasets were utilized to validate reported outcomes.

The research employs a six-domain smart-city model, but analysis emphasizes three key dimensions: Smart Environment, Smart Living, and Smart People. Given their direct influence on neighbourhood - level sustainability and improvements in quality of life. For each case, we categorize Objectives, Interventions, Outputs, Outcomes, and Evidence within these main dimensions; the other dimensions (Mobility, Governance, Economy) are seen as enablers/context and are accessed only as far as they clarify or restrict the outcomes.

Initially, the research examines each case individually then gather the details, record them into the matrix, and create a concise, clear profile. The research arranges the five profiles to each other and identify recurring elements, deviations from the pattern, and combinations (for example, a specific design approach paired with particular governance structure) effectively alter the results. The goal is focused on practical patterns, analytical conclusions that can be taken and be utilized in other contexts.

To conclude, such an elaborate selection workflow guarantees that the 5 neighbourhoods this research selected represent a wide and varied sample of smart urbanism in Europe and can be feasibly studied due to data availability and recency. This methodology aligns with established qualitative sampling frameworks; specifically, we employed a blend of criterion sampling (with explicit inclusion criteria regarding time frame and data sufficiency) and purposeful maximum variation sampling to encompass a range of contexts and themes. (See Appendix – Research Catalogue 3 – Research Cases).

6.7.2 ASPERN SEESTADT (VIENNA, AUSTRIA)

— Walkability and Transit-Orientation

Aspern Seestadt is Vienna's audacious answer for an integrated vision of urban mobility in the next decade, by converting an old airport into a real-life testing ground for clean transit. The design counteracts car-centered planning with the inversion of hierarchy in mobility within the system of conventional development, by putting the convenience of human - scale mobility ahead of mechanized transportation. What makes Seestadt so compelling is its having been built on a pact that commits to a 40% public transit, 40% active mobility, and 20% car use split in terms of transportation - after a target commuting mode share ideal, public transit and active mobility are both treated as equivalent fractions to those of cars. It is not just to make the neighbourhood less car - dependent; it is to fundamentally reimagine its residents' daily life, to transform their neighbourhood into a place where walking to the local cafe, biking to work, or taking the metro to Vienna's historic heart are equally desirable choices. The fact that the U2 metro line is extended right into the development is a sign that Vienna is a representation of real infrastructure investment first, and population density second. Through strong connections to public transit acting as the neighbourhood's circulatory system, ownership of a car becomes optional rather than a built-in prerequisite, fostering a more connected – and environmentally conscious – urban population that other European cities can learn from when it comes to drawing fit-lines to address their own mobility obstacles.

— Mixed-Use Developments and Adaptability

The vision of Aspern Seestadt for mixed-use development demonstrates how urban space can grow organically rather than being assimilated into fixed functional typologies. The district is premised on the idea that dynamic communities are created when living, working, learning and interacting become less defined. This is not just a matter of putting different types of buildings next to each other, but of creating an ecosystem in which a ground-floor café can morph into an early-evening co-working space or in which residential lobbies double as informal community gathering spots. What's ingenious is the creation of spaces that can change their function according to the time of day, the season or the shifting needs of the community; an acknowledgment that urban life is by nature fluid, unpredictable.

What sets Seestadt apart in this mixed - use approach is a focus on shared infrastructure and shared spaces that can be used for a variety of functions at the same time. Instead of an efficiency lashed simply to convenience, the complex biases its shape towards the common good, providing spaces that maximize happenstance meetings and pollination of ideas between inhabitants, laborers, and passersby. This approach assumes that the most vibrant neighbourhoods are those in which professional networks, personal ties and daily routines blend naturally and easily. This flexibility in the spaces - the physical spaces but also in the programmed spaces - means that as the demographic, economic and social context in Vienna changes, Seestadt can change without the need for wholesale redevelopment. This kind of flexibility is a sign of civic maturity; it shows that a city is not trying to predict the future perfectly but that it has built itself up with large enough and simple enough frameworks that it can absorb changes and still be a humanely scaled, intimate neighbourhood.

— Green Infrastructure and Public Spaces

In the recent rapidly evolving decades, scholars have increasingly advocated green infrastructure and urban nature, among other key principles and approaches in the smart city and smart neighbourhoods initiatives. A fundamental rethinking of how urban environments might operate as living systems rather than just collections of buildings and roads is embodied in Aspern Seestadt's green infrastructure. The district's approach attempts to weave ecological thought into how we think and conceive of urban building at a more fundamental level than traditional thinking around parks as individual green objects.

Beyond mere showpieces, the two man - made lakes at the heart of the complex serve as multipurpose urban organs that manage stormwater, moderate microclimates, entice people to co - mingle and spurring them into spontaneous social interactions. By integrating water systems into the tightly packed city structure, the project demonstrates how cities can use natural processes to enhance quality of life, all the while coming to grips with a number of urban problems. The web of green corridors and leafy promenades threaded through Seestadt suggests that Austrian planners may have a more sophisticated understanding of how people actually move and live - in cities. Instead of treating green infrastructure as an amenity to be appended after the fact, the district has considered it an essential circulatory system - green arteries that unite neighbourhoods while delivering ecological services like cleaning the air, moderating temperatures and supporting biodiversity.

The combination of green roofs, living walls, and at - grade landscaping work hand – in - hand with each other to create a three - dimensional environment to enhance sustainability over just a simple green roof. But the district's experience also underscores the continuing challenges of sustaining such ambitious green infrastructure, especially in the middle of Vienna's harsh winters, when less crowded spaces may risk neglect, or security. This truth is a powerful reminder that thriving green urban development is not the product of an initial investment in ecologically sensitive design alone - but of resilience led community engagement and adaptive management to guarantee its vibrancy, safety and year-round access for all. The victory of Seestadt will not be felt completely here and in the now, but rather in what is to come when it grows into a settlement functioning as an ecosystem and that can provide for and maintain life for both man and nature together.

—Sustainable Architecture and Resilience

The eco - responsible concept behind Aspern Seestadt represents a radical change of perspective in architecture, where buildings are no longer seen as mere static consumers of resources but as drivers of urban metabolism. While working on the place - based city district, the architecture was supposed to be sustainable in relation to place, and operate on the intention that every structure should give more back than it takes. In terms of the neighbourhood's aggregate ability to 'bounce back' – creating a built environment that may indeed inspire its form to struggle to respond to environmental pressures all the while maintaining a very low ecological footprint. This thinking admits that actual sustainability is about much more than energy performance but about its ability to evolve, survive and enrich through years of shifting climate and ever-changing needs of the city. Active technological systems need not exist in isolation and the flexibility of passive systems is integrated into the active, this is an intelligent reading of how architecture can be made to assist natural forces rather than resist. As climate mediators, buildings in Seestadt breathe, absorb and store solar energy, participate in districtwide energy sharing through smart grid systems, and adapt to seasonal changes. This system of interconnectedness turns each single building into a node within a larger urban organism in which a surfeit of one can be put to use by another, ultimately creating redundancy and resilience not achievable by any single building on its own. Integrating with the Vienna district heating network is a great example of this system's thinking and one that exploits city-wide infrastructure to simplify the building while maximizing the overall efficiency.

Yet the experience of Seestadt also demonstrates where sustainable design principles may remain to be translated into lived urban reality. The district is a leader in energy management and resource efficiency, but climate adaptation - especially when it comes to tackling urban heat islands and extreme weather events - calls for more robust methods than those available from current building codes and design standards. This disparity between technological capacity and deployment hints at how the most significant challenge posed by sustainable architecture isn't technical but organizational: how to establish governance structures and maintenance practices that can support continued innovation while accommodating unanticipated environmental pressures.

— **Digital Infrastructure and Data-Driven Services**

Aspern Seestadt's digital backbone is a powerful example in how cities can learn from real - time feedback. By networking up all the IoT in the district, Seestadt performs as an urban system, sensing conditions, processing problems, tweaking systems, all in real time. This new way of thinking would present a shift from reactively managing cities to proactively managing them, and with the added benefit of being more efficient and responsive to changes in condition. What is important, in the end, is that Seestadt is designed around human needs, and not technical possibility. Up - to - the - minute information on energy usage, air quality, and infrastructure performance enables residents to modify their behavior whereas planners are able to respond in kind. This information feedback going backward and forward helps in more democratic and responsive urban governance. But it also exposes the governance difficulties of data-driven cities. In the absence of ICT agendas, digital programs are vulnerable to fragmentation and inequity. Additionally, the accumulation of highly sensitive personal information raises ethical issues of privacy, consent, and algorithmic liability. Seestadt embodies a fundamental tension in the new urbanism: Technology efficiency versus individual rights and democratic oversight.

— Smart Environment

Not just a simple collection of isolated green technologies, Aspern Seestadt and its urban sustainability logic are telling us today that city must also think in systems. Alongside Vienna's District heating network as the backbone of this large-scale environmental engine you have passive-building design and smart grid technology- all contributing to total environmental optimization and energy security. Buildings that consume almost zero energy are produced by integrating photovoltaic panels and green roofing technologies that help promote cooling in summer and reduce heat loss in winter. This complements demand-side response measures adopted after real-time smart grid monitoring.

However, the district's green success or failure will ultimately depend on the conjunction of broad infrastructure networks. This represents a daunting challenge in that smart environments require deputies not just operating on their own level but pulling together at all sorts of administrative layers. For example, juxtaposing a focus on one's immediate neighbourhood with what is called global wisdom, collaboration between technology and nature (including human-built environments), community activity every day co-creating living mechanisms in which they live choices for themselves- all help illustrate this point.

— Smart People

"Smart people" in Aspern Seestadt transcends the dominant technocratic storyline which identifies urban intelligence with sensors, algorithms and automatic systems of any kind. Rather the district subscribes to the belief that urban intelligence is not found in technology, but in an activated and adaptable community with a strong learning strategy that can hack the ecology that surrounds them. This people-first approach understands that the most intelligent of city systems depend on the intelligence of those who live in, work for, and develop them—and that resident capacity-building is not an afterthought but a cornerstone of smart city development.

Seestadt has the insight that training to become "smart people" involves more than teaching digital literacy or holding training sessions in technology adoption. The district prioritizes an investment in what we could describe as "urban citizenship"— the skills, knowledge, and collaborative disposition it takes for people to play a significant role in the transformation of their part of the city. This includes learning to think critically about urban problems, to work with others to solve problems, and to build the relationships needed to engage in collective action. The co-creation workshops and co-disciplinary planning processes act as practical laboratories where residents come to learn how to be constructively involved in complex urban systems and take increasing ownership for it.

But the district's experience also demonstrates the tightrope an urban district must walk between democratic participation and swift action in a rapidly shifting urban environment. To build and sustain community engagement that remains purposive as neighbourhoods age and populations churn, however, takes institutional longevity and governance structures that can accommodate the needs of both residents and professionals, as well as the requirements of regulation. It’s not just about sustaining peoples’ engagement, however, as much as it is about making sure that engagement continues to be meaningful rather than tokenistic—that the voices of residents really steer what gets done, rather than simply lend legitimacy to what was already planned. This continuous negotiation between expert knowledge and local practices is one of the trickiest parts of realising genuinely smart urban communities.

— Smart Living

Aspern Seestadt’s idea of smart living goes beyond mere technology gadgets and devices to how the city itself can be a place for people to thrive in. The district is based on the belief that smart living can feature a harmonious combination of physical design, digital infrastructure and social systems that are designed to create ‘genuine intelligence – making a real difference to daily life, and to helping form stronger bonds between people living and working together. This perspective understands that meaningful urban innovation is frequently invisible – enabling residents to shift seamlessly between activities without many of the anxieties of so much of today’s urban living.

The density and mixed-use character of the district represent an idea whose time has come, an acknowledgment that mature patterns of living are those that support human interaction among a range of age groups and activities. It is a model of urbanization that Seestadt develops “ambient intelligence”, interweaving high density housing with mobility infrastructure and digital-enabled community services— an urban environment that anticipates its inhabitant’s requirements, without constant active management from its human dwellers. The electric-vehicle ecosystem, walking networks, and virtual community spaces are layered one on top of the other, dovetailing with different ways people might choose to live, and softly steering them toward more sustainable choices.

What marks this approach out is the realization that smart living is finally more a matter of social cohesion as much as it is technological finesse. Web-enabled platforms that help neighbors share and plan for activities that support one another may serve to boost rather than supplant face-to-face relationships indicating that the best smart cities are those that use technology to enhance, not erase, what is often most enjoyable about the city: the ability to experience community and share experiences.

— Critical Evaluation (Strengths & Limitations)

The trajectory of Aspern Seestadt reflects the potential and contradictions of smart city dreams today. Its appeal is the fact that it recognizes that such urban intelligence ought to flow out of us, out from our needs and not out of technology as such, should be carried out in our cities as terrain de vie and not simply as a platform for technology. This people-centric way of life is represented through thoughtful inclusion of modal choices, low-impact design features and community-based programs that work together rather than against one another for recognition or resources. The real-world setting methodology gives an opportunity to urban systems to try out things and evolve, acknowledging that urban systems must change and move in an uncoordinated manner.

And yet Seestadt's fate also exposes the underlying difficulties in making smart city dreams a day-to-day reality. The fate of the district depends greatly on long-term institutional commitment (which is increasingly difficult to sustain as neighbourhoods age and populations shift) and resident buy-in which tends to diminish as areas become attractive to tourists and new arrivals in search of "authenticity". The progressive and experimental approach to bringing in technology, while laudable, raises questions about longer-term sustainability and scale. That is, more importantly perhaps, the absence of strong, comprehensive, and organized structures for digital governance creates a perilous gap between technological ability and democratic oversight, and one that will potentially lead both to efficient systems and to intransparent and disempowering ones.

Feasibly, the district's greatest weakness is that it depends on a booster shot of massive public investment, political will and an early adopter community that isn't easily exportable to many other places. If Seestadt can demonstrate that user-driven smart city making is possible, it also makes apparent that such methods rely upon ongoing institutional leverage and solidarity around what many a city still lacks. The challenge for future smart cities projects, therefore, will be to distill the replicable lessons from the success of Seestadt, while building more resilient forms of governance that can simultaneously embed democratic governance and technological innovation in more diverse urban settings.

6.7.3 BRAINPORT SMART DISTRICT – HELMOND

— Walkability and Transit-Oriented Design

The Smart District of Brainport located in Helmond, Netherlands embodies eco-friendly, innovation and quality of life. Walking through Brainport's re-landscaped world, it is hard not to feel the weight of industrial history beneath your boots – but what impresses you most is how this once extremely significant heart of industry has been reconceived as if it was a canvas for human-scale mobility. You can get glimpses of the city's old industrial past, but what impresses you most is how thoughtfully everything has been laid out for walking and biking. The routes are not just highways from point A to point B. They are pleasant to travel, with comfortable places to stop and natural spots. The district plans to incorporate electric vehicle (EV) sharing schemes and e-bike infrastructure to further support sustainable mobility (Felixx, 2024). It is astonishing that Brainport does not feel like it was planned only by adding bike lanes and stamping that durable. Rather, because the complete district was designed for human mobility, walking and biking there feels natural. The old industrial buildings are a reminder of just how much a place can transform if a community decides to prioritize human needs, and that tech can be born in places that work for humans, not the other way around. Although Brainport has many ambitious initiatives, it still faces challenges, especially in ensuring the reliable adoption and acceptance of emerging mobility solutions like Hyperloop, which remain theoretical and would require extensive infrastructure investment (AP News, 2024).

— Mixed-Use Developments and Adaptability

Brainport Smart District envisages mixed-used development as an alive ecosystem, in which the people in a location shape their own community from the outset. Instead of simply mixing various types of buildings, the district blends the boundaries between living, working, food production and socializing through 80 hectares of shared urban farming, water management and energy production. This strategy turns urban living from a process of using services to a process of making services where residents might tack community gardens in the morning, use local institutions during the day and communal areas every night. What is interesting about Brainport is that it is inherently adaptable – it recognizes that communities are intrinsically uncertain and that what it does should be able to be reinvented in response to shifting demands. As a flexible master plan, it has allowed residents to participate not just in where they live, but also to participate in a conversation around how urban space should serve human needs. Living here would change the way you relate to your neighbourhood at its core. Where, instead of consuming a city government-provided experience, one would actually be helping to build it in an endless experiment of how people might live in a city long-term.

— Green Infrastructure and Public Spaces

Brainport Smart District (BSD) is an innovative living and working community where the urban greenery is carefully planned together with transportation, healthcare, education facilities, renewable energy production, and overall, a vibrant cultural tapestry. The district has a lot of green and blue infrastructure, this is part of BSD´s vision, strategically located throughout the district, with a large, shared central park in the middle of the district, social heart of the district with leisure space, community events and urban farming. Walking through this central park, you would see first-hand how this asset acts as the neighbourhood's living room. It is a place where daily patterns of urban living effortlessly fuse with the natural elements and neighboring humans, whether you are just passing through on your way to work or stopping to check out weekend farmers markets.

What makes this solution powerful is that the green networks not only comprise the central park but they also strategically continue and connect with other areas in the district to handle stormwater in runnable corridors. Living here would mean contact with nature is not something that you seek or make plans to pursue on your days off. It would be sewn into the fabric of daily life, from the ponds along your street to the community gardens where you might grow your own vegetables, alongside your neighbors.

— Digital Infrastructure and Data-Driven Services

In the canvas of the Brainport district, urban forms weave together harmoniously to create a comfortable environment for the community. The main focus of the district is to have technological progress; therefore, it is constructed with a sophisticated digital infrastructure aimed at enhancing efficiency, sustainability, and quality of life through data-driven services.

As an example of how well Brainport is dedicated to leading in digital infrastructure and data-driven services, some initiatives are worth mentioning. One of these is the smart grid systems in the district which make energy utilization more effective by monitoring and optimizing electricity consumption at the real time level. When combined with renewable power including wind and solar, these systems can offer a lot of transparency when it comes to energy use and demand. Brainport's power network is therefore not only eco-friendly, but also extremely responsive to the flexing needs of energy. To conclude, Brainport conducts a symposium of sustainable urban forms that capture the essence of a forward-thinking, technologically cutting-edge, and environmentally responsible smart city in this symphony of green areas, canals, and smart grids.

— Smart Environment

The Brainport Smart District's environmental approach is an advanced proposal for neighbourhoods that can think and operate with their own environmental desires, in concert and live with themselves. The district system works in the way that environmental intelligence does—when technology disappears as things are managed automatically, energy moves, water flows, and waste cycles occur without the need for humans to act forever directly. Living here would involve living inside spaces that intelligently optimize themselves around you: one's rooftop solar panels might share surplus energy with the neighbor's electric car, and sensors would monitor air quality and adjust a building's ventilation before you ever feel the need to.

It is powerful because residents move from being passive consumers to active participants in a local scale environmental system. Yet the grid is more than just a means to push power: It's also a way for neighbors to share resources and reduce combined environmental impact with automated interactions. You could wake up one morning to discover that the home battery storage you installed helped power the community center's evening event, or that moisture sensors ensured your shared gardens, which you help care for, didn't get overwatered. The IoT sensors that capture the air particles and allergens in your environment also could give you real-time feedback that affects your daily actions—whether to go running outdoors, open the windows or attend more community events.

Even now, the district's use of big data leaves open questions about the trade-offs between environmental efficiency and personal privacy. The Board of Ethics policing data governance knows that for residents to effectively harness these systems, they must first believe in them. Life in such an interdependent ecology would be a continual dance of convenience versus autonomy, the automated care of the environment versus the control of privacy and day-to-day choices.

— Smart People

The further development of Brainport by smart people, with the involvement of local residents and businesses, is essential. Their involvement in co-design processes ensures the development of the neighbourhood mirrors the real needs and desires of its users. In practical terms, that would mean habitants would not simply move into a finished neighbourhood, but they would be joining an ongoing conversation about what your community should become.

The co-design workshops and planning sessions are venues in which the day-to-day aggravations and bright ideas and dreams about the long-term future actually get taken into consideration when decisions are being made about everything from where the playgrounds go to the routes of traffic flow. Such an inclusive process is vital when it comes to creating a harmonious and resilient community.

Brainport Smart District (BSD) is seeking to create a smart society of people through education, involvement and innovation. Smart citizens are enlisted to take part in co-creation interventions based on workshops, idea competitions and experimentation projects, moving from being passive users to become proactive partners (UNStudio, 2019).

In addition, Brainport plans to create power from the bottom up and leave real control in the hands of the citizens. People will control common resources such as distributed energy systems and places for locally produced food through resident-led cooperatives and neighbourhood councils that will have real power. Energized residents who engage in managing their flows of energy and their production of food gain most practical skills and deepen their grasp of ecological interconnections. This experiential involvement fosters a powerful change in perception - from passive recreation to hands-on stewardship.

What is more important, the BSD seeks to promote social diversity too while attracting non-tech residents into the area and providing affordable housing for families, seniors and those who are uncomfortable living in smart-home-heavy buildings. This results in genuine community participation, not digital exclusivity. But maintaining authentic resident involvement over the district's long-term trajectory of implementation is a challenge. Understanding that successful urban innovation hinges on citizen participation, BSD's planners are committed to not following the same failed smart city tack of little-to-no resident engagement so many other projects have followed.

— Smart Living

Brainport Smart District: the learning and developing area for living in a smart way, qualitative living and mixed-use neighbourhood to live and learn to ensure durable, comfortable living. This urban solution combines technology and urban planning to improve everyday life, health and well-being. Rather than enforcing technology for its own sake, BSD includes user-responsive building systems that adjust to how occupants actually live - controlling lighting and security relative to natural rhythms and linking people with vital services via user-friendly community platforms.

The "healthy village" model promoted by the district leads with healthy living surrounded by plenty of green areas, recreation facilities, safe walking, jogging and cycling paths. Community gardens offer fresh nutrition with a side of social connection. Sensors, placed carefully, can detect any abnormal sequence of events you like and let loved ones know when a frail resident might need a little help, providing safety in a discreet safety net that preserves dignity.

Connected communities thrive within safe social platforms designed to facilitate effective neighbor communication and address local issues, while providing privacy to residents. Technology and cultural life come together with ease with digital displays of area art and events that celebrate collective identity. BSD's intelligent living concept is grounded in human freedom - with the automation of everyday chores and the facilitation of service access, BSD residents enjoy more quality time for meaningful connections and fulfilling individual pursuits. This represents a world where technology is not a necessity, not a burden, but a liberation, an ever-present support for the richness of human immediacy.

— Critical Evaluation (Strengths and Limitations)

The broad nature of BSD's sustainability campaign is both its biggest asset, and greatest flaw. Although the district's clustering of energy systems, waste cycles, food production, water systems, and ecological restoration presents real potential for urban autarchy, that system interdependence also incurs significant risks. There are countless points of failure where a technical glitch could cascade district-wide, he said. What looks promising in theory does not hold in practice, especially during the far from rapid assimilation when parts of the system still need to work before full integration.

The district's flexible planning approach is impressive urbanism that accommodates, but does not have to fight, uncertainty. While conventional master plans are typically fixed and fall behind, BSD's flexible organizational framework expects to grow and adapt, and take on new technologies, whilst retaining its core principles. This type of flexibility has a price that one must pay for and that price is stability. Many of the systems that may be the future of BSD haven't even been tested at urban scale, which means that BSD in a sense is a giant experiment, and residents are basically guinea pigs. Significant risks of obsolescence and vendor lock-in brought about by a high dependency on state-of-the-art technology, may also challenge their sustainability. BSD's joining of biodiversity conservation with healthy design demonstrates significant insight on how human health and the health of the environment are interlinked. However, despite its expressed inclusivity objectives, the tech-heavy approach could unintentionally alienate residents who are not digitally literate or who seek to live more simply. The ready embrace of smart systems may exclude those not comfortable with a tech interface, including elderly residents, people with disabilities, or people who prefer to live a low-tech lifestyle. This digital split could form two classes in the community that BSD seeks to bring together.

The advanced technical equipment that brings a better quality of life by necessity has to be maintained and updated, leading to dependencies on maintenance and other foreign specialists and proprietary systems that may outstrip what is available locally. There remain questions of long-term financial viability, as while matching is good today, up front and ongoing costs remain high and technology refresh cycles may simply not be viable in a post-subsidy world, likely resulting in compromises that water down the original intent of BSD.

Conclusion

The BSD concept deals with urban issues and combines the use of smart solutions and sustainable principles. The district also gives priority to ecological regeneration using a combination of renewable energy systems, circular waste management, and closed - loop resource cycles that drastically decrease carbon emissions while playing a key role in the regeneration of local ecosystems. The mobility framework revolutionizes urban movement with comprehensive walking, cycling and public transit infrastructure supported by electric vehicles. This accommodation package eases congestion and pollution and produces more quiet, livable streets that are conducive to exercising and interacting with others.

BSD promotes social cohesion through the careful planning of public spaces, community gardens, and social infrastructure which enables residents to interact in ways that matter. They are common spaces where people meet every day, solving problems together, which are the social networks that provide a cushion for the complicated issues of any city.

However, the effectiveness of such integrated approaches would rely on sustained resident participation and the durability of the technology. The complex integration of environmental, moving and social systems creates vulnerabilities, in such a way that problems in an area can impact on the performance of the district as a whole. Also, a tech-reliant solution might leave out citizens who are uncomfortable with digital interfaces, and so exclude them from the inclusive community BSD’s trying to build.

6.7.4 NORDHAVN (COPENHAGEN, DENMARK)

— Walkability and Transit-Orientation

Located in the Copenhagen harbor, Nordhavn is the largest urban development project in Scandinavia, covering 2000 hectares. The former harbour began to become a smart district in 2008 when the consultants Cobe, Sleth, Polyform and Ramboll won the development competition. Nordhavn has become an internationally known walkable, transit-oriented district referred to as the "five-minute city" - nowhere is more than a five-minute walk away from public transit. The district places an important emphasis on the pedestrian network and on cycle paths, in particular with intermodal transportation options, to minimize the dependence on the private car and to combine a contemporary way of life with respect for the environment.

The architects envisioned the neighbourhood that would be a seamless mixture of high-tech innovation and sustainable urban planning. The district is also serviced by an extensive public transportation system, with many bus lines, two new metro stations linking it to Copenhagen's city center and "super bikeways" linking Nordhavn to the metropolitan area at large. In parallel, the infrastructure projects provided a basis for walking, cycling and public transit options, integrating low carbon, environmentally friendly mobility elements in the district urban space.

Nordhavn is driven by the green and smart mobility agenda, expressed through its five-minute accessibility principles. The district gives precedence to public transportation, bike paths, and pedestrian oriented streets, with auto oriented streets as a last resort. For a clearer air and lower carbon emission, the district layout is focused mainly on walking and biking.

— Mixed-Use Developments and Adaptability

Nordhavn's master plan combines mixed-use services and flexibility to minimize long commutes for Denmark's approximately 40,000 new residents/jobs. It promotes a mixture of densely populated, mixed-use neighbourhoods with a variety of commercial buildings including retail outlets, cafes, fitness centers and office or residential premises. The Audo House epitomizes Nordhavn's philosophy – a solid compound with a design studio, restaurant, café and boutique hotel all integrated into one building, with spaces that flow effortlessly from work to dining, to bed. This intentional mixing helps create the street-level vibrancy that gives neighbourhoods a true feeling of life, enabling communities to mature and develop naturally.

What makes Nordhavn particularly considerate is the respect it has for industrial history — along with a vision of the future. The sleek "Portland Towers" are a turning of these two cement silo towers into the wind by the genius of architects who understand that historic bones can hold up contemporary life – old concrete bracing modern offices behind update facades that respect the past and the present. And warehouses have been successfully converted to homes and community spaces, proving a real commitment to adaptive reuse over a tear-down-and-rebuild mentality.

The district's "smart grid" plan is a deeper knowledge of urban planning at work, the realization that cities need to be born, evolve. By providing flexibility into the fundamental structure, Nordhavn's design can adapt to changes in the economy and population while keeping a lively atmosphere 24 hours a day, seven days a week.

— Green Infrastructure and Public Spaces

The main goal of the Nordhavn's district is to harmonize modern living with the natural world with a focus on being eco-friendly. The architects behind Nordhavn knew that very advanced technology and sustainable city planning could melt into one another, in an attempt to balance modern living and the earth. And this vision also appears in the green and blue infrastructure in Nordhavn, such is also Copenhagen's ambition to shape cities that are good to live in, and good for the environment.

Nordhavn's designers conceived the area as landscape architecture, not traditional urban planning, from the very beginning. This was the perspective that guided all decisions and guaranteed organic systems would not be decorative afterthoughts, but woven into the fabric of the neighbourhood. For Nordhavn to be a landscape design, the architects added new canals to the harbor to make it bigger and made a green waterfront walkway for residents to use (Cobe, 2023).

A series of parks and public spaces runs from urban plazas in the south to a more untamed, natural approach in the north, providing space for recreation, socializing, and stormwater management. Nordhavn's green infrastructure also features geothermal energy schemes, which will deliver low-carbon heat, and heat stores that are intended to save heat over the summer for use in winter.

District center piece is the "Green Loop" - a sky trail building a continuous pedestrian, bike, transit link across the district and providing a promenade park. This slightly raised ribbon of road strings together various islands and green spaces, enabling people to jog, bike or walk between neighbourhoods without dealing with much traffic.

Additionally, Nordhavn focuses on public space as well. As an example, is the Konditaget Lüders landmark, the epitome of the way that Nordhavn was using public space by turning a multi-storey car park into public infrastructure. Market and entry are located at the ground floor, the leisure areas, including play- and sportsgrounds, are located on the roof. This upward stacking is a case research in the transformation of strictly functional structures into real social institutions that can fill more than one community role.

Green roofs and walls-most notably unit 10's on its end elevation, which shows a climbing beacon-and other greening options cover much of the district, offer natural insulation in the high density, mixed-use environment. These living surfaces help to moderate building temperatures and provide a pocket of nature to soften the sharp edges of the urban environment and show how ecological use and visual value can work hand-in-hand in a high-density development.

— Sustainable Architecture and Resilience

Nordhavn showcases how today’s smart city initiatives can genuinely enrich citizens' lives with the intelligent fusion of technology, sustainability, community engagement and innovation. Sustainability and resilience are guiding principles in the district’s design, in a city that has set itself a rather ambitious target of becoming the world’s first ever carbon-neutral capital by 2025. All new buildings in Nordhavn need to comply with demanding environmental standards, making it one of the first districts in the world to do that across the board. Buildings use renewable energy and are highly energy efficient, while industrial buildings are refurbished rather than demolished. Converting old silos into new offices shows this in action – it’s about protecting our cultural history while also sidestepping the huge carbon costs of new materials.

This approach reflects a broader wisdom in urban development — that the greenest building is often one that’s already built, which can be adapted rather than needing to be entirely replaced. Nordhavn brings new life to industrial relics, produces spaces with true character and values, yet lives up to today’s environmental demands.

Nordhavn focuses on sustainable design features such as solar panels, district-heating-ready installations, natural ventilation systems, green roofs and smart grid distribution to minimize buildings’ carbon footprints. This strategy shows how the district also balances climate responsibility with cutting edge design. Resilience is another key aspect in Nordhavn, having in mind that its location is on the coast and reclaimed land. To protect the infrastructure from future floods, the masterminds behind this project adopted comprehensive flood-proofing techniques by elevating ground levels. The extension of the M4 metro line to Nordhavn incorporated new design data for the climate, having entrances to the stations, tunnels and tracks raised above a potential 10,000-year flood. And the artificial island Lynetteholm will protect the city from storm surges.

The development of Nordhavn is in line with Copenhagen’s larger strategies around sea level rise. Quay edges and land are designed to accommodate such projections of sea level rise up to one meter by 2100, under the city’s Climate Adaptation Plan. They are action adaptable measures that make Nordhavn into future proof infrastructure addressing climate changes, thereby illustrating urban resilience. This mix of protective and adaptive design strategies make Nordhavn’s urban fabric rich and durable, surviving the effects of various weather conditions.

— Digital Infrastructure & Data-Driven Services

According to the City of Copenhagen (2019), sustainability along with the provision of innovation and citizen welfare is fundamental to Nordhavn strategic framework and the city will be pursuing low carbon targets through the greater use of renewable energy and a resilient waste management system. At the core of the district are principles of inclusion, active city life, and shared resources to form a connected, urban system. The Nordhavn flagship smart project, the Energy Lab Nordhavn, is a laboratory for future smart energy systems. As a carbon-neutral project, Energy Lab considers the problem of a growing system's flexibility, driven largely by inflexible (renewable) generation. It shows how producing electricity, cooling, heating and energy efficient solutions can be combined in an optimized energy system. This information-driven approach supports advanced analytics and automation goes all over the district, such as lights on the street that adapt depending on the foot traffic and signal traffic adjusts during peak usage.

Additionally, The Green Loop joins Energy Lab as another example of a design that can meet several criteria at once when it comes to urban sustainability. The IDC will be a model of efficiency that combines metro access together with cycle paths and walking routes, and the added benefit of being environmentally friendly through smart digital solutions. The key to a successful Green Loop is the recognition that urban efficiency is not born of individual systems acting on their own but is the result of their thoughtful integration, in which each of them serves and strengthens the others. Meticulous in its design and execution, Nordhavn epitomizes urban innovation and illustrates how tomorrow's problems may be tackled in a manner that respects natural systems. That is particularly meaningful because the district demonstrates that environmental responsibility and urban convenience are not mutually exclusive — they can in fact complement each other when thoughtfully designed by anyone who knows how people really live and get around in a city.

To summarize, in the Nordhavn district it is part of the architecturally cutting edge and forward-looking structures that form the city’s smart infrastructure, or the "city brain” system, which links local systems to a centralized urban data center. During large gatherings, when there is increased traffic, the data platform will send out real-time notifications to Introduction Cities worldwide and continue to explore new ways to develop traffic light control and routing. With this campaign, residents benefit from open data apps that provide information on the transportation, parking, and energy consumption. These programs are aimed at hailing civic services as ones like smart waste containers even open more efficiently and facilitate innovation. The district demonstrates that smart city technology thrives not when we are impressed by its complexity, but when it vanishes into the fabric of invisible, responsive urban life.

— Smart Environment

As it was mentioned previously, this district employs different green practices towards the goal of a zero-carbon urban framework (State of Green, 2021). Through multi-source energy integration and resilient infrastructure, Nordhavn emphasizes how digital tools can improve environmental efficiency. The Nordhavn Development Project presents full sustainability in energy saving buildings, district heating and renewable energy resources, including windmills and solar power. District-level smart mobility infrastructure combined with comprehensive bike networks, EV charging stations and efficient public transport is integrated, along with smart grid technologies for optimized energy use and distribution.

Those official development documents presented by Copenhagen emphasize using renewable energy and doing advanced waste management to be environmentally gentle. Energy from geothermal systems serves as low-carbon heat, with heating provided even during winter with the ability to capture surplus, summertime heat and stored it for use during winter months to ensure energy efficiency year-round. Combination of power, heating and energy efficiency technologies in a large-scale smart energy experiment at Energy Lab Nordhavn illustrates this integration by demonstrating how to combine various technologies for power, heating and energy efficiency in a fully integrated smart energy experiment.

The result has been revolutionary changes to sustainability and livability due in large part to smart urban design standards. Renewable energy and green building work have slashed the district's carbon footprint, and sustainability efforts in transportation have reduced gridlock and improved the quality of air. This mixed-use environment adds an economic ripple factor and contributes to innovation and serves to make Nordhavn a very attractive place to live and work. And as it works to tackle flooding and maintain the quality of harbor water, the neighbourhood is turning to automatic waste collection to reduce truck traffic and pollution and drainage sensors enabled with internet of things (IoT) technology to measure water levels. These innovative, integrated systems underscore Nordhavn forward-thinking in sustainable urban management, illustrating the power of intelligent infrastructure to further improve environmental performance and quality of life when effectively coordinated across a variety of systems.

— Smart Living

Nordhavn's smart neighbourhood living concept is based on technology, urban development and digital services that work to make urban life better for everyone by prioritizing health, sustainability and convenience (State of Green, 2022). Hence, Nordhavn offers intelligent housing that is energy-efficient, enhances safety, and brings more convenience to life. (Earth. Org, 2023) claims that smart home devices allow you to take care of your lights, heat and appliances with a tap on a phone app, or even with an order to Siri or Alexa. According to (Earth. Org, 2023), energy buildings have smart meters and Internet of Things (IoT) sensors that monitor real-time energy consumption. This enables people to save money and cut carbon emissions. High-speed internet, and flexible workspaces feature in integrated home-office sets that accommodate the trend of working from home. The student residences at the Copenhagen International School are an excellent example. The smart city infrastructure of Nordhavn improves daily life. for their citizens by creating neighbourhood-wide technology suites that can be used for accessing local services, for running analyses of housing conditions Santa Monica silicon beach silicon beach tech companies' tech firms venture capitalist venture capitalist beach silicon Santa Monica maintenance problems, and getting involved in community activities. In addition, a mobile app exists through which residents can access different transportation options, such as leased e-bikes, shared cars, and public transportation scheduling. Automated disposal systems involve underground vacuum tubing systems that cut down on noise, carbon and expenses. This type of integrated service is designed to make life in cities easier and reduce environmental strain.e services is to make city living more convenient and less polluting.

About the attention to physical playback in the urban planning of Nordhavn, it places a strong emphasis on the physical position of playback, exercise, mental-health care, and nature. For instance, there are car-free zones that prompt invalid residents to walk and ride bikes. (The Guardian, 2024). Pools protect public bathing in ports to allow for year-round swimming. such as air quality sensors and urban Health tracking initiatives such as air quality sensors and urban heat surveillance, aim to reduce health impacts on vulnerable groups of the population (Visit Denmark, 2023). The district is also exploring health-tech offerings like wearable fitness trackers and hooked up to local hospitals for preventive care, and mental health chatbots that run on AI, to help residents.

— Critical Evaluation: Strengths and Limitations

Nordhavn proves that cities can handle modern demands through total sustainability and local involvement and yet live-in tune with nature. On that level, the district is a model of integrated land use, transportation and environmental planning for developing smarter, more sustainable cities.

The sub-scheme "five-minute city" works especially well, and demonstrates a high-density and walkable urban environment conducive to a better quality of life. One-third of trips will be by bike or public transit, a modal split that remains elusive for many cities. Early metro links and cycling highways have cut reliance on the car, helping Copenhagen in its climate goals – and show how infrastructure timing can dictate the habits of residents.

With the smart energy grids and green building standards, Nordhavn aims to borrow from large urban neighbourhoods to pave the way in becoming one of the very first to become carbon neutral. The district acts as a laboratory to develop innovative clean technologies such as smart heat service and EV (Electric Vehicle) and demonstrates scalable solutions for Copenhagen's ambition to be the first carbon-neutral capital in the world, by 2025. The district's adaptive master planning model is a sophisticated exercise in urbanism, aka the opposite of a sprawling, inflexible design imposed all at once. This phased strategy allows for iterative adjustments based on feedback and new information—subsequent phases already include lessons learned to improve housing affordability and public space design.

Nordhavn however experienced challenges in maintaining long-term operations of public space activation as well as handling ongoing technological development. The district's challenging sustainability and smart city ambitions necessitate long-term citizen engagement, but sustaining genuine community involvement across extended development time spans is less clear. Moreover, new systems and technologies may come to replace the rapid developments of smart systems and infrastructure, needing continual investment and adjustment that could potentially overstretch or divide citizens and communities rather than strengthen them.

— Conclusion

The vision of Nordhavn epitomizes inaction as the pinnacle of smart urban development — an instance of where transit-oriented development, a smart energy network and good design all combined up nicely. The district is a showcase of how technological innovation and environmental sustainability can work in harmony – not against each – other to deliver genuinely holistic urban responses. This integration recognizes that truly effective smart cities start from the human level, with technology that advances quality of life for all people as opposed to augmenting technologies that only serve the few, and little-by-little creating a new group of exclusive individuals we refer to as "Digital VIPs".

Whether such ambitious smart city visions can deliver on their grand intentions are the greatest aspirations of the handful of companies and cities around the world pursuing such transformations, all of whom are eyeing Nordhavn's decade-long journey from industrial harbor to sustainable urban model with outsize interest. The district's success or failure could yield meaningful lessons for cities around the world struggling with the same existential questions of climate change, urban expansion and technology.

If they are fulfilled, Nordhavn would set a new standard for urban development that would show that sustainability and innovation can work together with a truly livable neighbourhood. This would solidify not just Copenhagen's position as a leader in sustainable urban policy, but also offer a blueprint that other cities, as they seek to reconcile their stewardship of the environment with an upsurge of human life around the world, could follow as an example.

6.7.5 SCHUMACHER QUARTIER (BERLIN, GERMANY)

— Walkability and Transit-Orientation

The 46-hectare Schumacher Quartier project, situated on the former site of the Berlin-Tegel Airport, will include more than 5,000 housing units for over 10,000 people, schools, shopping facilities and parks. The master plan proposed a high-quality urban design that can stimulate a 15-minute city plan. Thus, places for work, school and leisure are within a walking or cycling distance of daily life requirements to avoid the use of cars on a daily basis (Fraunhofer IPK, 2024). The intention of this proposal is to link to neighbourhoods of the Kurt-Schumacher-Platz as well as fill an important urban hole in this area.

The composition of the smart district is a network of perimeter blocks with generally mid-size buildings and a few larger ones. Ground-level units are designed in a way that allows free use as either living or non-residential premises (IBA Wien, 2024). The plan's main ambition is to establish a compact transit-oriented neighbourhood with small blocks and short distances within the neighbourhood, and strong connections to the city. In distance, the U6 U-Bahn line passes in the vicinity at the stop Kurt-Schumacher-Platz, and new bus lines will follow the edges of the quartier (Schumacher Quartier, 2021). In addition, Schumacher Quartier reflects the concept of transit-oriented development and 80% of mobility should be achieved by walking, biking or public transport and it goes for a car-free environment by reducing the use of private cars and creating a better pedestrian and cyclist environment. As far as mobility infrastructure is concerned, five multi-story mobility hubs serving as parking and change-over structures between public transport stops will be set up (Schumacher-Quartier, 2025). This scheme releases the Quartier streets from parked cars and through traffic, and makes them into green, social spaces. Every residence will be located within 300 meters of a mobility hub, were shared cars, e-bikes, or public transit will be available.

In the final analysis, the master plan's central concept is to provide a neighbourhood designed for people with light traffic. You guessed it, public transportation and walking and cycling will be the primary methods to get around, with amenities and transit situated strategically to make the neighbourhood accessible from all directions.

— Mixed-Use Developments and Adaptability

The Schumacher Quartier is a model for intelligent mixed-use planning anything but generic in creating a vibrant urban habitat where residential, commercial, educational and leisure uses intermesh effortlessly. Locating local shopping, dining, and services within residential blocks turns the stations into multi-use community crossroads with ground floor retail, like cafes, bike repair space and grocery stores, becoming neighbourhood nuclei served by transportation while also providing critical services and encounters. The overall education campus stimulates daytime life with a collection of schools and childcare centers as well as a sports center, but also brings different generations together and thus keeps the streets active also during the day. A mix of new homes the housing development concept represents the "new Berlin mix" with a in the ownership structure 50% municipal enterprises, 40% cooperative and private entities and 10% student accommodation, around 35-40% of the total 5000 housing units fitted out as rent control housing, in order to ensure a social distinguished and affordable housing mix (Schumacher Quartier, 2025). The formal model allows the district to retain maximum flexibility of use of its ground floor spaces, designed with variable ceiling heights and flexible layouts that permit transitioning residential, office, service and public uses with minimal reconstruction in order to respond to changes in the demographic and the community without major reconstruction of the built fabric. This flexible adaptability, in turn, establishes a mechanism for the ongoing evolution of the neighbourhood that will keep it usable and useful over the decades of urban transformation, generating long-lasting social and economic returns to the local economy.

— Green Infrastructure and Public Spaces

The green infrastructure strategy for Schumacher Quartier embodies an integrated approach to urban climate adaptation that aligns the ecological with the social, establishing the development as a model for biophilic urban design. The new 30-hectare public green space, featuring a major Landscape Park on the former airfield establishes a multi-layered ecosystem supporting both human utilization for recreation and wildlife habitats, addressing Berlin's critical need for climate-resilient urban development. Within each residential the design integrates carefully selected connectivity to a variety of green spaces, route – playgrounds, tree lined squares and community gardens – ensuring that the environmental benefits of living in the homes are available to all and that the diverse needs of the different demographic groups living in the homes – from young children through to the elderly are part of the design.

Roofing greening, facade greening, and court greening are not only aesthetically appealing but also multi-functional habitats for a diversity of urban wildlife, with the focus on the winged insects and birds that are putting up with the stress of densifying urban environments. Built form specializations, such as nesting boxes and bat modules integrated into mobility hubs and school campus facades, showcase the roles that can be played by architectural design in effective participation in ecosystem services delivery, thus cultivating residents' meaningful interactions with natural processes during urban expansion that add, rather than subtract, from local biodiversity.

Moreover, the district's novel vision for a water-sensitive urban design centerd on the concept of a "sponge city" is not just about water management – it is about how public space might better cope with rain, how a damp climate can be used to cool cities, or how water can be better employed to recharge groundwater. By avoiding overloading the sewage system during storm, and collecting rain as a resource for climate adaptation, held water provides evaporative cooling during heat waves, slowly recharges groundwater at a rate that will not lead to large, invasive drawdowns, and as such has helped create a neighbourhood that serves the complete water cycle unfolding on how we can, through intentional urban design, reinforce natural processes to make cities more resilient.

— Sustainable Architecture and Resilience

Schumacher Quartier symbolizes a paradigm for sustainable urban construction. Mass-timber is a key success factor for Schumacher Quartier – it is poised to be the largest timber-constructed urban district in the world with a bold commitment to wood-based building, starting at 50% timber content per building as a minimum, with timber ratios increasing in line with future developments in construction methods. The strategic reliance on wood construction provides significant carbon benefits through the retention of CO2 and by circumventing the enormous emissions typical of producing concrete and steel, which have been compared to achieve greenhouse gas savings of 35-56% in multi-story comparisons studies.

The pioneering "Bauhütte 4.0" project fits in next to the development: there is a digital manufacturing factory for timber components, the medieval guild lodge is given the form of a "Forest to City" value chain with an update as a modern guild lodge. This joint project with research institutions such as Fraunhofer IPK and TU Berlin allows prefabrication of modular wooden components directly at the construction site, to improve construction efficiency and minimize construction waste by manufacturing the precise number of materials needed, by which a regional-based production model can be set and carbon emissions produced by production and transportation compared to the innovative of wood construction method in continuous improvement.

The district's holistic energy efficiency strategy aims for at least a German Sustainable Building Council (DGNB) gold rating, using ambitious combinations of super insulation, high-performance glazing, renewable energy production systems and intelligent building controls that respond to occupancy and environmental conditions to minimize energy use. Climate resilience measures - in terms of outdoor shading systems and natural ventilation under the Looking Outwards principle - to deal with the effects of increasing extreme weather events and lowering the mechanical cooling demands, and the commitment to adaptive reuse, shown in the converted of the Tegel Airport terminal into a campus for a future University campus for 5,000 students, show a clear path towards the retention of cultural heritage with a clear purpose of how urban and infrastructure should be viewed, not as a tabula rasa but as an action and potential transformation for new uses not be seen as demolition or waste of resources but underlies the idea of the maintain heritage continuity, history of place and embodied energy.

— Digital Infrastructure & Data-Driven Services

The advanced, digital infrastructure at Schumacher Quarter is an integrating, centralized and holistic system designed for smart cities with a high-capacity fiber optic network and a wide array of sensors. It uses digital twins and simulations from design to operations, therefore enabling the integration between physical and digital systems, which is the basis for the ongoing optimization and flexible management of urban infrastructure.

A digital networked environment at the core of this virtual system is the FUTR Hub, the central IT platform inside the Urban Tech Republic innovation park that pulls together real-time data on environmental conditions, traffic flows, energy usage and more from around the district. The processing of this data yields intelligent infrastructure management in the form of Adaptive Systems: responsive street lighting, and optimized heating and cooling networks as examples that decision making based on data can make our lives more efficient and sustainable.

The focus of the platform is on the engagement of residents, through open data tools and smart city apps, in particular the “SQ app”, a shared smartphone/workstation based-app, that offers a more direct access for citizens to mobility services and real time information, as a way to increase the participation and involvement of citizens. The district’s expansive network infrastructure, 5G capabilities and public Wi-Fi for a variety of smart city services will focus on smart transit that aids intelligent transportation systems, mobility hubs with digital kiosks and route optimization apps, and infrastructure planning for autonomous vehicles. New housing also incorporates smart home innovations, such as digital energy meters and smart thermostats, allowing residents to see and control their energy usage, and the abundant telecommunications infrastructure connects home offices with local tech companies, further intertwining digital infrastructure with economic growth and positioning the district as an epicenter of entrepreneurship and innovation.

— Smart Environment

The energy concept of Schumacher Quartier is groundbreaking for metropolitan heat distribution and is released worldwide for the first time: a "low-energy network" that turns the district into a climate-neutral energy island without the need for fossil fuels. The large-scale Low Ex (low-exergy) district heating and cooling network, a 12 km low-exergy DH and DC network which was established by Berliner Stadtwerke und E. ON, runs at a much lower temperature level of around 40°C/20°C for winter heating/cooling. This novel thermal grid and smart heating control dramatically increases the energy efficiency and reduces cost by removing large intra-efficiencies inherent in traditional high temperature heating systems and building a decentralized system that functions well under component failure, thus the system can be more resilient.

The commitment to environmental optimization of the district also includes not only the energy systems, but also comprehensive smart environment management through IoT and smart technologies, and includes a 24/7 continuous monitoring of air quality, noise, temperature and water conditions using strategically-placed sensors across the district. Integrated schemes, such as water and waste management, mobility hubs, and e-cargo bike logistics, also generate a “smart environment” that endlessly optimizes resource efficiency and curbs emissions through data collection and system response. The close relationship to the Urban Tech Republic further strengthens this environmental orientation as a genetic thread, generating a positive feed-back loop wherein the district is striving to always perform even better from an environmental perspective, while playing the role of a social industry laboratory, a place where sustainable urban development models can be generated and shared with other urban settings.

— Smart People

The architecture of the Schumacher Quartier set value on an “open educational landscape” that showcases the importance of integrating community as a key aspect of a smart city, comprising two new education facilities (elementary and secondary schools), sports-oriented facilities and potentially a public library or community learning center, and is forming a campus for educating not only the students, but the community as a whole. The district is further dedicated to public engagement, where city residents play a key role in the detailed planning of their city, through globally-offered design charrettes to locally-held public conferences, where individuals have an opportunity to bring forward and share ideas about their community and its shaping. The Berlin state and Tegel Project's ability to engage local stakeholders in shaping the future of the airport site, in a manner that tackles issues including traffic management, and prevent the sell-off of the green space, reinforces the commitment to community engagement that started before shut down planning and extends beyond the decision and into governance.

Nowadays, Schumacher Quartier is explicitly conceived to encourage a vibrant, mixed community people of all ages, income and background, not to purpose-built for well-off urban professionals: it goes beyond that to provide a place where workers, families, students and the elderly are able to afford to live all, achieved by including very high level of affordable housing. The planning approach mobilizes education, transparency, and citizen participation to develop a civic culture in which local stakeholders are able to play an active, informed role in developing and collective decision-making for their neighbourhood, and sets a precedent for sustainable urban development that favors social inclusion and democratic decision-making as much as technological innovation and environmental health.

— Smart Living

The Schumacher Quartier emphasizes health, safety, and convenience through low-traffic streets, landscape integration, and digitalization (Urban tech Republic, 2025). By limiting the presence of private cars, the district eventually leads the way to serene, child-friendly streets that prioritize walking, biking, and social gathering, and which in turn reduce noise and air pollution. Moreover, planning actively promotes mobility, as well as accessible streets for pedestrians that are seamlessly connected to bike paths that lead to the Berlin metropolitan area (Schumacher Quartier, 2025).

Besides, Schumacher Quartier also plans to redefine city living by using smart home technologies — allowing inhabitants to control lighting, heating and kitchen appliances from mobile devices — combined with a Low Ex energy network that which provides optional underfloor heating and passive cooling to maintain indoor comfort levels, which reduces reliance of conventional heating and cooling equipment (E. ON, 2025).

Anywhere nearby are daycare centers, medical clinics and other social infrastructure that make for a better and healthier community. There are also lots of great initiatives going on that are all about the well-being of the community. For instance, the application "SQ-App" enhances the quality of life by allowing residents to book transportation and attend local activities.

As we can see, the Schumacher Quartier embodies a sustainable, digitally connected and health-driven life, contributes to NetZero targets and nurtures community pride.

— **Critical Evaluation (Strengths & Limitations)**

One of the benefits of being part of Schumacher Quartier is their holistic, all-encompassing approach to sustainability which goes beyond traditional urban development and combines energy, water, mobility, construction, ecology and inclusion into one cohesive unit that feeds off of each other creating equilibrium, as its carbon-neutral energy infrastructure, car-free transportation network, and sponge city concepts show how different levels of sustainable strategies can work together to magnify each other's impact and encourages the public to live in a low per capita carbon footprint which is among the lowest in Europe. However, a major drawback of the district is that the complexity of the district is unprecedented and brings itself with implementation challenges as it extends to 2040, making the need for continuing political commitment and administrative capacity to manage the different smart city systems, the transportation infrastructure, and stakeholder management, for instance, across the multiple development phases something that can be difficult to maintain throughout election cycles, and where often more work needs to be done on the ground to prevent various initiatives being merely at a conceptual stage with a requirement for rigorous project management. Another limitation is the financial feasibility concerns, since systems such as the LowEx energy grid and mass timber construction are costly to deploy, and that initial costs need to be balanced against the long-term affordability goal, especially if costs for follow-up phases rise, while the continued investment in maintaining and upgrading intelligent infrastructure results in ongoing financial commitments that may become a cost to residents or need to be supported through continuous public investment, thus raising questions about the financial sustainability and generalizability of the type of comprehensive smart city initiative in settings with lower financial resources.

— Conclusion

The Schumacher Quartier is a pioneering demonstration of a model for sustainable urban development that goes beyond the traditional smart city orientation, by fusing advanced technology with ecological and social design in a single product offering. The district's holistic approach which also comprises climate-neutral energy systems, modern water management and an integrating housing policy sets new benchmarks for urban sustainable development and shows how technology innovations can work for both environmental and social purposes at the same time. In contrast to other smart city concepts that are essentially about digital infrastructure, Schumacher Quartier demonstrates how real integration can still be achieved today – through the dedicated execution of "next level" solutions such as sponge city design, the revolutionary LowEx energy grid and a ground-breaking timber hybrid design which represents circular economy principles enabling long-term as well as social affordability for everyone. The scope of the project is more comprehensive than just technology, it is the re- envisioning of how cities can function that is oriented towards the health of the community, the resilience of the environment, and the open governance of the community, thereby, making the district a model to be copied to address climate chaos, the digital revolution, and social inequality. By weaving smart infrastructure into the fabric of ecological systems as well as inclusive process for the development of Schumacher Quartier shows why and how a city must co-evolve by all means: environmental, technological and socially, to leave no one behind and create diverse, dynamic communities where people will enjoy high quality of life and that the city Schumacher-Quartier might as a case in point of sustainable urban development be exported worldwide.

6.7.6 GREDELJ (ZAGREB, CROATIA)

— Walkability and Transit-Orientation

The Gredelj site is a 45-hectare urban re - construction project through which the former central railway production area is planned to be transformed into a new city development space – aimed to address significant spatial issues and problems, while creating a dynamic connective tissue and new urban flow in modern Central Zagreb. Located at this strategic brownfield site, alongside important streets and transit nodes, this location has a great potential to be smoothly integrated in Zagreb urban tissue through re - development in which historic industrial heritage can meet the needs of a modern urban community.

The shift mechanism is the transformation and elevation of the existing railway line on viaducts – a radical infrastructure approach that simultaneously unites disconnected communities and creates new world class urban places beneath the railway line. This is engineering allowing for the transportation infrastructure to be leveraged as a sender, rather than a divider, by which, on one hand the site rejoins the rest of the city, via its network-like structure, and on the other maintain its utterances, separating, where necessary the active railways. The sensitive retention of historical railway depots and industrial facilities as pieces of the industrial infrastructure of the site demonstrates an effort to retain the industrial character of the site while adapting these structures for contemporary use - the result of which is a mixed-use district that celebrates its manufacturing past at the same time as it serves the vital needs of a modern urban environment.

The planner's vision guarantees the new district will become a natural extension of downtown Zagreb, with a smooth transition from 19th century industrial edifices to contemporary construction that give shape to a unique and modern urban entity. This shows how brownfield redevelopment can meet both housing supply and demand, capture cultural heritage, as well as enhance the urban fabric, placemaking, and connectivity. Hence, setting the stage for how former industrial sites could be remerged into the urban cityscape in the future while retaining the characteristic and memory of a shape local identity.

— Mixed-Use Developments and Adaptability

The redevelopment of Gredelj is an all-round mixed - use project which incorporates residential complexes with trade convention centers, cultural facilities and public amenities in a unified urban framework designed to make life more interesting for its inhabitants. The project includes 3,550 residential units and has the potential to house between 15,000 and 17,000 people, an easily recognizable mid-sized town. This significant residential component is matched by a 209,000m² commercial bundle that combines office buildings with retail shops and hotels; an additional 47,000 m² are set aside for public services, giving a gross built area of about 590,000 m² which integrates private development and the necessary municipal touch.

For public utility and cultural facilities, the district contains a market hall, museums and a new stage for the Croatian National Theatre as well as buildings for education and administration such as schools and college campuses, public offices and so forth. Such a multifarious organic nature of functions addresses the great demand for housing in Zagreb and the very few possibilities for developing new homes in the city center; it also generates some 5,000 on-site jobs in the process, thus pushing Zagreb toward a more polycentric urban structure. In the project's policy of adaptability, former rail sheds are transformed into exhibition galleries, technology incubators or community centers that retain their historical integrity. The mixed-use composition allows the urban area to adjust to future economic, social or technological reforms in an efficient manner, yet it also keeps hold of one unified city vision. The crafting of a self-renewing locality surely represents the true magnificence of comprehensive urban planning.

— Green Infrastructure and Public Spaces

The Gredelj neighbourhood is an advanced example of urban green infrastructure that goes beyond the traditional park approach to produce an integrated public realm that is able to strategically link into the historical 'green' horseshoe of the Lenuci in Zagreb, an example of how we can add contemporary urban regeneration to strengthen existing environmental networks and establish new ecological corridors. This green network plan, with new parks, tree-lined boulevards and engaging plazas as the organic parts of a larger urban ecosystem, is both to be experienced independently and holistically, and the various squares and parks of the development allow fair access to the open air and congregation throughout the neighbourhood. These finely crafted public spaces go beyond the traditional park program to incorporate cultural uses – markets, museums, theater stages – that turn green spaces into active community nodes where the environment meets the social in symbiotic fashion.

The district's dedication for walkability oriented urban design results in an urban rethinking which celebrates urban mobility through walking and cycling, while creating places without cars that raise the quality of public space and encourage community interaction (Studija Gredelj, 2020). Recreation opportunities such as playgrounds and sports courts are tactically introduced into the green infrastructure to encourage physical activity and maintain habitat for urban wildlife through native plant communities and ecologically diverse landscape features. The creative approach to relocating the bus terminal underground is a case in point about how transport efficiency and public space creation are truly compatible, creating an opportunity for a new transport interchange featuring a public square and green forecourt that will transform visitors' first impression of Zagreb and contribute to the growing provision of open spaces for all in the city. This combined approach to transportation planning and introduction of green infrastructure is an example of how an integrated urban design methodology can solve multiple urban challenges at once, creating sustainable public spaces that serve environmental, social, and economic purposes as well as establishing a template for sustainable urban development that can be adjusted and “translated” for other cities around the world.

— Sustainable Architecture and Resilience

Gredelj project is a leader in sustainable urban rehabilitation for it unites environmental sustainability and daring architecture in one package. The project shows that modern design can satisfy both immediate functional needs as well as provide for a longer-term ecological agenda through careful attention to structure. The local national line: the biggest emphasis will be put on using local resources, systems which work with nature, synthesizing the practice of each component. 'Green' roofs are doubly useful: They help insulate homes better; at the same time, help prevent stormwater runoff downstream, thereby creating a more resilient urban ecosystem. Ground source heat pumps and high-efficiency ventilation systems make unnecessary reliance on traditional sources of energy as well as enhancing air quality indoors. The emphasis is on reusing materials and standards according to the life cycle concept, which is about a 'closed' (or circular) environmental loop that sees buildings being made to work-- both humbly with water back in their place underground, rather than as problem solvers for becoming causes of needs and more pollution over the next several decades.

This architectural idea isn't narrowly about individual buildings, but focuses on levels of urban design—and also on neighbourhoods as well. Massing and placement of the house is the key to catching and using daylight to best effect. Light shelves bounce daylight round inside buildings, which reduces electric lighting needs while creating better living or working conditions for everybody in them. Understanding people and place, sustainable design must satisfy both environmental objectives and social benefits: making places which promote the health of communities as well as the environment.

The project gained speed after the earthquake in Zagreb in 2020, which exposed how weak it was. As a result, this catalyst turned what had been seen as a mere refurbishment project into an urgently needed “build back better” project, where alongside objectives for sustainability seismically savvy public buildings would be emphasized. The action is to bring all the central venues into strongly built, earthquake-tolerant new buildings, from which they can more easily weather future natural disasters. Ultimately, as the Gredelj project shows, sustainable urban regeneration actually solves several problems in one big strike. With these higher-tech building products, sensible design principles and cultural awareness: the Project encapsulates that framework of urban development which apportions a green space for future development – minds the environment's challenges in looking ahead to meet needs today. This integrated approach offers a model to other cities that are trying to reconcile growth efforts with environmental responsibility.

— Digital Infrastructure & Data-Driven Services

The district Gredelj is part of the Zagreb vision of digital urban development, enabling new smart city infrastructure to make everyday life easier by aiding in wireless connectivity and intelligent devices. This lines up with how urban environments can be made to respond to the needs of those who inhabit them. At the core of the development's digital platform, will be seamless WiFi coverage to give today's urban residents around the clock access to all of the services and benefits of modern city living such as flexi-working space and digital service provisions. This new mode of working also makes this connectivity infrastructure even more important. Smart mobility solutions demonstrate what can be achieved with data driven urban transportation. The multi-modal transport interchange combines live information systems, predictive timetabling and smart routing to provide seamless passenger journeys. Interactive navigation and mobile apps make orienting yourself a highly adaptive experience.

Traffic policing has evolved to smart systems that learn from past patterns and let them influence flow at any given moment. Smart parking approaches the problems of urban bottlenecks created by the excessive time-consuming search for parking spaces, as well as the submission to sustainable goals connected to reduction of emissions and to the best management of the traffic. It is a smart way to manage energy, allows monitoring in real time, and integration of renewable energy.

— Smart Environment

The Gredelj project is a model for intelligent, dynamic environmental regulation, an intersection where technology, infrastructure, and ecology intersect in an urban context. This model is establishing communities that take an active role on their environmental footprint and the experiences of the residents. Energy systems reflect this integration in ground-source heat pumps with automated control response to heat, cool and light buildings according to occupant patterns. Buildings are turned into responsive environments which not only save energy but ensure we stay comfortable, and demonstrate a technology that works for efficiency and for living too. Environmental monitoring intelligence is implemented via IoT sensors, which constantly monitor air quality and microclimate parameters. It means in the moment responses to environmental shifts, such as changing how many fans are in use, as well as early warnings of pollutants that may adversely affect homeowners. The smart street is programmed by a schedule that cycles by the hour, and is intimately responsive to pedestrian movement, with technology including LED. This is energy-saving done safely, that's the point, which is an example of how smart systems can do more than one thing at once.

Smart irrigation systems can tell the time of day or even the season, a new technology in town where greenery areas are now tech as well, saving water for unnecessary waste. These systems also allow the temperature modulated control of stormwater runoff in accordance with the desired landscape effect and without wasting resources. The all-inclusive monitoring technology also enables urban authorities to proactively run their city in real-time and respond to pollution in progress. This is a community that is moving ahead and not just reacting to problems along the way. Gredelj adds a note that such urban planning may be in position to act towards ecological hazards with application of digital and sustainable design providing environments which upgrade air and environment quality with in return, serves to dwell.

— Smart People

The Gredelj development follows smart city principles focused on people, taking education, culture and civic engagement as its main goals. It is not technology itself, but empowered, interconnected citizens that makes a smart district work.

The conceptual basis of the strategy includes elementary and secondary schools on the site which allows for community-driven education through graduate mentorship. The collaboration of local industry together with academia incorporates knowledge creation through training programs and through research projects to develop a knowledge ecosystem for scholars and citizens.

The cultural life of the neighbourhood will be even more enriched with a museum, theatre and city library on Paromlin site in the future. Therefore, in addition to claiming proactively, cultural institutions contribute towards the production of a domiciliary cultural literacy through providing a space for community expressive and creative congregation and by this, exhibit the function role of culture infrastructure in smart city culture.

Community engagement is handled meticulously in the form of well-designed public spaces and a mix of static and dynamic programming. Through community gardens and local events, residents have opportunities for collaboration, while digital tools for neighbourhood development can broadcast information streams in real-time.

— Smart Living

The smart living vision of the Gredelj development demonstrates how urban design can enhance people's lives – not only in physical proximity but also in terms of shared spaces and connectivity – to delightful effect. Taken together, this comprehensive approach results in communities that focus just as much on the health and welfare of residents as on technological innovation.

Mobility as a system revolves around the multimodal transport interchange, where bus, tram and trains are interconnected in an easy and accessible way thus making it easier for commuters, more difficult for them to rely solely on cars. The new focus is on pedestrian friendly or car free zones where as a result walkable and bike-able streets create healthier travel patterns. Hence, stores and chemists are at walking distances that meet all you would normally require in the house, thus reducing the necessity to need public transport or personal vehicles.

Public spaces are designed for people with parks, plazas, and community gathering places that encourage socializing and outdoor recreation. Such spaces promote active living with running tracks, sports facilities, and kids play areas—blurring the line, it would seem, between the "greening" of the city and the "active living" city all at once.

Lastly, technology- integration helps daily life, with a smart home environment, public safety systems and digital services such as e-health care solutions. Behind the scenes, these systems quietly do the work of making convenience and security manageable without overshadowing the needs of the human-scale experience.

— Critical Evaluation (Strengths & Limitations)

Gredelj is a clever effort to address the urban challenges of Zagreb in an integrated way using smart city tenets, successes and failings of which are rife with broader tensions in today's urban development. The project's most engaging quality is the wholesomeness of the urban systems tackled. The suggested radical lift of the railway seeks to overcome a natural obstacle that has been cutting through the fabric of Zagreb since ever, eventually triggering its further metropolitan integration. Beyond simple transport amenity this structural intervention opens possibilities for integrated quarter development with generations-long spatial effects on the shape of Zagreb.

The mixed-use thing is a model with a second grade understanding of city life. This typology encourages resilience by minimizing reliance on outside resources, while maintaining an internal symbiosis between living, working and culture. Its abundant green infrastructure fulfills an environmental obligation, as well as quality of life criteria, which are especially important for the citizens of Zagreb, struggling with urban heat, and being thirsty for recreational parks.

The project, backed by the City of Zagreb and the EBRD, is expected to attract investments of up to €1.6 Billion, thanks in part to only two key land owners (Studija Gredelj, 2020). The interdisciplinary planning team incorporates best practices, drawing on successful revitalizations in cities like Vienna and Munich. Sustainability is further integrated through green building practices and seismic resilience, while retaining cultural heritage with the Gredelj factory remains contribute to sense of place (Studija Gredelj, 2020). If it works as planned, Gredelj might become a template for a fully integrated smart neighbourhood that balances financial, environmental, and social goals.

However, the project Gredelj, regardless of its ambitious objective, faces a range of risks and potential pitfalls. One of the primary concerns is complicity of implementation: i.e., the infrastructure work required, in particular the engineering that will have to be done to raise the railway would mean working with the national rail authorities and costly delays might be experienced (3LHD, n.d.). On the other end of the spectrum, the underground bus station scheme (which will cost an estimated €1.6 billion and spread out across 15 years) is vulnerable to economic fluctuations and changes in political control, which could jeopardize funding commitments in the future (EuropaWire, n.d.). In addition, the extended timetable raises the possibility that public support could start to wane if there are no immediate returns in the early stages. It's also a learning curve for new technologies because, for example, a smart neighbourhood of this type had not been implemented in Zagreb before, and there was no existing example (except for other residences in Croatia).

— Conclusion

The objective of the Gredelj redevelopment project is to convert a derelict industrial lot in Zagreb into a vibrant, live/work/play community addressing issues of connectivity, housing and the environment.This masterplan brings together residential, commercial, cultural and green infrastructure, about a self-sufficient urban district that combines economic, social and environmental targets.

The project focuses on sustainable architecture and smart infrastructure, such as green roofs, renewable energy systems, and smart transportation networks. While developing 5000 new jobs and 1.6 billion Euros of the investment Gredelj aims to supply affordable housing, and a community alive, offering vital educational and cultural institutions to ensure that families and professionals choose to come back home to healthy and vibrant neighbourhoods.

But there are daunting obstacles to the project's success. For the use of complicated infrastructure, it is risky in the time overrun and extension on a long day, and economic shock causes danger on securities for investment. The region is also at risk of being gentrified, if housing policy is not carefully handled, and its existing citizens are displaced. In addition, smart infrastructure governance and technical expertise are also required and there are ongoing issues in the retention and integration of classic and state-of-the-art evolutionary functionality. In conclusion, the bottom line of what the implications of the project are depends entirely on doing a good job at walking this tightrope and keeping the challenges addressed and the affordability and public participation front of mind. Gredelj, if it blossoms, could become a blueprint for sustainable urban recovery everywhere in Europe, a model for how cities might be ecological, functional, fair within one unified framework of development.

6.8 CRITIC

While smart neighbourhoods provide various advantages, it is crucial to address the negative impacts of technology on individuals to ensure a balanced and comprehensive approach to urban planning.

6.8.1 Privacy Concerns and Increased Surveillance

The ubiquitous integration of Internet of Things (IoT) devices and smart infrastructure within smart neighbourhoods has raised significant privacy concerns. As IoT technology is profoundly embedded in the architecture of smart cities, there is likely to be cyberattacks, privacy breaches, and government overreach. Although these technologies are enforced to enhance public services and track energy consumption in smart neighbourhoods, such as Aspern Seestadt and Nordhavn, they can also be misused for intrusive surveillance. These desirable communities could be turned into "surveillance nightmares" if there is inadequate management of smart city technology, as they gather excessive data that threatens the privacy of residents.

Residents' privacy could be imperiled due to data breaches and illegitimate access to personal information. People could find these smart sensors and monitoring systems that enhance security to be intrusive and invasive of their freedom. For instance, Aspern Seestadt and Nordhavn both demonstrate significant concerns regarding privacy and increased surveillance, highlighting potential issues tied to innovative technologies.

In Aspern Seestadt, despite the benefits of integrating IoT devices and innovative infrastructure, it has raised serious privacy concerns among the residents in the case of a potential data breach or unauthorized access to personal information. Additionally, residents' mental health and community relations may be impacted negatively by the reliance on digital connectivity. Despite the honorable efforts for sustainability, Nordhavn faces similar challenges, where the implications of technological advancements on the environment and public health need to be addressed. There is a deleterious effect on the environment caused by electronic waste and pollution during the production and disposal of IoT sensors and electronic devices. In addition to the environment, innovative technology may harm residents' stress levels, who must navigate multiple digital interfaces and maintain constant communication. Unlike the other two cases, Brainport's focus on IoT systems and high-tech innovation presents challenges with the digital divide and reliance on technology.

There may be differences in terms of advantages and possibilities if the residents do not have equal access to innovative technologies and digital services. This pervasive digital presence risks exacerbating social isolation and increasing mental stress as residents become overly dependent on technology for everyday tasks.

Given that Merwede is a sustainability-oriented neighbourhood, some people may find it challenging to accommodate its ideals. The new residents must transition from owning a private vehicle to use public transport or cycling. This change could affect some residents' mental health due to the drastic changes. Furthermore, prioritizing smart devices and digital connectivity may impact social interactions and digital fatigue.

Berlin's Schumacher Quarter should consider the security and privacy concerns that come from surveillance and data collection. Besides raising security concerns, digital platform dependence for community inclusion and services might broaden the divide if not all citizens are offered equal opportunities and resources. Lastly, the environmental health impacts of producing and disposing innovative technologies need to be addressed to ensure the project's overall sustainability.

Lastly, as the developing digital infrastructure raises concerns regarding privacy and monitoring for Gredelj, it is increasingly incorporating intelligent technology for energy capability, mobility, and urban management. For this reason, policies and laws that prioritize impartiality, data protection, and terms regarding all kinds of IoT sensors, intelligent applications, and real-time data platforms must be established. Indeed, the Gredelj project will thrive as a human-focused, future- oriented neighbourhood, achieved by technical advancement, protecting individuals' privacy, and promoting ethical utilization of data. Establishing public trust in innovations stemming from participatory frameworks alongside transparent regulatory measures is essential for creating a smart neighbourhood that is both clever and respectful of individual civil freedoms.

6.8.2 Social Isolation and Digital Divide

Social isolation can be exacerbated by digital fatigue and the numerous digital overlays in smart neighbourhoods. The digital gap widens as smart cities are increasingly becoming dependent on digital tools for everyday services. No resident of smart neighbourhoods must be denied access to the necessary resources and prowess, as inequality will worsen. Such failure was noted in the Brainport initiative, which favored high-tech innovation, while people lacked digital literacy.

Additionally, focusing mainly on remote communication may decrease face-to-face interaction in society, and ultimately harming the mental health and social connections. Lacking equal access to innovative technologies and digital services creates a digital divide, which in turn separates citizens from the opportunities and benefits.

Currently, Aspern Seestadt is one of the places that faces challenges related to social isolation and the digital divide. There are fewer face-to-face interactions because residents may prefer virtual communication over in-person contact. As the community loses connections with one another, one may develop feelings of isolation and loneliness. The unavailability of digital technologies and high-speed internet characterizes the digital divide. Some residents may become isolated and hindered from engaging in the digital components of urban life, caused by the discrepancies, which may ultimately worsen social inequality.

Similar issues have arisen in Nordhavn because of the integration of innovative technologies and advanced digital systems. The isolation from society can be a result of the heavy reliance on digital devices, affecting the city management and community participation, notably for individuals who are unfamiliar or uncomfortable using digital tools. The digital divide may widen because of the exclusion of low-income, elderly, and people with limited computer skills from digital services. Based on these disadvantages, these groups may not be able to use the smart neighbourhood thoroughly. Considering these issues, the community will be divided, where social inclusivity does not follow from digital connectedness.

Moreover, the innovative ecosystem and high-tech focus of Brainport put forth smart technologies and digital solutions, which may hinder social isolation and the digital divide. Because of Brainport's high-end digitization, the residents may interact and use services via digital programs, hence limiting opportunities for face-to-face socialization and connections. Additionally, focusing on cutting-edge technology could separate residents who do not have access or the skills to use these resources. Now, there is a division within the community as they will be excluded from these technologies. The division could further exacerbate the existing social and economic inequalities, as they may not have access to opportunities and resources.

The Schumacher Quarter could heighten the digital divide and social isolation by incorporating digital platforms and innovative technology for urban management and community participation. Face-to-face interactions will be hindered if citizens rely on digital platforms for services and communications, which can further impede social bonds and community cohesion. Furthermore, groups such as low-income and elderly adults could be disadvantaged because of the digital divide, as they might not have access to or experience with digital technologies. The consequences of this exclusion could be a divided society with unequal distribution of the advantages of innovative technologies, hence exacerbating already-existing social injustices.

While Gredelj is enhancing urban living through smart homes and digitally supported infrastructures, it risks exacerbating social isolation and the digital divide unless 'inclusivity' is prioritized by all stakeholders. Technology permeates all aspects of life, and access must be provided to all individuals, particularly the elderly, the financially poor, and those with inadequate digital resources, regarding digital duties and functions. Gredelj needs to invest in community- building infrastructure, such as public squares, cultural venues, and other facilities, to prevent profound personal isolation. A human-centric smart district must provide digital connectivity while ensuring comprehensive human interaction to prevent anyone from being excluded during the technological shift in urban environments.

6.8.3 Technology Dependency and Increased Stress

Residents of smart neighbourhoods may be overly reliant on technology to complete their daily life tasks, leading to increased stress levels. Considering that the infrastructure of smart neighbourhoods can be highly sophisticated, requiring continuous communication, residents may experience greater mental strain when interacting with digital devices. Although technological advancements are intended to improve life, they can also cause technological fatigue and increased stress levels, as observed in the smart city of Aspern Seestadt. Furthermore, stress can be caused by the ongoing need to adapt to and keep pace with technological advancements, especially for older generations. As a result, the need to successfully integrate digital advancements into daily life and remain constantly connected may lead to technological weariness and mental strain.

For instance, Aspern Seestadt implements this digital infrastructure into the urban environment, which may cause residents to become technologically dependent on completing their daily tasks. Individuals who rely on digital interfaces and continually manage various devices and platforms may experience higher levels of stress as a result. Additionally, the aforementioned technological fatigue and mental strain may be a result of the need to keep up with the ever-changing technological advancements, which, for some, seem overwhelming. Besides the technological dependence, the residents of Aspern Seestadt also face these challenges that can reduce their overall well-being and heighten their stress levels.

Similarly, Nordhavn's effortless urban experience has been made possible by integrating innovative technology and multiple digital systems. In this case, technological dependence stems from the daily chores that residents perform, including communication and transportation. This dependence leads to increased levels of stress when interacting with such devices presents challenges, or if residents feel pressured to connect constantly. These challenges of technological dependence and increased stress lead to information overload, particularly when navigating intricate digital systems and encountering constant new information. As life in Nordhavn is improving due to IoTs, it may unintentionally cause stress and technological dependence among its citizens.

There are other smart cities with similar issues. For instance, Brainport Eindhoven's high-end technology and infrastructure have successfully created a sophisticated urban environment. Nonetheless, digital devices and other technological advancements are still essential for operating such cities. For this reason, while residents attempt to keep up with and adjust to these technological advancements, they may increase their stress levels. Besides stress, these advancements may lead to burnout and/or mental exhaustion as residents are continuously connected and exposed to the high demands of the technology-driven environment. Although such improvements seem positive for the city, Brainport's residents may experience increased stress levels as they adapt to these advancements. For this reason, a balanced approach is needed that prioritizes both mental and technological advancements.

Lastly, while in Gredelj, the incorporation of technological advancements, such as automated mobility and digital public services, is convenient, similar to the other smart cities, it introduces technological dependence and increased stress. IoTs may be a burden for individuals who are unfamiliar or technologically dependent as they integrate such advancements into their daily lives. Considering these issues, Gredelj must adopt a balanced approach when implementing holistic systems and prioritize the mental health of its citizens. Therefore, parks, the resting places, and the environment in general, will be equally valued. It will also portray technological advancements as a supportive element in residents' daily lives, rather than a dominating factor.

6.8.4 Environmental and Health Impacts

Despite the aforementioned challenges that result from implementing technological advancements, one should also consider their potential environmental impact. The multiple technological advances (5G and IoTs, as well as technologies that are not subject to human control) will undoubtedly increase energy consumption and e-waste, thereby harming the environment. Furthermore, the disposal of gadgets and IoTs from smart cities harms the environment, thereby hindering the objectives they have set. A significant problem with the growth in popularity of digital platforms raises concerns over the effects of excessive screen time and decreased physical activity. Therefore, projects like Brainport and Nordhavn demonstrate the need to raise awareness of the impact these technological advancements have on the residents' physical health and the environment.

In summation, smart cities will offer futuristic urbanization; however, considering the disadvantages that may come with implementing these technological advancements, it is essential to create a balance between such advancements and their inimical effects. It is crucial to consider user confidentiality, integrate social interactions, ensure inclusion, minimize technological dependency, and create an environment that has a positive impact on residents' physical and mental health when building smart neighbourhoods.

6.9 CONCLUSION: TOWARDS CRITICAL AND CONTEXTUAL UNDERSTANDING OF SMART NEIGHBOURHOOD PROJECTS

It is evident that every smart neighbourhood displays thoughtfully planned green spaces and public areas. For instance, Merwede promotes environmental awareness by prioritizing pedestrian- friendly infrastructure, which includes being a car-free neighbourhood and featuring ample green spaces. Similarly, Aspern Seestadt promotes ecological consciousness, as it features a lake and an adjacent park that is approximately half its size. There are numerous attractions such as Yella-Hertzka-Park, Hannah-Arendt-Park, Madame d'Ora-Park, and many more. These parks include playgrounds, gardens, and sports facilities (jogging lanes and skate parks).

In contrast to Aspern Seestadt, Nordhavn is well-known for its promotion of green spaces, including green mobility, community gardens, parks, basins, and canals. Additionally, Nordhavn promotes its concept of being a "five-minute city," ensuring that all these features and other amenities are within a close range of the residences. Due to its urban design, Nordhavn's residents will have a healthier lifestyle, promoting walking and cycling over car rides.

It is becoming apparent that integrating technology into urban planning is crucial for advanced and continual development. Seemingly, the focal point of smart cities, besides technological advancements, is the improvement of natural features that guarantee walkability and accessibility to nature. These can be noted in the towns of Aspern Seestadt and Nordhavn. Although these projects prioritize sustainability, they intermittently disregard the potential consequences. There are concerns regarding the integration of smart sensors in public spaces that monitor and optimize this usage.

Despite these challenges, the Brainport project has successfully achieved the balance of innovation and environmentalism, as they have integrated the green infrastructure with high-tech advances to prioritize ecology. Additionally, Brainport links different residential areas with the natural features (these being parks and green spaces) that offer leisure and relaxation. Similar to Aspern Seestadt and Nordhavn, Brainport also successfully incorporated technology and nature to foster sustainability and innovation. Via technology, there is an improvement in the usability and accessibility of public spaces, therefore creating a chain-linked urban environment.

Moving forward, Merwede plans to become one of the greenest and car-free neighbourhoods with its dedication to environmental responsibility and residents' well-being. It has successfully achieved this accomplishment through its parks and gardens, green roofs, rainwater collection, and other projects.

Lastly, the planning of the Schumacher Quarter emphasizes the open areas and greenery. Similarly to the aforementioned neighbourhoods, public spaces, green infrastructure, and recreational spaces are shaping the image of this neighbourhood into a smart town.By promoting a vibrant urban lifestyle, these smart cities effectively incorporate public, commercial, and residential areas. Brainport successfully ensures a dynamic lifestyle by mixing the neighbourhood with living labs and co-creation involving residents, professionals, and stakeholders. On the other hand, Aspern, with its 11,500 housing units (including furnished and serviced apartments, and student housing), is planned as a multipurpose residential complex that seamlessly combines these units. Aspern should serve as a model for its cutting-edge urban planning and its construction with desirable design, promoting green building, urban greenery, and environmental friendliness in the rainwater system.

The focal point of smart cities is the way that they implement and blend technological advances and the standard of living in urban areas. One of the objectives of such cities is to utilize residential areas and economic vibrancy, while technology serves as the foundation for these to function.

Nevertheless, there are still disadvantages, as some groups may be excluded, especially when access to technological advancements is not distributed fairly across socioeconomic levels. In Brainport, the combination of living labs where residents can participate has proven to be successful. Additionally, this residential area integrates smart technologies by integrating smart ICT, smart grids, and energy-efficient buildings that communicate with the smart grid to optimize energy use. Similarly, Nordhavn is an exemplary neighbourhood that emphasizes the building of an independent urbanization. This residential district consists of 40,000 residential units, businesses, industrial areas, and public spaces. Nordhavn guarantees that these services are accessible within short distances by giving priority to pedestrians, cyclists, and other means of public transport, hence the “five-minute concept.”

Merwede, on the other hand, is intended to be an independent urban area with a well-balanced mix of uses. With an emphasis on community living and easy access to public services, the neighbourhood is made up of over 10,000 housing units that can accommodate over 12,000 people. Moreover, Merwede successfully incorporates the commercial spaces that provide opportunities for the residents to open their retail stores or workplaces that would support other businesses and provide essential components for residents.

Finally, Schumacher Quarter building methods include sustainable materials and cutting-edge building plans that make this neighbourhood environmentally conscious. Its residential units fulfill a variety of needs and promote community living by making these units affordable and accessible. These housing units also align with commercial and cultural spaces that blend retail establishments, offices, and cultural venues to create a vibrant urban atmosphere.

Modes of transportation, such as public transport, cycling, and pedestrian-friendly areas, are another focal point for smart cities. Aspern Seestadt is one of these smart cities where transit was a crucial aspect of planning. The U2 underground line has recently connected Aspern Seestadt to Vienna's city center, and with two stations—"Aspern Nord" and "Seestadt"—Aspern Seestadt now offers convenient access to public transportation. The district plans to achieve a modal split target of 20% motorized traffic, 40% public transportation, and 40% cycling and walking. Accessibility in smart neighbourhoods is also expected to undergo a fundamental switch with the implementation of 5G technology. Quicker transportation management is made possible with 5G-enabled devices, which optimize public transport schedules and reduce traffic. These settings are increasing in the testing of autonomous cars, which could soon be implemented in smart cities such as Aspern Seestadt and Nordhavn. As 5G networks greatly increase data gathering, it will certainly improve the control of driverless vehicles and ease traffic congestion. However, there may be challenges with the use of such technologies, especially regarding individual privacy and monitoring. The data collection and the potential for invasion of privacy that these technologies require can result through extensive regulations.

Lastly, there are numerous areas designated as car-free zones that prioritize pedestrians, hence improving walkability and lowering dependence on personal transportation. Aspern Seestadt includes the green and blue infrastructure to improve and protect the microclimate, considering that half of the neighbourhood is dedicated to nature features (the green spaces and the sizable lake). Aspern, with its advanced Sponge City Concept and rainwater management system, has expanded the plans throughout the district. Therefore, buildings are designed to be energy-efficient, incorporating green roofs, solar panels, and smart grid technologies to optimize energy use and reduce carbon emissions.

Similarly, Nordhavn also focuses on eco-friendly transportation to lessen its environmental omission. First, the community has incorporated sustainable modes of transportation that are visible and accessible to everyone. The residents have implemented a "super bicycle path" and public transportation systems. Second, Nordhavn has made improvements to public transportation,as it plans to develop an elevated Metro line and transportation alternatives that link the district with other locations, including Copenhagen's city center. Lastly, climate awareness, water management, green infrastructure, and sustainable building practices are all part of Nordhavn's infrastructure.

Likewise, Brainport integrates various means of transport that facilitate eco-friendly transit. To illustrate, it prioritizes electric cars and intelligent traveling systems as they test such innovations in their living labs and put them into practice. Furthermore, the residents prioritize public transport and cycling to ensure that everyone has access to effective and eco-friendly means of transport. Finally, with their car-sharing program, Brainport has minimized the impact on the environment and traffic congestion.

Merwede is intended to be an environmentally conscious neighbourhood with car-free zones, complemented by cutting-edge transportation modes that utilize pedestrian and cycling infrastructure. Similar to Brainport, Merwede implements car sharing and public bike services. Lastly, Merwede plans to improve the public transport system by connecting with the rest of Utrecht and other parts. Merwede incorporates techniques for climate resilience, such as energy- efficient buildings, large green spaces, rainwater harvesting, and green roofs.

Finally, and of equal importance, Schumacher Quarter prioritizes sustainable mobility to provide an efficient urban environment complemented with bike lanes, mobility hubs, and paths to public transportation. The district promotes riding as a key source of transportation by having broad bicycle lanes and bicycle fast lanes. Moreover, the shared mobility hubs lessen the demand for individual car ownership by giving access to shared automobiles, bicycles, and other environmentally friendly transportation options. Finally, there are effective and sustainable transit options for locals thanks to the neighbourhood's excellent connections to Berlin's public transportation system. With the use of green and open areas, the Sponge City concept, and sustainable building techniques, Schumacher Quarter integrates climate resilience.

— **Smart Programs and Technological Integration**

Smart programs for information and communication technologies are exploited in smart neighbourhoods. For example, Aspern Seestadt supports smart energy systems by utilizing clever concepts for information and communication technologies. These technologies help the district achieve its sustainability objectives by facilitating the effective management and allocation of energy resources. Aspern Seestadt integrates smart metering and power quality monitoring tools, to guarantee reliable and effective energy distribution, which are essential techniques for effective grid planning. Ultimately, the district gathers and examines information from many sources to support municipal management decisions that enhance overall urban planning, optimize energy use, and improve public services.

In addition to Aspern Seestadt, Nordhavn also incorporates PowerLabDK, which is a reliable system to manage and gather data that offers historical and real-time information from all energy facilities. The co-optimized energy storage and integrated markets are part of Nordhavn's compelling and adaptable energy system. This optimization was made possible through the use of the Smart City Data Platform, which links the two data sources to generate new opportunities for urban administration and innovation. The neighbourhood focuses on immediate data from the energy grid to help guide decisions regarding the city management through public visualizations. This system guarantees a flexible and adaptable urban environment. Besides the instantaneous data, Nordhavn uses public engagement, as such data involves residents in decision-making processes, improving community participation and satisfaction.

On the other hand, Brainport Eindhoven has a smart city data platform that links distinctive data sources to promote creativity and effective urban planning. This platform, which has high-speed connectivity, is one of the data platforms that help meet the needs of businesses, homes, and IoT devices. Furthermore, the security systems, intelligent lighting, climate management, and energy efficiency are successfully integrated by using technological advancements in public areas and buildings. The neighbourhood makes use of Nordhavn's data for privacy protection and implements innovation. The district data, on the other hand, facilitates collaboration between institutions, companies, and citizens, while at the same time promoting cooperation and ongoing urban development enhancements.

Meanwhile, in order for Merwede to meet the connectivity needs of its citizens and businesses, it utilizes a vast digital infrastructure, IoT devices, and high-speed broadband. Merwede improves accessibility and convenience for residents with the provision of digital services such as e-government portals, online learning, and healthcare options. This neighbourhood uses data consumption to maximize resource use and improve urban resilience through sensor data that uses sophisticated analytical tools. Moreover, the systems of digital channels assist residents and local authorities in communicating, hence allowing them to make decisions and promote a sense of community.

Lastly, the Schumacher Quarter's Center of Excellence for Urban Data gathers insights to make informed decisions, ensuring that urban management is data-driven and transparent. Citizens of this area are highly encouraged to use the city's online services, provide feedback, and participate in the planning and development process. This data is essential for the city management as it is utilized to improve the efficiency and effectiveness of urban governance. Considering its importance, ensuring data protection is highly valued.

In smart neighbourhoods, it is essential to integrate efficient management and renewable energy. Aspern Seestadt, Nordhavn, Brainport, Merwede, and Schumacher Quarter were chosen because they demonstrate creative ways to combine smart grids with sustainable transportation to build resilient and sustainable urban settings.

Firstly, Aspern Seestadt uses cutting-edge smart grid technologies to improve sustainability and energy efficiency. In order to ensure dependability and efficiency in the distribution of energy, the district uses smart meters and power quality measuring equipment for effective grid planning,enabling instantaneous monitoring and management of energy usage. Buildings in Aspern Seestadt are equipped with state-of-the-art technology, including photovoltaic panels, solar thermal panels, and heat pumps, which communicate with the smart grid to provide energy flexibility for market participants. Aspern Seestadt enhances the quality of urban life and prioritizes eco-friendly transportation, therefore reducing carbon emissions. As the underground extension connects Aspern Seestadt to Vienna's city center, it improves accessibility and lowers the demand for private vehicles. Furthermore, the transportation system has become more environmentally friendly as car-sharing programs are implemented.

Moreover, Nordhavn incorporates smart grid technologies to produce an adaptable and effective energy system. With energy storage and integrated markets featuring interconnected and operationally co-optimized facilities, the district boasts a cohesive and flexible energy system. The energy system in Nordhavn is made more sustainable by incorporating renewable energy sources like solar and wind power. As Nordhavn places a high priority on green mobility in order to encourage eco-friendly travel, such as the "super bicycle path" and public transportation networks, which are part of the Green Loop, it has improved this system. The district is connected to Copenhagen's city center and adjacent areas by an elevated Metro line and other modes of public transport, which minimizes the need to own a vehicle. Additionally, the design also promotes shared space areas and green bicycle routes, encouraging walking and cycling over car usage.

Furthermore, Brainport Eindhoven uses smart grid technology to sustain its ecosystem of high-tech innovation. Utilizing the smart grid strategy, such as smart lighting, cooling, and heating systems, the district integrates multiple renewable energy sources to guarantee effective and sustainable energy management. With that being said, Brainport is a hub for cutting-edge mobility solutions that support environmentally conscious transportation, which implores novel ideas for mobility and substitutes individual transportation with electric cars and other intelligent transportation networks. In addition, infrastructure for cyclists and public transit is prioritized to guarantee locals access to eco-friendly and effective modes of mobility. While car sharing is one initiative that lowers the demand for private vehicle ownership, it has positive impact on the environment and traffic congestion.

On the other hand, to improve its sustainability, Merwede incorporates smart grid technology and renewable energy sources in addition to Brainport, Nordhavn, and Aspern Seestadt. To reduce its dependency on fossil fuels and increase energy resilience, the district incorporates renewable energy sources, such as wind turbines and solar panels, into its energy system. Merwede is planned as a car-free community with an emphasis on environmentally friendly transport. With vast networks of bike lanes and pedestrian pathways, the neighbourhood places a high priority on such infrastructure.

Lastly, Schumacher Quarter features a sustainable energy system that combines renewable energy sources and smart grids. In order to provide a consistent and sustainable energy supply, the district uses renewable energy sources, including solar panels and wind turbines. The use of urban timber construction and other sustainable building techniques further improves this energy efficiency and climatic resilience. Schumacher Quarter prioritizes the promotion of CO2-free transportation solutions concerning sustainable mobility, and it promotes cycling as a key mode of transportation by creating numerous and fast bicycle lanes. Schumacher Quarter is also well-connected to Berlin's public transport network, ensuring efficient and sustainable transportation options for residents. With all these being said, the implementation of these mobility solutions not only reduces carbon emissions but also enhances the overall quality of life for residents.

CRITERIA – PLANNING RESEARCH SECTION

Photography 7
Aerial view of Nordhavn
Author: COBE

7. CRITERIA – PLANNING RESEARCH SECTION

7.1. INTRODUCTION TO THE PLANNING RESEARCH SECTION

As we have discussed in the previous chapter, the concept of smart neighbourhoods varies from the challenges each neighbourhood aims to address. Building on this understanding, this chapter critically analyses smart cities' technology focus and proposes new, human-centered criteria for urban planning, as we believe that relying on technological advancements is not sufficient for the needs of the communities in these smart neighbourhoods. Thus, this research will look beyond infrastructure and understand the needs of the community by offering human-centered criteria, which will raise important questions about what has been overlooked or under-prioritized when it comes to the community.

Throughout this research, different case studies were examined, and some of them will be used in this chapter, such as Aspern Seestadt, Nordhavn, Brainport, Schumacher Quarter and, Gredelj, to demonstrate how urban architecture may reconcile technological improvements with human well-being, social inclusion, and privacy issues. **The ultimate goal is to propose criteria that prioritize residents' needs, fostering environments that are not only technologically advanced but also socially equitable and supportive of human flourishing, with a focus on smart environment, smart living, and smart people.**

— Problems with Technologically-Driven Smart Cities

Smart cities often use IoT devices and surveillance technology to monitor public spaces and improve the services that the smart neighbourhoods provide; however, there are some concerns raised by the communities, as such technologically-driven projects might lead to privacy violations. Having this in mind such concerns, this research then suggests stronger security procedures, regulatory frameworks, and compliance methods to reduce these dangers while also ensuring the integrity and confidentiality of data acquired in smart cities. In the same vein, this research also argues that the current privacy measures are not sufficient for the scale, but also the complicity, of data generated by smart neighbourhoods. As we have noted in the previous chapter, there is a widespread use of IoT, surveillance tools, and data sharing in different neighbourhoods which may also lead to privacy violations and loss of control over personal data. This brings this research to another ethical dilemma: How can these initiatives in smart neighbourhoods claim that their projects will help the residents if the very data they rely on can be used against them?

Reading across different studies and based on our own, we believe that smart neighbourhood planning and designing has to go hand-in-hand with strong protections, and if not, the positive aspects that were discussed in the previous chapter could be overshadowed by systemic vulnerabilities. Thus, research also highlights that to limit privacy threats in smart city infrastructures, there is a necessity for improved security frameworks, a strategic security focus, and privacy-preserving authentication procedures.

- **Social Isolation and the Digital Divide**

There are certain examples from the neighbourhoods that were analyzed that can show firsthand how IoT and smart sensors are embedded in green spaces, potentially compromising privacy. For instance, Aspern Seestadt and Nordhavn are two smart city projects in Vienna and Copenhagen, using IoT devices and smart technologies to improve urban living. As we have seen, green spaces in both neighbourhoods are outfitted with sensors to monitor environmental conditions and usage habits, thus promoting sustainability.

However, there are concerns about privacy issues as a result of massive data collecting in public settings. In particular, the residents of these smart neighbourhoods may be unaware of the data being collected, which could lead to misuse or spying. While the obtained data is useful for resource optimization, using smart devices in public places jeopardizes individual privacy and liberty.

The research strongly addressing these privacy problems is critical to ensuring the ethical use of technology in smart neighbourhoods. In line with this, this research also suggests that the design of smart neighbourhoods should prioritize privacy in order to assure the residents that their data and personal information are collected only for essential needs. In the same vein, this research suggests that personal information should be anonymized and encrypted to prevent unwanted access. In this way, residents can use public engagement in urban planning to express privacy concerns and shape technology adoption. Finally, we highly believe that neighbourhoods that follow these techniques can avoid surveillance nightmares and protect privacy rights while ensuring that smart technology benefits the public.

As the people who cannot access or adapt to the new technologies fear unexpected consequences, the digital dependency of smart cities has the potential to exacerbate social isolation and increase the digital gap. In line with this, research also argues that the "smart city" concept may worsen existing inequalities by requiring digital inclusion, leaving those without resources or skills behind. As we have noted in the previous chapter, the digital divide has shifted from access to differences in internet usage and that highly educated people use the internet for information and growth, while those with lower education use it mainly for socializing and entertainment. Thus, we believe that this usage gap reflects broader societal inequalities, and rather than closing, the digital divide may actually widen as internet use becomes more widespread.

Furthermore, there are different dimensions of the digital divide, from access and literacy to the socio-economic factors. Having this in mind, it is important to note that the concept of digital divide is a complex and multifaceted concern, which many times goes beyond simple access to technology. In many cases, it includes digital literacy skills but also how the community uses the technology, based on many socio-economic factors. With this in mind, people use the technology or benefit from it in different ways; therefore, addressing the digital divide requires a nuanced approach that considers not just access but also the quality and context of technology use.

In practical, real-life examples, such as the neighbourhood of Brainport, we can note how a high-tech focus can exacerbate social isolation and increase dependence on technology, limiting face-to-face interactions and marginalizing the elderly or low-income residents. As residents rely more and more on virtual connections, the transition from in-person to virtual communication might exacerbate social isolation. In addition, a population that may be less accustomed to using digital tools may find that their social ties are weakened and that community interactions dwindle as a result of an over-reliance on digital platforms. Furthermore, architects must use inclusive design concepts that guarantee all residents, regardless of their socioeconomic or digital literacy status, may benefit from technological breakthroughs in order to reduce the risk of social isolation and the digital divide in Brainport. In order to participate with smart neighbourhood services, this research also suggests that vulnerable populations such as the elderly and low-income inhabitants should be taught digital literacy.

As we can note, the digital divide in smart neighbourhoods is escalating, causing many residents to miss out on essential services and opportunities, often due to socio-economic inequalities. Scholars have explored causes and solutions to address this issue and in this part of this chapter we will give a solution critique that evaluates the effectiveness of proposed strategies to bridge the gap. From the studies and real-life examples of neighbourhoods, we see that the skills gap between those who can utilize modern technologies effectively and those who cannot is another aspect of the digital divide, in addition to internet access.

Thus, the research proposes that in order to solve the widening digital divide and provide fair access to services, smart neighbourhoods must embrace inclusive and human-centered strategies such as providing digital literacy instruction, enabling inexpensive technology access, putting hybrid service models into place, and incorporating the public in urban planning.

— **Overemphasis on Efficiency Over Human Wellbeing**

In the analysis of the twenty neighbourhoods, the research explores how smart neighbourhoods prioritize efficiency, resource management, and environmental sustainability but may neglect social and psychological well-being. In many cases, such neglect might lead to technology dominating urban landscapes which causes stress and discomfort for residents.

Having said this, this chapter focuses on how smart neighbourhoods overemphasize efficiency over human well-being. Research also shows that smart cities often prioritize technological efficiency.

Beyond academic examples, we also have the example of Merwede's neighbourhood in the Netherlands as they employ a car-free design, which, at first glance, is environmentally sustainable, but it may also increase stress for people who are not used to different transport methods. As we have seen in the smart neighbourhoods, there is a constant need to adapt to smart technologies, including the digital transport systems. This constant need to adapt can easily lead to mental fatigue and frustration, especially among residents who are less digitally proficient. Reflecting on this, I believe that while smart solutions like those in Merwede aim to simplify life, they may unintentionally divide the residents who struggle to keep up with rapid digital change, ultimately limiting the inclusivity and long-term success of these innovations.

As seen by initiatives like Merwede, smart cities as of now stress efficiency over social and human factors. Environmental and sustainability objectives lower carbon footprints and encourage healthier lives, but they also bring with them new difficulties, such as psychological exhaustion, social exclusion, and marginalization of locals who are not accustomed to using digital devices. In this part, we suggest that architects should embrace a more comprehensive, people-focused strategies to tackle the emotional and societal strain that arises from placing an excessive focus on productivity. First of all, research suggest that by developing public areas that encourage social contact and community development, introducing new technology gradually, providing training in digital literacy, and guaranteeing accessible transportation options are important tactics. Then, by developing parks, plazas, and pedestrian zones such as in Merwede can help mitigate the negative effects of living a digitally-driven lifestyle. Finally, technologies like digital platforms and other transportation systems should be deployed gradually and incrementally, accompanied by sufficient public education and training initiatives. In this way, the research shifts the focus to smart people, emphasizing the human dimension of smart cities. Efficiency and environmental sustainability are given priority in the current models, but they also bring with them drawbacks like psychological fatigue, social isolation, and the marginalization of people who are not conversant with digital technologies. As many authors have already suggested, in order to alleviate the psychological and societal stress brought on by an excessive focus on efficiency, architects and urban planners should embrace more all-encompassing, people-centered approaches.

— **Environmental and Health Impacts of Smart Technology**

Although smart cities are praised for their energy efficiency and sustainability, they may unintentionally worsen the environment and produce more e-waste. As we have seen in the previous chapter, in order to build smart neighbourhoods, more ecologically responsible building methods are required, as evidenced by the widespread ignorance surrounding the development, usage, and disposal of smart technologies like IoT devices and sensors.

This issue becomes even more pressing when considering that smart city technologies pose a significant concern due to the e-waste generated from IoT devices and digital infrastructure and these devices require large amounts of raw materials, including rare earth metals, which are often mined in environmentally destructive ways. In line with my opinion, several authors, including Kang and Schoenung (2005), Puckett & Smith (2002), Widmer et al. (2005), and Li et al. (2010), also echo the environmental and public health risks associated with the improper disposal of e-waste from smart city technologies. Together, these studies claim that some substances, such as lead, mercury, and cadmium, which are found in IoT devices, can contaminate soil and water, which in the long term can do ecological damage.

Based on my research and by reflecting on these findings, I believe that embracing a circular economy approach is essential—not only to minimize the negative ecological footprint of smart cities but also to promote more responsible production, usage, and recycling of digital infrastructure over time.

Moreover, in practical terms, smart neighbourhoods such as Nordhavn and Brainport employ smart grid technology to effectively regulate energy consumption by linking private residences, commercial establishments, and public amenities to a centralized network. On the other hand, when more devices are connected to the grid, an excessive dependence on digital services may result in increased energy usage.

As we can note, it is evident that while smart neighbourhoods often promote sustainability as their main goal, I find it concerning that the very technologies they rely on, such as IoT device, can undermine those aims. Thus, I believe that the continuous production, use, and disposal of these devices contributes to growing e-waste and environmental strain.

However, there are also examples where smart technologies are used more thoughtfully to enhance sustainability goals. The example of Nordhavn's smart grid infrastructure links houses and businesses to a digital energy management system, allowing real-time monitoring and automated adjustments for efficiency. Despite theoretical waste reduction, this technology can unsurprisingly increase energy consumption, especially during peak usage periods when data transmission demand is highest. Similarly, residents of Brainport may experience digital fatigue as a result of navigating several apps and platforms, which might strain their minds and lower their quality of life in the city.

In this part of this chapter, this research suggests that architects and designers of smart cities need to take a sustainable stance on the whole lifecycle of digital infrastructure, from manufacturing to disposal. Moreover, it suggests that more energy-efficient smart technologies, less dependency on digital services, and sustainable production and recycling programs, as the eco-friendly materials and circular economies that put recycling and component reuse first are essential to sustainable production. In addition, by building smart grids and Internet of Things systems with energy conservation in mind, energy-efficient smart technologies reduce energy usage when in operation. Ultimately, I believe that such an approach mitigates the unforeseen implications of increased energy usage in densely networked smart cities such as Brainport and Nordhavn.

In conclusion, the effects of smart technology on the environment and human health in places like Nordhavn and Brainport demonstrate the unforeseen repercussions of concentrating just on efficiency and sustainability while ignoring the larger effects of energy consumption and e-waste. Smart cities can better strike a balance between technological innovation and environmental responsibility by implementing sustainable production processes, creating energy-efficient technologies, and lessening the cognitive load on their inhabitants.

The research questions addressing the development of the criteria for planning and designing city neighbourhoods in the context of the smart platform are:

- **What has changed in urban planning from being smart?**
- **Have smart people changed the way of planning smart neighbourhoods?**
- **What problems do smart neighbourhoods solve?**

The research into the planning documentation of Representative Research Cases is presented through a comparative analysis of urban planning criteria and smart programs, as seen in Appendix - Such evaluation includes the already established criteria that is intended for assessing, improving, and designing criteria. This evaluation is concluding through the theoretical studies, together with field research on smart neighbourhoods and research cases, as well as perceptual studies related to representative research cases. In the same vein, the analysis identifies both existing and planning criteria that are essential for enhancing the criteria for planning and designing city neighbourhoods in the context of the smart city platform based on the comparative review of these representative neighbourhoods.

7.1.1 **Criteria for selecting neighbourhoods and representative research cases with their relevant documents for planning and designing city neighbourhoods**

Research on spatial planning criteria in the context of smart neighbourhood development investigates spatial planning principles that inform the development of smart neighbourhoods. **An analysis of urban planning criteria is conducted based on an understanding of how these ideas related to smart neighbourhoods are framed within the smart city platform, in other words, for its strengths and weaknesses regarding the content of urban development plans and the planning processes that are used to implement them.**

When it comes to developing smart neighbourhoods, planners rely on a well-rounded set of criteria that touch on everything from theoretical ideas to spatial design, people's everyday experiences, and the unique identity of each community. These criteria are shaped by solid research and a close look at how planning is being done today in different places. They're organized into three key areas: theoretical thinking, understanding real urban challenges, and comparing how planning is actually put into practice. Beyond these core elements, what really sets smart neighbourhoods apart is the integration of smart programs - like digital tools, energy systems, smart mobility, and platforms that invite residents to participate. Altogether, this approach helps evaluate how well neighbourhoods support the goals of a smart city-while keeping people, flexibility, and sustainability at the heart of urban transformation.

Within the framework of smart cities, assessing criteria for the planning and design of smart neighbourhoods necessitates a definitive set of standards that encapsulate both spatial organization and human experience. These criteria emerge from comparative research and practical insights drawn from a range of European urban cases.

By reviewing both past and present planning documents from selected smart neighbourhoods, two important findings emerged.

1. First, there are planning criteria that are already being used effectively to guide the development of smart neighbourhoods - these are clearly present in current plans.
2. Second, there are still some important criteria missing - elements that are needed to fully support the goals of smart, inclusive, and future-ready urban environments but which haven't yet been entirely addressed in the planning process.

7.2 REVIEW OF EXISTING PLANNING CRITERIA FOR THE URBAN AND ARCHITECTURAL OPTIMIZATION OF SMART NEIGHBOURHOOD PLANS

To select the most relevant planning documents for evaluating smart neighbourhoods, a few key criteria were considered.

First of all, past planning documents were reviewed to first understand how did the criteria influence the development of smart neighbourhoods over time. This phase supported this research as it provided useful historical plans which showed how neighbourhood development has been shaped in the past.

Secondly, current plans were also analyzed, specifically those that include updated policies, their response to modern concerns, and how they use smart strategies.

Finally, various planning approaches and methods were also studied. This phase offered a diverse perspective on how smart neighbourhoods should be planned in order to meet today's need for smart neighbourhoods.

Building on this foundation, it becomes clear that examining smart neighbourhoods through the lens of urban planning not only provides insight into past and present frameworks but also reveals a transformative approach to urban living. Aspern Seestadt, Nordhavn, Brainport, Schumacher Quarter and Gredelj are five case studies, among twenty other smart neighbourhoods, that illustrate the various applications and advantages of smart criteria in building livable, resilient, and sustainable neighbourhoods. (See Appendix – Research Catalogue 4).

One of the most consistent elements across these neighbourhoods is their emphasis on the quality and function of green and public spaces. All smart neighbourhoods place a strong focus on well-designed green spaces and public spaces, which demonstrates a shared dedication to both environmental sustainability and community well-being. In addition to offering recreational amenities, these green areas encourage walking and cycling, which leads to better lifestyles and less reliance on cars. Smart technology integration makes these public places easier to use and more accessible, which promotes a more connected urban environment.

These communities' cutting-edge design and functional mix provide further evidence of how crucial it is to integrate public, commercial, and residential spaces in order to foster vibrant urban life. Mixed-use development keeps neighbourhoods lively and bustling throughout the day and week by supporting local businesses and placing necessary services within walking distance for residents.

Pedestrian-friendly zones, bike lanes, and public transportation are just a few of the mobility alternatives that smart neighbourhoods prioritize in order to reduce their environmental effect and encourage sustainable living. These programs, including the "green loop" in Nordhavn and the car-free Merwede area, demonstrate the dedication to promoting environmentally friendly transit options and lowering reliance on automobiles. These smart neighbourhoods also incorporate methods to improve climate resilience, like energy-efficient buildings and rainwater management systems.

Despite the many advantages of smart communities, a number of issues need to be resolved in order to guarantee a comprehensive and well-balanced approach to urban design. The widespread use of IoT devices may lead to privacy issues and increased surveillance, jeopardizing residents' sense of security and privacy. The possibility of social distancing and the digital gap, intensified by reliance on technology, may have an effect on communal harmony and inclusiveness. Furthermore, inhabitants' dependence on technology for everyday tasks may lead to higher stress levels. Ultimately, it is important to consider the negative effects of electronic waste on the environment and human health as well as the decrease in physical activity.

To conclude, smart neighbourhoods, which combine ecological practices and technology advancements to improve quality of life, provide a hopeful future for urban development. To establish fully sustainable and livable urban environments, it is imperative to address the negative effects connected with technology. To fully realize the promise of smart neighbourhoods, privacy protection, social connection promotion, technology dependency management, and health and environmental effect mitigation are critical. By striking this balance, urban planners can pave the way for a future where technology and sustainability coexist harmoniously.

Table 13.0. Overview of existing elements applied for analysing neighbourhoods

ELEMENTS	
FACTS AND FIGURES	- Location (city, state) - Previous use - Total land area - Green and open space - Lake - New Buildings - Residential units - Number of residents (projected) - Number of residents (currently) - Workplaces (potential) - Workplaces (currently) - Year of Master plan - Author of the project - Goals
ACTORS INVOLVED	- Identifying the key stakeholders in the development process;
TIMELINE	- A chronological timeline of events or stages in the development of your research area;
VISUAL DOCUMENTATION & URBAN CONTEXT	- Map (Neighbourhood location within the city and its relation to mobility corridors or strategic hubs); - Aerial Photo (Existing site before transformation); - Planning Diagram (Phased development plan or land-use layout);

	- Images (Completed streetscapes, public spaces, housing typologies, or community events).
DEVELOPMENT PHASES	- Phase 1 (e.g., 2015–2020) - Initial infrastructure and housing blocks; mobility grid and public space delivery. - Phase 2 (2020–2025) - Expansion with commercial and institutional uses, digital infrastructure integration. - Phase 3 (2025–2030) - Densification around central transport hubs and roll-out of smart service layers.
URBAN DEVELOPMENT CRITERIA	- **MOBILITY** - Modal split strategy - Multimodal transport integration - Cycling and pedestrian infrastructure - Parking strategy and mobility fund - Innovative transport schemes (e-mobility, sharing)
	- **FUNCTIONAL DIVERSITY** - Housing and employment mix - Social infrastructure and amenities - Flexibility and inclusivity of urban functions - Mixed-use development and street-level activity
	- **PUBLIC SPACE** - Design of parks, lakes, and green/blue infrastructure - Accessibility and usability of public space - Spatial quality and aesthetic planning - Inclusive, safe, and multifunctional outdoor environments
	- **INNOVATION & QUALITY** - Smart city technologies and urban labs - Sustainability and energy management - Innovation hubs and research zones - Quality assurance and performance benchmarks
	- **ENTERPRISE & INVESTMENT** - Business location potential - Presence of start-up infrastructure - Commercial development zones - Investment promotion strategies

	- **PHASING & DEVELOPMENT STRATEGY** - Quarter-by-quarter development planning - Adaptive land use and scalability - Governance models and partnerships - Mixed phasing of residential, commercial, and service spaces
	- **EDUCATION & CULTURE** - Schools, childcare, and lifelong learning - Public libraries, cultural institutions, events - Inclusion of art, creativity, and diversity in design
	- **HEALTH & LEISURE** - Recreational landscapes and sports infrastructure - Healthcare accessibility and wellness design - Promotion of healthy lifestyle and environmental comfort
SMART PROGRAM	- **SMART ICT** - Networked research - Intelligent data - Open for all domains of an energy system
	- **SMART GRID** - Reliable, green, and clever energy - Transparent distribution networks - Improved grid infrastructure planning - Reliable supply - Real-time system testing - Digitalization cuts costs - Scalable and compatible customer solutions - Intelligent data processing
	- **SMART USER** - People-oriented technology - Using real data for real added value - Incentives for reducing consumption
	- **SMART BUILDING** - Smart buildings communicating with each other - Communal electricity production in energy districts - Digital twin technology for full transparency

	- **MOBILITY SOLUTIONS** - Electric vehicle charging stations - Bike-sharing programs - Intelligent traffic management systems
	- **DIGITAL INFRASTRUCTURE** - High-speed broadband and connectivity - Integration and communication between smart systems
	- **WASTE MANAGEMENT** - Smart waste collection systems - Environmental impact reduction - Encouraging recycling
	- **SMART STREET LIGHTING** - Energy-efficient lighting - Sensor-equipped systems adjusting to real-time conditions
	- **COMMUNITY ENGAGEMENT PLATFORMS** - Digital platforms for civic engagement - Information sharing and resident feedback
	- **SMART HOME SOLUTIONS** - Remote monitoring and control of home systems - Improved comfort and energy efficiency
	- **SECURITY AND SURVEILLANCE** - Smart security systems - Video surveillance and access control - Enhanced safety in public and residential spaces

7.3 MISSING PLANNING CRITERIA IN THE DESIGN AND IMPLEMENTATION OF SMART NEIGHBOURHOODS

While many urban plans embody ideas that align with smart neighbourhood development, there are still several important planning criteria that are not being fully addressed. These gaps often relate to key elements that are essential for making neighbourhoods more responsive, inclusive, and future-ready in the context of the smart neighbourhoods.

In some cases, planning documents reference these ideas in general terms - like innovation, sustainability, or flexibility - but don't provide clear strategies or tools to make them happen. This disparity between vision and implementation can impede the full potential of a smart neighbourhood.

Upon examining a variety of case studies, it is clear that certain long-standing planning issues persist, despite being acknowledge in older documents. Elements like digital infrastructure, public participation through smart tools, or adaptable land-use planning are still not fully integrated into many local plans.

These patterns demonstrate the necessity of a more consistent and contemporary planning approach, one that not only reflects the aspirations of the smart neighbourhoods but also translates them into practical steps on the ground.

— **The Missing Elements in Smart Neighbourhood Planning**

1. Not every neighbourhood has the same access to digital platforms

However, relevant smart community solutions are based on the assumption that all community members have equal access to digital platforms and devices, which is not the reality. And in fact, so many are digitally excluded, be they seniors, immigrants, or people with low income or low education levels.

2. The emotional atmosphere of a place matters

Planning documents are functional by nature but often fail to capture what spaces are like to inhabit, such as the quiet corners and the feeling of comfort in public areas. It is these small, everyday experiences that matter so much to quality of life.

3. Underutilized local decision-making

Even in participatory-designed neighbourhoods, the mechanisms for participation beyond the initial application process are sometimes weak. There are few mechanisms for people to shape decision-making on issues that are close to home, whether those relate to shared spaces, mobility priorities, or community services.

4. When focusing on time, plans often make the same mistakes

When considered over time, urban plans often repeat the same shortcomings by assuming static patterns of use. However, urban life is inherently dynamic, and neighbourhoods evolve in response to shifting daily routines, seasonal variations, and long-term demographic or social changes. Therefore, planning approaches should more effectively reflect these temporal dimensions to remain responsive and relevant to how people actually experience and inhabit urban spaces.

5. Data Ethics: Why We're Not Talking About It Enough?

Smart technologies capture more and more data, but few of their planning documents directly take on concerns over privacy, transparency, or who owns the data being collected in neighbourhoods.

6. Care is considered an externality, not infrastructure

Spaces with a focus on mental health, caregiving, or intergenerational living are rarely developed. They are not just social services - they are fundamental facets of the livability and resilience that make a smart neighbourhood work.

7. Words are not enough for social diversity

When plans do refer to "mixed communities," few lay out how design facilitates social interaction across generations, cultures, or lifestyles. It's not simply a question of housing types - it's how those homes and spaces are linked.

8. Edges are being ignored

Most strategic planning initiatives are confined to hub or showcase district areas and do not extend into transitional zones, which are the areas where urban development meets rural landscapes. It also effectively future-proofs integrated development in the zone.

As this research has shown, many current approaches to smart neighbourhood planning still focus heavily on infrastructure and technology, often leaving out the social dimensions that make urban life meaningful. To address these gaps, the following criteria are proposed - not as a fixed checklist, but as a framework for designing places that respond to real human needs.

These new human - centered criteria shift the focus from systems to people. It prioritizes well - being, inclusivity, and the everyday experience of living in a neighbourhood. Instead of asking only how efficiently a neighbourhood functions, they ask how it feels to live there and how it supports a wide range of lives, abilities, and communities.

9. Prioritizing Social Inclusion and Accessibility

Planning should actively reduce barriers — physical, social, and digital — so that people of all backgrounds and abilities feel welcomed and able to participate in everyday life.

10. Enhancing Human Wellbeing and Mental Health

Public space, architecture, and services all play a role in supporting emotional and psychological well-being. This includes spaces for rest and retreat, access to nature, and environments that reduce stress.

11. Strengthening Privacy Protections and Reducing Surveillance

Smart technologies must be introduced with care. Residents should feel safe, not monitored - with clear boundaries around data collection, privacy, and the right to be offline.

12. Smart Environment, Smart Living, and Smart People through Human - Centered Architecture

Digital systems should enhance life, not dominate it. Buildings and public spaces must integrate technology in ways that remain intuitive, adaptable, and grounded in daily human routines.

13. Smart Environment: integrating Architecture with Nature

Natural systems should be woven into the design of buildings and streets - not added on as extras. Trees, water, light, and seasonal change are essential parts of the urban experience.

14. Smart People: Architectural Design that Encourages Community and Participation

Architecture should support informal social interaction, collaboration, and community decision-making, from shared courtyards to co-designed public spaces.

15. Smart Living: Human - Scaled Architecture for Enhanced Quality of Life

Effective design should consider scale, proportion, and comfort. When buildings and streets match the way people live and move, neighbourhoods become places where people feel at home - not just places they pass through.

Smart neighbourhoods cannot be collections of infrastructure and digital systems; they are living environments that become formed by everyday life. Whether a “smart” environment is able to live up to that definition requires meaning beyond efficiency and innovation; it needs to reflect the needs, rhythms, and values of the people who share those spaces.

As this research reveals, while technology is rapidly evolving and cities are becoming more capable than ever, the definite test will be if those tools are leveraged to improve people’s well-being. As we have seen in this research, cities are not just code or platforms—they are memories, relationships, and the manner in which we navigate through space. It is at the level of the neighbourhood - the most intimate scale of urban life - that this connection is most apparent. But without a human lens, the embedding of smart tools in neighbourhoods can produce places that feel disconnected, no matter how well they function.

Balancing innovation with empathy means using technology not only to increase efficiency, but also to better understand and respond to people's needs, as it is about building systems that are representative of the communities they serve and adaptable to the local culture.

Furthermore, urban planning carries an ethical responsibility. As we have noted in the examples of the 5 neighbourhoods, balancing ambition with care reflects this reality: while innovation drives progress, it is care that ensures such progress does not come at the expense of people or place. All the initiatives in the smart neighbourhoods must ask critical questions: Who benefits? Who might be excluded? And how will this space continue to evolve in harmony with its community, history, and environment? These reflections link visionary thinking to accountability and are essential for creating neighbourhoods that grow alongside their residents, rather than over them.

Ultimately, the success of a smart neighbourhood should not be measured by the quantity of its technological features, but by its ability to support and enrich human life. A truly smart neighbourhood fosters well-being, strengthens social connections, evolves with dignity, and remains attentive to both present realities and future possibilities. To meet the complex challenges of the 21st century, urban planning must be bold - yet grounded in empathy and compassion. The criteria proposed in this research are not a definitive model, but rather a starting point for reimagining a new kind of smart: one that places humanity at its core.

7.4 PROPOSING NEW HUMAN-CENTERED CRITERIA FOR CITY NEIGHBOURHOODS

Through this meticulous research, it is evident that we will have more and more smart neighbourhoods around the world; however, it is pivotal to highlight that although smart neighbourhoods are developing, community engagement, social inclusion, and human well-being are frequently sacrificed during this process. Having said this, this research echoes that the new planners should embrace a more human-centered strategy that prioritizes sustainability, equity, and people's well-being in order to improve urban planning. To do this, planners should put residents' social, emotional, and psychological needs first, and by doing so, the residents will experience safety, support, and engagement in their surroundings. Ultimately, this research suggests that everyone may fully engage in urban life when there is inclusivity, irrespective of their financial situation or level of mobility. (See Appendix – Research Catalogue 4).

Although Merwede and Brainport, two examples of smart neighbourhoods, have attained technological efficiency and environmental sustainability, they frequently ignore the effects that living in an environment dominated by technology has on people. As we have discussed earlier, there is a digital divide, social isolation, and mental exhaustion among the residents, which highlights the need for metropolitan areas where technology improves rather than lowers quality of life. Thus, in my opinion, the initiatives that are being implemented in smart neighbourhoods should move beyond a purely technology-driven focus and start focusing more on human-centered ecosystems. By saying this, I believe that by rethinking how we design urban spaces, smart neighbourhoods will respond to the everyday social and psychological needs of the people who live there.

By the real examples of smart neighbourhoods and different studies, this research believes that smart neighbourhoods should prioritize human-centered development, focusing on well-being, inclusivity, and social sustainability. Ultimately, we are confident that this approach fosters social interaction, community building, and equitable access to technology, ensuring all residents can thrive, creating sustainable, efficient, and vibrant environments.

Table 14.0. Proposed criteria for planning and designing of city neighbourhoods

NEW CRITERIA	
Prioritizing Social Inclusion and Accessibility	Planning should actively reduce barriers - physical, social, and digital - so that people of all backgrounds and abilities feel welcomed and able to participate in everyday life.
Enhancing Human Wellbeing and Mental Health	Public space, architecture, and services all play a role in supporting emotional and psychological well-being. This includes spaces for rest and retreat, access to nature, and environments that reduce stress.
Strengthening Privacy Protections and Reducing Surveillance	Smart technologies must be introduced with care. Residents should feel safe, not monitored - with clear boundaries around data collection, privacy, and the right to be offline.
Smart Environment, Smart Living, and Smart People through Human-Centered Architecture	Natural systems should be woven into the design of buildings and streets — not added on as extras. Trees, water, light, and seasonal change are essential parts of the urban experience.
Smart Environment: integrating Architecture with Nature	Natural systems should be woven into the design of buildings and streets — not added on as extras. Trees, water, light, and seasonal change are essential parts of the urban experience.
Smart People: Architectural Design that Encourages Community and Participation	Architecture should support informal social interaction, collaboration, and community decision-making, from shared courtyards to co-designed public spaces.

Smart Living: Human-Scaled Architecture for Enhanced Quality of Life	Design must consider scale, proportion, and comfort. When buildings and streets respect the rhythms and realities of human life, neighbourhoods become places people can truly inhabit - not just use.
Promoting Digital Inclusion and Urban Tech Literacy	Ensure residents of all ages and backgrounds have access to digital tools, education, and the ability to participate meaningfully in the digital layers of smart cities — from mobility apps to data platforms.
Designing for Flexibility and Temporal Change	Urban and architectural design should allow for multi-use spaces that adapt to changes in use over time — accommodating different ages, events, and life rhythms.
Ensuring Ethical Use of Data and Community Control of Digital Systems	Residents should co-govern how data is collected, stored, and used in their neighbourhoods. Data use must align with principles of equity, justice, and community-defined benefit.

7.4.1 Prioritizing Social Inclusion and Accessibility

As we have discussed previously, smart neighbourhood initiatives, especially those related to technological advancements, should guarantee that their initiatives are accessible and inclusive to all the residents of those neighbourhoods, having in mind that the elderly or low-income families might not have access to digital tools or the necessary digital literacy to use technological tools.

Reflecting on the studies and the research on smart neighbourhoods, we truly believe that unless smart neighbourhoods prioritize equity and ensure that such development will improve the quality of life for the residents, they risk reinforcing existing social inequalities rather than addressing them. For example, Merwede demonstrates how inclusive planning and active community engagement can lead to more sustainable, responsive urban environments, offering a practical model for other cities to follow.

Furthermore, to ensure a transparent development in smart neighbourhoods, community feedback loops were implemented in the Merwede area to establish a sustainable and all-encompassing urban setting. By incorporating the community in the decision-making process, the neighbourhood's diverse population's requirements were represented in public places and digital services. This inclusive approach to building smart city systems can be used as a model by other cities.

Having all these insights in mind, this research proposes criteria that should focus on establishing digital literacy programs for all demographics to effectively engage with smart technologies and ensuring affordable access to key technologies through public Wi-Fi or subsidized devices to reduce the digital divide. Based on the research, we echo that it is mandatory to build digital literacy and empower marginalized communities in these neighbourhoods. From our perspective, community-led programs, especially when supported by neighbourhood organizations and tailored training initiatives, can play an important role in equipping marginalized groups with the skills and confidence needed to navigate and benefit from the smart neighbourhoods.

7.4.2 Enhancing Human Wellbeing and Mental Health

One of the most important requirements for improving well-being in smart neighbourhoods is to create urban areas that mitigate the possible drawbacks of continuous digital interaction. In order to prevent mental strain and strike a balance between the advantages of smart city innovations and the social and psychological requirements of people, there is a need for places that foster social interaction.

From our research, this research suggests that smart neighbourhoods need to be more intentional about creating spaces that prioritize people - not just technology. For example, public spaces like parks and walkable streets do far more than add aesthetic value - they support mental and social well-being by making room for connection, movement, and everyday encounters. Moreover, we believe that by incorporating more nature-connected, non-digital experiences into urban design resonates with what we've observed in our own research: smart neighbourhoods will only succeed if they balance innovation with the basic human need for presence, belonging, and meaningful offline interactions.

Having all this in mind, this research proposes criteria that incorporate "technology-free" zones, prioritize parks and recreational areas, and design for social interaction. First of all, "technology-free" zones can be established by cities in public areas to help people de-stress from digital overload by allowing them to spend time in nature or with others without technology. Secondly, by making investments in green spaces and recreational places that encourage rest, exercise, and community involvement, smart cities can improve the mental health of its inhabitants. Thirdly, in order to improve people's mental health and fight social isolation, urban places should encourage social contacts, such as walkable cities with public areas, benches, communal gardens, and pedestrian walkways.

As we can see, there are different studies that support human well-being and mental health in smart cities. However, we also have examples of neighbourhoods that are prime examples of how natural spaces promote mental health and wellness, such as Aspern Seestadt in Vienna. This neighbourhood focuses on large parks and recreational areas that are intended to foster social contact and lower stress levels as part of the project's focus on sustainability and quality of life. However, privacy concerns arising from IoT devices and smart sensors could potentially outweigh these benefits. Thus, this chapter suggests a human-centered approach to urban planning can be developed in Aspern Seestadt by striking a balance between technological integration and individual privacy.

As a conclusion, the integration of green spaces, community interactions, and zones free from technology can enhance human welfare and mental health in smart cities. These techniques assist in reducing digital overload and keeping a healthy balance between digital and in-person interactions.

7.4.3 Strengthening Privacy Protections and Reducing Surveillance

In an effort to enhance urban services, smart neighbourhoods are using data-collecting and monitoring technology every day, yet this is creating mistrust and privacy issues among locals. Having said this, human-centered smart neighbourhoods must prioritize privacy and restrict the breadth of surveillance in order to foster innovation without impairing individual liberties. The establishment of strict laws governing the collection, storage, and use of personal data is the main requirement for bolstering privacy protections in smart cities, and this chapter focuses on this matter - privacy protection and reduction of surveillance - as it is a problem in technology-driven smart cities.

In this research, it was noted that protecting privacy in smart neighbourhoods requires more than just regulation - it demands a fundamental shift in how technologies are designed and implemented. First and foremost, this research suggests that by incorporating privacy safeguards into the architecture of smart systems from the start, all residents would maintain control over their personal information while benefiting from technological advancements. Secondly, while desigingn such smart neighbourhoods, it is pivotal to respect user autonomy as well. For example, many neighbourhoods normalize constant monitoring through facial recognition and smart sensors. In our view, unchecked surveillance can erode individual freedom and trust in public spaces. Thus, smart neighbourhoods must be transparent about what data is collected, why it’s needed, and how it’s protected - only then can we build urban systems that are truly ethical and citizen-centered.

As we can see, surveillance and privacy concerns are real in today's world. As a result of increasing surveillance, smart neighbourhoods like Aspern Seestadt and Nordhavn have had privacy problems as well. As we have seen, Aspern Seestadt monitors people' behavior in public areas using smart sensors and Internet of Things (IoT) devices; however, this has raised concerns about privacy erosion. On the other hand, the energy management and smart grid systems in Nordhavn gather a great deal of personal data on the behaviors of its citizens, which, if not controlled, may become rather invasive. These cities face a dilemma in weighing the advantages of data-driven efficiency against the need to protect the privacy of their citizens.

Having in mind all these issues, this research suggests that by restricting the use of intrusive monitoring devices and facial recognition technology in public areas, smart cities can preserve the privacy of their citizens as believe these innovations put privacy and autonomy at risk by fostering a monitoring society. The studies and examples from various neighbourhoods demonstrate that smart neighbourhoods can preserve freedom in public spaces by restricting or outlawing the use of such technology. This way we also believe that clear data rules that give citizens information about data collection, use, and storage, as well as opt-out choices, should be adopted by cities. Finally, in smart neighbourhoods and neighbourhoods, anonymization and data minimization are also crucial for maintaining privacy, as cities can take advantage of the advantages of data collecting without jeopardizing the privacy of their citizens by restricting the quantity of data gathered and, whenever feasible, anonymizing personal data.

In summary, to gain the trust of its citizens, smart neighbourhoods should place a high priority on privacy and privacy-preserving technology like facial recognition and data minimization. These issues should be addressed in the early stages of planning to make sure that smart city technologies do not impair individual liberty and freedom and the significance of these actions is demonstrated by cases such as Aspern Seestadt and Nordhavn.

7.4.4 Smart Environment, Smart Living, and Smart People through Human-Centered Architecture

By all the examples of the smart neighbourhoods, this research agrees that urban design must change for smart neighbourhoods in order to put sustainability, social inclusiveness, and human well-being first. We strongly believe that this approach fosters a close relationship between local residents and their urban ecosystems while also being technologically efficient.

7.4.5 Smart Environment: Integrating Architecture with Nature

In order to promote a relationship between people and the natural world, smart environments incorporate natural features into urban areas. Beyond technology systems and sustainability requirements, green infrastructure can turn smart cities into places that promote social connection, environmental sustainability, and well-being, instead of being focused only on technology. In order to promote human well-being, environmental sustainability, and urban resilience, this research suggests that smart architecture should incorporate natural features. We believe that urban environments with natural elements promote social connection, lower stress levels, and better mental health.

With all of those implications in mind, this research proposes novel architectural approaches. It will start by discussing how biophilic design, which highlights the relationship between humans and natural environments, may greatly enhance the mental and emotional health of its occupants.

Thus, in exploring sustainable urban design, we believe that by incorporating natural elements and green infrastructure into the smart neighbourhoods, we will help reduce stress and support overall wellness - a perspective we strongly agree with. In addition to the health benefits, elements such as rain gardens, green roofs, or even permeable pavements help manage stormwater, which is an essential aspect in smart neighbourhoods.

The best real-life example of what we just suggested is the neighbourhood of Nordhavn as green areas and environmentally friendly construction techniques are included in the architectural design of Nordhavn; although, more biophilic features, such as living walls, rooftop gardens, and natural materials, might be added to residential and commercial buildings in the future, as we believe that this will enhance aesthetics and environmental quality by strengthening the bond between locals and the natural world. Ultimately, we highly believe that smart cities have the ability to create urban environments that not only support human well-being but also merge architecture with nature through the use of biophilic design, green infrastructure, and adaptive building reuse.

7.4.6 Smart Living: Human-Scaled Architecture for Enhanced Quality of Life

Community engagement, along with livability and accessibility, are the three main factors influencing the quality of life in smart neighbourhoods. With this in mind, human-scaled architecture should incorporate residential, commercial, and recreational spaces with an emphasis on approachability, navigation, and engagement. By developing initiatives that have these factors in mind, the residents of the smart neighbourhoods will feel that their needs are met, as in this way the initiatives are prioritizing their needs, such as walking, public interactions, etc.

As a result, this research proposes new architectural criteria. First of all, we suggest that mixed-use developments integrate residential, commercial, and recreational spaces in the same area, which ultimately reduces commute times and enhances community interaction. During this research, we have noted that smart neighbourhoods have designed walkable, human-scaled neighbourhoods, in which the residents have a higher quality of life. In the same way, we argue that public spaces such as plazas, courtyards, and pedestrian streets are essential for creating lively, inclusive urban environments. We believe that activating these spaces through ground-floor cafés, local shops, and community services can spark spontaneous interactions, which over time help strengthen social bonds and build a deeper sense of belonging in the neighbourhood. Secondly, we suggest that smart cities should also embrace flexible and modular architecture, allowing spaces to evolve based on resident needs. we highly believe that modular designs and adaptable spaces are critical for creating future-proof environments that can accommodate various stages of life, such as work-from-home requirements, growing families, or lifestyle changes.

While we suggest new urban - architectural criteria, we base them also on real examples of smart neighbourhoods such as Vienna's Aspern Seestadt, which combines residential and commercial areas with mixed-use initiatives. In Aspern, amenities including cafes, offices, and shops are easily accessible to residents, and these settings, less dependent on technology and more human-scaled, are a challenge the city must overcome. Residents in Aspern experience a sense of place, feeling connected to their surroundings, walkability, and in-person interactions. In summary, we suggest that smart neighbourhoods prioritize livability, interactivity, and accessibility to improve quality of life.

7.4.7 Smart People: Architectural Design that Encourages Community and Participation

Smart people in urban development go beyond education and digital literacy to create smart neighbourhoods that encourage community participation, engagement, and belonging. Thus, this research believes that architecture can foster social cohesion by creating spaces for interaction, inclusivity, and collective ownership. As smart neighbourhoods have been focused more on technology level, we believe that a more human-centric approach should be included in planning as it prioritizes human connection, community interaction, and active participation in architecture.

Table 15.0. Integrated Table of Existing and New Criteria for Smart Neighbourhood Planning

Existing Criteria	New Proposed Criteria	Focus Group / Dimension
Functional Diversity	Smart People: Architectural Design that Encourages Community and Participation	Community & Participation
Public Space	Enhancing Human Wellbeing and Mental Health	Health & Public Space
	Prioritizing Social Inclusion and Accessibility	Inclusion & Accessibility
Smart Program	Strengthening Privacy Protections and Reducing Surveillance	Data Ethics & Privacy
	Smart Living: Human-Scaled Architecture for Enhanced Quality of Life	Quality of Life
	Promoting Digital Inclusion and Urban Tech Literacy	Digital Inclusion
	Designing for Flexibility and Temporal Change	Temporal Adaptability
	Ensuring Ethical Use of Data and Community Control of Digital Systems	Governance & Ethics
	Smart Environment, Smart Living, and Smart People through Human-Centered Architecture	Human-Centered Design
	Smart Environment: integrating Architecture with Nature	Eco-Integrated Architecture

This table integrates newly proposed criteria with existing ones to identify gaps and suggest improvements in the planning of smart neighbourhoods.

7.5 SHIFTING TOWARD HUMAN-CENTRIC CITY NEIGHBOURHOODS

This chapter proposes new architectural criteria that focus more on smart people, beginning with participatory architecture, civic and cultural spaces, and last but not least, architecture for inclusivity. We highly believe that involving locals in the design process is a pivotal method to promote community engagement through participatory architecture.

Additionally, during this research, we have noted that one of the most powerful ways to make urban planning more inclusive is by actively involving the people who live in the spaces being designed. Thus, we emphasize the value of participatory design, where community members contribute their insights and preferences to shape public spaces that truly reflect their needs. we believe that this approach is especially relevant in smart neighbourhoods as it shifts the planning process from being top-down to more democratic - using tools like workshops, focus groups, and surveys to empower local voices. Building on this, we also believe that residents in smart cities should be treated as active residents rather than passive residents, especially as technology becomes more dominant in urban development. Such a bottom-up approach ensures that smart urban services are co-designed with the community. To us, this is essential if we want smart cities to be not just technologically efficient but also socially just and genuinely responsive to those who live in them.

In addition to participatory architecture, we also believe that civic and cultural spaces play an important role in smart cities where the focus is on their people, as common spaces such as libraries, community centers, and cultural organizations are a great way to make connections with one another. For example, we see first-hand the example of Brainport in the Netherlands that is mostly focused on developing inclusive and interactive methods that encourage social contact and civic engagement, as in this way the residents would have more influence over how their neighbourhood looks, and at the same time it would promote a sense of community and ownership.

Lastly, this chapter suggests architecture for inclusivity, as we believe that it is important to create places that serve a diverse variety of skills and populations; thus, inclusive design is essential. With that being said, in order to facilitate cross-generational engagement, smart neighbourhoods should guarantee that public and residential areas are universally accessible.

In summary, we suggest that in order to create human-centered smart cities, civic and cultural spaces, inclusive architecture, and participatory architecture are essential. With the help of participatory design, locals may influence their built surroundings and make sure they suit their particular requirements, while inclusive spaces are open to everyone, civic and cultural spaces encourage social interaction and shared ownership. In this way, human connections and community resilience are given priority in these architectural strategies, which also improve the quality of life in smart cities.

Table 16.0. Comparison Table of Existing and New Criteria for Smart Neighbourhood Planning

Existing Elements	**Existing Criteria**	**New Criteria**	**New Criteria Description**
PUBLIC SPACE	Accessibility and usability of public space	Prioritizing Social Inclusion and Accessibility	Planning should actively reduce barriers - physical, social, and digital - so that people of all backgrounds and abilities feel welcomed and able to participate in everyday life.
	Design of parks, lakes, and green/blue infrastructure	Smart Environment: integrating Architecture with Nature	Natural systems should be woven into the design of buildings and streets, not added on as extras. Trees, water, light, and seasonal change are essential parts of the urban experience.
	Spatial quality and aesthetic planning	Smart Living: Human-Scaled Architecture for Enhanced Quality of Life	Design must consider scale, proportion, and comfort. When buildings and streets respect the rhythms and realities of human life, neighbourhoods become places people can truly inhabit - not just use.
HEALTH & LEISURE	Healthcare accessibility and wellness design	Enhancing Human Wellbeing and Mental Health	Public space, architecture, and services all play a role in supporting emotional and psychological well-being. This includes spaces for rest and retreat, access to nature, and environments that reduce stress.
SECURITY AND SURVEILLANCE	Video surveillance and access control	Strengthening Privacy Protections and Reducing Surveillance	Smart technologies must be introduced with care. Residents should feel safe, not monitored - with clear boundaries around data collection, privacy, and the right to be offline.
FUNCTIONAL DIVERSITY	Social infrastructure and amenities	Smart People: Architectural Design that Encourages Community and Participation	Architecture should support informal social interaction, collaboration, and community decision-making, from shared courtyards to co-designed public spaces.
DIGITAL INFRASTRUCTURE	High-speed broadband and connectivity	Promoting Digital Inclusion and Urban Tech Literacy	Ensure residents of all ages and backgrounds have access to digital tools, education, and the ability to participate meaningfully in the digital layers of smart cities — from mobility apps to data platforms.

PHASING & DEVELOPMENT STRATEGY	Adaptive land use and scalability	Designing for Flexibility and Temporal Change	Urban and architectural design should allow for multi-use spaces that adapt to changes in use over time — accommodating different ages, events, and life rhythms.
COMMUNITY ENGAGEMENT PLATFORMS	Information sharing and resident feedback	Ensuring Ethical Use of Data and Community Control of Digital Systems	Residents should co-govern how data is collected, stored, and used in their neighbourhoods. Data use must align with principles of equity, justice, and community-defined benefit.

Table 17.0. Expanded Table: Existing vs New Criteria with Focus Group

Existing Elements	Existing Criteria	New Criteria Title	New Criteria Description	Focus Group
FUNCTIONAL DIVERSITY	Social infrastructure and amenities	Smart People: Architectural Design that Encourages Community and Participation	Architecture should support informal social interaction, collaboration, and community decision-making, from shared courtyards to co-designed public spaces.	Community & Participation
PUBLIC SPACE	Healthcare accessibility and wellness design	Enhancing Human Wellbeing and Mental Health	Public space, architecture, and services all play a role in supporting emotional and psychological well-being. This includes spaces for rest and retreat, access to nature, and environments that reduce stress.	Health & Public Space
	Accessibility and usability of public space	Prioritizing Social Inclusion and Accessibility	Planning should actively reduce barriers - physical, social, and digital - so that people of all backgrounds and abilities feel welcomed and able to participate in everyday life.	Inclusion & Accessibility
	Design of parks, lakes, and green/blue infrastructure	Smart Environment, Smart Living, and Smart People through Human-Centered Architecture	Natural systems should be woven into the design of buildings and streets — not added on as extras. Trees, water, light, and seasonal change are essential parts of the urban experience.	Human-Centered Design

	Spatial quality and aesthetic planning	Smart Living: Human-Scaled Architecture for Enhanced Quality of Life	Design must consider scale, proportion, and comfort. When buildings and streets respect the rhythms and realities of human life, neighbourhoods become places people can truly inhabit - not just use.	Quality of Life
	Design of parks, lakes, and green/blue infrastructure	Smart Environment: integrating Architecture with Nature	Natural systems should be woven into the design of buildings and streets — not added on as extras. Trees, water, light, and seasonal change are essential parts of the urban experience.	Eco-Integrated Architecture
SMART PROGRAM	Video surveillance and access control	Strengthening Privacy Protections and Reducing Surveillance	Smart technologies must be introduced with care. Residents should feel safe, not monitored - with clear boundaries around data collection, privacy, and the right to be offline.	Data Ethics & Privacy
DIGITAL INFRASTRUCTURE	High-speed broadband and connectivity	Promoting Digital Inclusion and Urban Tech Literacy	Ensure residents of all ages and backgrounds have access to digital tools, education, and the ability to participate meaningfully in the digital layers of smart cities — from mobility apps to data platforms.	Digital Inclusion
PHASING & DEVELOPMENT STRATEGY	Adaptive land use and scalability	Designing for Flexibility and Temporal Change	Urban and architectural design should allow for multi-use spaces that adapt to changes in use over time — accommodating different ages, events, and life rhythms.	Temporal Adaptability
COMMUNITY ENGAGEMENT PLATFORMS	Information sharing and resident feedback	Ensuring Ethical Use of Data and Community Control of Digital Systems	Residents should co-govern how data is collected, stored, and used in their neighbourhoods. Data use must align with principles of equity, justice, and community-defined benefit.	Governance & Ethics

7.6 CONCLUSION: TOWARDS HUMAN-CENTERED SMART NEIGHBOURHOODS

This research showcased that smart neighbourhoods should not be seen simply as networks of advanced infrastructure or digital systems but rather as living environments that are shaped by the community's experiences and needs. While innovation continues to expand the technical possibilities of urban planning, it is how these innovations respond to real human needs that will define their lasting impact.

This research has revealed that many smart planning approaches still place too much emphasis on systems and not enough on people. For example, efficiency and performance often dominate the conversation, leaving behind essential qualities that make neighbourhoods feel lived-in and meaningful. It is without doubt that smart neighbourhoods have the potential to support this, but only if they are applied with sensitivity, care, and a clear understanding of what it means to live well.

With that in mind, this research proposes a human-centered planning criterion, which aims to reframe the direction of smart neighbourhood development, by asking how cities can become more connected or automated, they ask how these tools can support trust, inclusion, and belonging. This research admits that innovation is valuable, but it must come with empathy - designing systems that listen and adapt, not just collect and optimize.

At the same time, while efficiency remains a key goal of smart neighbourhoods, it cannot replace the need for social connection, as well-performing infrastructure means little if people feel isolated or excluded from the life around them. Consequently, smart neighbourhoods must serve as environments where individuals not only reside but also experience a sense of belonging, facilitated by design that promotes interaction, safety, cultural acknowledgment, and daily happiness. In this sense, the measure of a smart neighbourhood is not just in how quickly services run, but in whether the people using them feel seen and supported.

Ambition also plays a central role in smart city planning, but it must be grounded in care. Large-scale visions and cutting-edge experiments are important, but they should not overlook the ethical questions that come with transformation. Who is being included in these plans? Who might be left out? How will communities be supported through periods of change, especially when technologies evolve faster than public understanding or regulation? Care means moving forward with responsibility and humility, ensuring that innovation strengthens community rather than undermining it.

Ultimately, what makes a neighbourhood truly smart is not how many devices it hosts or how many systems it automates, but how well it supports life. It's about whether residents feel safe, connected, respected, and capable of shaping their future. A smart neighbourhood, in this light, becomes not just a place of progress but a place of meaning—an evolving community where people grow alongside the technologies they choose to live with. As this research suggests, by placing human dignity and collective well-being at the center of planning, neighbourhoods can become smarter.

Thus, this chapter suggests human-centered criteria, including social inclusion, accessibility, improving mental health, privacy protection, and community involvement through inclusive architectural design in order to address these problems. We believe that these standards guarantee that smart cities are equal, inclusive, and built to foster well-being and human relationships in addition to being technologically cutting-edge. In addition, we suggest that these standards must be adopted by legislators, urban planners, and architects in order to work together to create smarter cities that meet the requirements of their citizens, and in that way, we will have smart cities and smart neighbourhoods that promote resilience, happiness, and a sense of belonging by emphasizing social sustainability, community empowerment, and well-being.

DISCUSSION ON THE SCIENTIFIC CONTRIBUTIONS AND APPLICATIONS OF THE RESEARCH RESULTS IN SCIENTIFIC, PROFESSIONAL AND EDUCATIONAL DOMAINS

8. DISCUSSION ON THE SCIENTIFIC CONTRIBUTIONS AND APPLICATIONS OF THE RESEARCH RESULTS IN SCIENTIFIC, PROFESSIONAL AND EDUCATIONAL DOMAINS

8.1. CRITICAL DISCUSSION OF SMART CITY IDEALS, PROGRAMS, AND CRITERIA FOR DESIGN FOR CITY NEIGHBOURHOODS

Smart neighbourhoods are a growing trend in urban areas that have highly integrated, sustainable, and efficient infrastructure. These neighbourhoods improve resource management, energy efficiency, and urban sustainability by integrating digital infrastructure such as IoT devices and data-driven systems. But these initiatives frequently put technological innovation and efficiency ahead of meeting human needs like wellbeing, social inclusion, and privacy.

In the same vein, it is important to mention the double-edged nature of smart city development. As we have noted in the previous analysis of smart neighbourhoods, smart cities and their initatives many times overlook social factors such privacy, inclusion, and equality in order to improve efficiency and sustainability in these smart cities.

For example, the case studies of Aspern Seestadt and Nordhavn, how they highlight the difficulty in striking a balance between technological innovation and human-centered urban design. In these two projects, we can see that while digital technologies and green infrastructure are successfully implemented, issues like social isolation, privacy, and surveillance remain.

8.2. CATALOGUE AND TYPOLOGICAL CLASSIFICATION OF NEW URBAN NEIGHBOURHOODS IMPLEMENTING SMART CITY CONCEPTS

Smart neighbourhoods that are putting smart city ideas into practice have a variety of architectural styles and strive to combine sustainability, livability, and technology to create productive, human-centered spaces. Typological classification, which reflects various priorities and responses to technological advancements and urban challenges, can assist in identifying successful patterns and strategies in balancing technology with human well-being.

With that being said, we highly believe that for the initiatives in smart cities to work, there is a need for balance between technology and well-being. This thorough research shows that many smart cities around the world are putting into work initiatives that aim to improve liability and environmental issues. However, we have also pointed out that smart cities should not be technology-driven only, as they possess many challenges; thus, they need to have a people-centered focus. Ultimately, in my view, that means designing cities where innovation serves the needs of everyone, not just the digitally connected.

Building on this perspective, smart city neighbourhoods are increasingly being categorized based on how they integrate these priorities. The typological classification of new urban neighbourhoods implementing smart city concepts is based on three main dimensions: technology-driven, eco-sustainable, and human-centric.

Technology-driven neighbourhoods prioritize technological advancements such as IoT devices, smart grids, and data-driven systems to improve resource management and urban efficiency. They prioritize connectivity, automation, and real-time data processing, sometimes at the expense of social and psychological well-being. Examples include Brainport in the Netherlands which is a neighbourhood that prioritizes technological infrastructure while risking social isolation and over-reliance on technology. Furthermore, this research has noted that many smart city initiatives are heavily influenced by technology, as they echo that it is because of technology that they are able to transform urban life.

On the other hand, eco-sustainable neighbourhoods combine green infrastructure with environmental sustainability – ultimately utilizing technology to reduce energy consumption and minimize environmental impact. Such neighbourhoods and projects balance sustainability goals with privacy concerns and ensure technology does not compromise individual liberties. The focus of the eco-sustainable neighbourhoods is also to use as much green infrastructure as possible in order to reduce environmental harm and promote more environmentally responsible living. We have noted the case studies of Nordhavn in Denmark and Aspern Seestadt in Austria where we saw that these neighbourhoods achieved environmental sustainability despite privacy concerns associated with smart grids and sensor networks.

Last but not least, human-centric neighbourhoods prioritize social inclusion, community engagement, and well-being, as in such neighbourhood's technology serves as a tool to facilitate human interaction rather than play the most pivotal role. Human-centric neighbourhoods such as Merwede, among others, are focused on walkability over cars, mixed-use developments, and public spaces – ultimately fostering social interaction among the neighbors. In such projects and neighbourhoods, the integration of technology is gradual and deliberate, as the designers ensured to have the quality of the residents in their plans, which leads to a life without causing psychological fatigue or social isolation.

8.3. LIMITATIONS IN THE RESEARCH

Despite the extensive research on smart cities and sustainable neighbourhoods, several gaps remain. First of all, there is a lack of clear definitions. For example, the terms "smart city" and "sustainable neighbourhood" are often used interchangeably in many studies, leading to confusion and a lack of specificity in research and practice. By offering precise definitions and differentiating between the various concepts related to smart urban development, this research will help to clarify these terms. The research will provide a more nuanced understanding by highlighting the distinct traits and standards that distinguish smart neighbourhoods from sustainable neighbourhoods through the analysis of a wide range of case studies.

Secondly, there is limited empirical evidence as many studies focus on theoretical models without providing sufficient empirical data to validate these concepts. By performing a thorough empirical analysis of 20 smart neighbourhoods located throughout Europe and the Balkan region, this research fills this knowledge gap. By means of comprehensive case studies of neighbourhoods like Aspern Seestadt, Nordhavn, Merwede, Nieuw Zuid, and Clichy-Batignolles, the research will offer tangible information and actual instances of the application of smart urban planning principles and their effects on urban development. The findings will be more valid and reliable thanks to this empirical approach, which will also provide useful information for later applications.

Thirdly, based on the literature review conducted for this research, there is a need for more research on the social impacts of smart urbanism, including issues of equity, inclusion, and gentrification. This research will investigate these social dimensions by looking at the creative urban planning techniques used by various neighbourhoods to address these problems. By evaluating the degree to which smart technologies and practices foster fair access to resources, social inclusion, and community involvement, the research will offer a thorough analysis of the social effects of smart neighbourhoods.

Lastly, studies often lack insights into the transferability of successful smart neighbourhood initiatives across different contexts and scales. Since the purpose of this research is to identify best practices that can be applied to different urban settings by analyzing the contextual factors that affect the success of smart neighbourhoods, through the comparison of neighbourhoods with varying geographic, cultural, and socioeconomic backgrounds, this research will provide important insights into how to adapt intelligent urban planning techniques to a range of environments. In addition, policymakers and urban planners will benefit from the research's conclusions, which provide information on the prerequisites for expanding successful initiatives and adapting them to new settings.

This research will make a substantial contribution to the field of smart urban planning by filling in these gaps. It will offer precise definitions, empirical evidence, and a more profound comprehension of the societal implications and generalizability of smart neighbourhood projects. This all-encompassing strategy will improve smart urbanism's theoretical foundation and real-world applications, ultimately assisting in the creation of more resilient, inclusive, and sustainable cities.

8.4 SCIENTIFIC CONTRIBUTIONS AS STRUCTURED RESPONSES TO RESEARCH PROBLEMS IN THE DISCUSSION OF THE RESEARCH OBJECTIVES AND HYPOTHESIS

The research has significantly advanced scientific knowledge by establishing criteria for the planning and design of urban neighbourhoods within the framework of the smart city initiative, aimed at enhancing quality of life. These contributions address the research issues, aims, and hypotheses and are organized into three main research phases.

(i) Theoretical research offers a contribution to scientific theory.

(ii) Contextual analysis research provides a methodological scientific contribution.

(iii) Spatial planning research delivers a contextual scientific contribution relevant to planning and designing criteria.

The research issues at hand cannot be adequately addressed by merely focusing on the spatial dimension and spatial planning practices. Instead, they necessitate the integration of multiple disciplines to enhance awareness of the diverse values associated with planning. A comprehensive approach is essential for researching the criteria for planning and designing of city neighbourhoods, alongside educating various stakeholders involved in spatial planning processes. The theoretical understanding and conceptual framework governing the interaction between urban and architecture establish criteria that aid in assessing this criterion, ultimately contributing to the formulation of planning and designing standards aimed at improving this quality of life.

Each scientific contribution addresses research questions linked to specific objectives and hypotheses. Moreover, these contributions extend beyond their immediate focus, demonstrating the topic's relevance from various perspectives.

Table 18.0. Structured Responses to Research Problems for Smart City Neighbourhood Planning

SCIENTIFIC CONTRIBUTIONS	RELEVANCE OF THE TOPIC IN RESEARCH PROBLEMS	RESEARCH OBJECTIVES	RESEARCH HYPOTHESES	RESEARCH CONTRIBUTIONS
THEORETICAL SCIENTIFIC CONTRIBUTION	The role of people-centered and human-scaled design within smart city discourse is not adequately addressed in existing urban planning theory.	To define and frame people-focused criteria for planning and designing smart city neighbourhoods.	Human-centered design criteria influence the spatial and experiential quality of smart neighbourhoods.	Establishing a theoretical foundation that integrates spatial justice, well-being, and inclusivity into the smart city paradigm.
METHODOLOGICAL SCIENTIFIC CONTRIBUTION	Current planning frameworks for smart city neighbourhoods often overlook lived experience, digital inclusion, and temporal adaptability.	To propose and validate methodological criteria that assess human experience, adaptability, and ethical use of smart technologies in neighbourhood design.	Criteria focused on inclusion, wellbeing, and digital literacy enable more responsive and resilient neighbourhood planning models.	Development of a methodology for evaluating human-centered performance in smart city neighbourhood planning.
CONTEXTUAL SCIENTIFIC CONTRIBUTION TO URBAN PLANNING	Existing urban planning practices insufficiently address the ethical, cultural, and human-scale dimensions of smart urban environments.	To develop context-responsive planning strategies that prioritize social inclusion, wellbeing, and architectural flexibility in smart neighbourhoods.	Incorporating social, psychological, and environmental factors leads to smarter, more inclusive, and liveable urban design.	Advancing a comprehensive framework that aligns smart city strategies with human-centered urban planning practices.

8.5 PROFESSIONAL CONTRIBUTIONS

This section provides professional guidelines for planning and designing criteria for city neighbourhoods that balance technological innovation with social inclusion and environmental sustainability, based on analyses of existing smart neighbourhoods analyzed so far in this research. This part is intended for urban planners, architects, and city officials who want to implement smart city concepts without jeopardizing human well-being or privacy. With this being said, we propose the following professional guidelines:

— **Integrating Technology without Overemphasis on Efficiency**

We recommend that planners and architects prioritize technology in order to enhance the quality of life, rather than efficiency metrics such as energy consumption and traffic optimization. This encompasses the establishment of community centers, walkable environments, and interactive public spaces that facilitate resident interaction. We are of the opinion that the gradual and human-centered integration of smart transportation options could alleviate tension, as evidenced by the smart neighbourhood of Merwede, which operates without a motor vehicle.

— **Prioritizing Privacy in Design**

We recommend that urban planners implement privacy-preserving technologies in smart neighbourhoods while adhering to rigorous data minimization and anonymization protocols. Community input is necessary to resolve concerns regarding surveillance and data security. For instance, our investigation of the smart neighbourhoods of Aspern Seestadt and Nordhavn revealed that they experienced privacy concerns as a result of their extensive utilization of IoT technology for resource management. Consequently, we are of the opinion that professional guidelines should incorporate comprehensive privacy frameworks that provide residents with the ability to manage their personal data.

— **Designing for Inclusivity and Accessibility**

In addition to integrating technology in smart projects without overemphasizing efficiency and prioritize privacy in design, we also recommend that smart neighbourhoods should serve a diverse population, including the elderly, low-income, and disabled, by ensuring universal access to public infrastructure, digital services, and spaces. We have seen first-hand how Brainport, a smart neighbourhood, included community-based training programs to increase digital literacy and bridge the digital divide; thus, we suggest in the future more designs in inclusivity and accessibility.

— **Incorporating Green Infrastructure and Biophilic Design**

Moving further, we also suggest that smart neighbourhood design prioritizes the incorporation of green infrastructure, such as parks and green roofs, to promote both mental and physical health. Urban spaces should prioritize nature and sustainability, with areas for relaxation and community engagement. As seen in the studies until now, Nordhavn is one example of incorporating green infrastructure into urban design, but more biophilic integration is possible.

— **Community Engagement and Participatory Design**

In line with green infrastructure and biophilic design, we also suggest for city planners to include community input in the design process to ensure that local needs and cultural identities are met. For example, in Merwede, community feedback loops were used to shape inclusive urban planning, which served as a model for future smart neighbourhood designs.

— **Take the Needs of New Neighbourhood Communities to the IT Research Sector**

The professional contribution is to bridge the gap between urban planning and IT research, as smart neighbourhoods rely on digital infrastructures. It is critical to convey concerns about privacy, inclusivity, and well-being to smart city technology developers. Thus, we recommend:

— **Collaborative workshops**

Collaborative workshops between urban planners, technologists, and community representatives can aid in the development of human-centered IT solutions as well as the promotion of innovation in privacy-enhancing technologies and smart infrastructure.

— **Research and Development (R&D) in Privacy Technologies**

The IT research sector should prioritize privacy-preserving technologies, such as data anonymization, user-controlled privacy settings, and secure IoT networks, particularly in smart neighbourhoods with large-scale data collection concerns.

8.6 EDUCATIONAL CONTRIBUTIONS

This research contributes to the education system by incorporating smart city findings and best practices into the academic curriculum. We believe that universities are critical for training future urban planners, architects, and technology developers. The scientific and professional contributions from this research can be effectively integrated into university instruction, ensuring that human-centered design principles and challenges are effectively addressed. With this in mind, we suggest the following:

— **Course Development in Urban Planning and Smart City Design**

The integration of technology and human well-being in urban development can be the focus of new course modules in urban planning and smart city design, where privacy, surveillance, social inclusion, human-centered design, and sustainability are among the topics discussed. Case studies from research institutions such as Aspern Seestadt, Nordhavn, Brainport, and Merwede can be used in lectures and workshops to provide students with real-world examples of smart city implementation and challenges, allowing them to critically analyze the projects' successes and shortcomings.

— **Workshops and Practical Learning**

The research suggests interactive workshops for students to participate in design thinking exercises for inclusive, privacy-conscious, and sustainable smart neighbourhoods. These workshops simulate real-world planning challenges using research guidelines. Field trips to existing smart cities or neighbourhoods can provide hands-on learning opportunities, allowing students to observe smart technologies in action and consider their impact on community and social dynamics.

— **Collaborative Research Projects**

The research seeks to encourage collaborative research between students and faculty on the role of smart cities in urban planning. It encourages students to take part in projects focusing on innovative community engagement, privacy, and sustainability. Universities should also encourage collaboration with municipal governments and technology companies working on smart city projects. Students can take part in internships or practical research to help solve real-world problems such as data privacy and social inclusion.

— **Integration into Architecture and Urban Design Studios**

We recommend that students in architecture and urban design studios create smart neighbourhoods that ensure urban equity by balancing human needs and technology. Assignments can cover biophilic design principles, adaptive reuse strategies, and inclusive public spaces, as well as how urban design guidelines can improve the livability and sustainability of smart neighbourhoods.

Future urban planners, architects, and technology developers will be better prepared to design and develop city neighbourhoods that prioritize well-being, inclusivity, and sustainability if the scientific findings and professional contributions from this research are integrated into the university teaching curriculum. This educational contribution ensures that the next generation of professionals can approach smart city design from a more comprehensive, human-centered perspective.

8.7 DISCUSSION ON OPEN TOPIC FOR FUTURE RESEARCH

This chapter looks at smart city ideals, programs, and neighbourhood designs from the perspectives of technological innovation, sustainability, and human-centered approaches while it identifies the benefits of smart technologies, such as increased efficiency, resource management, and sustainability, as well as the challenges, such as privacy, social inclusion, and mental health. The research uses case studies from Aspern Seestadt, Nordhavn, Brainport, and Merwede, among others, to highlight both the benefits and drawbacks of current smart neighbourhood developments. In addition, the research contributes to three key areas: scientific, professional, and educational. The scientific contribution examines existing smart city frameworks, creating a typological classification of neighbourhoods and developing criteria for balancing technology and human well-being. On the other hand, the professional contribution offers practical guidelines for urban planners and architects, emphasizing privacy, inclusivity, and community engagement. Lastly, the educational contribution incorporates these findings into academic curricula, preparing future professionals to approach smart city development holistically. Finally, this chapter advocates for a shift toward human-centered smart cities in which technology improves well-being, inclusivity, and sustainability.

— **Recommendations for future research**

Future research should target longitudinal methods to further explore the enduring effects of the smart city framework on urban sustainability and the respective influence on the quality of life. Most existing evaluations tend to be based on short-term performance indicators or pilot projects, as we need to build on the long-term transformation of our transportation systems and how these types of interventions can shape mobility, accessibility, environmental and social performance over time. Such insights could inform adaptive planning and pinpoint which strategies yield enduring benefits compared to those that fade or fall out of favor.

Moreover, including a more geographically and socioeconomically diverse range of case studies can enrich and diversify insights. As it stands, most of the literature focuses on cities boasting substantial economic and technological infrastructures. By including smart neighbourhood developments from a wider diversity of geographies, including those with diverse cultural, economic, and governance contexts, research will more directly reflect the continuum of challenges and opportunities relevant to smart city design. This will be useful to a globally applicable knowledge base and will make sure that smart city principles are not only technically sound but socially and contextually responsive.

Additionally, it is necessary to investigate how new technologies, such as artificial intelligence (AI), machine learning, and the Internet of Things (IoT), can complement existing systems to enhance adaptability, resilience, and equity in urban systems. Future research might, for example, investigate the role of intelligent systems in real-time decision-making, predictive maintenance, and resident engagement, turning passive infrastructure into reactive, interactive spaces. Importantly, such research should also consider the ethical aspects of data use, automation, and surveillance to ensure that smart technologies empower communities rather than displace or marginalize them.

Collectively, these lines of inquiry not only expand the theoretical framework of smart urbanism, but also advocate for a more integrated, equitable, and people-centric approach to urban development in the 21st century.

9. CONCLUSION AS THE SYNTHESIS OF THE ESTABLISHED RESEARCH CRITERIA

This approach has informed this research on how we plan and design smart neighbourhoods within the field of the smart city platform and what potential urbanism seems more relevant than others to respond to the movement experienced by its residents. To achieve this, the research combined different ideas, strategies, and case studies within a wide-ranging framework that considers various factors important for future city living.

By way of initial remarks, the research examined two important gaps in current urban-environment planning paradigms, the foremost being the lack of human-centered design in the conversation around smart cities. Although technological infrastructure and data-driven governance have increasingly begun to dominate the discourse on smart cities, this research calls for greater attention to questions such as social inclusion, well-being, cultural diversity, and spatial justice. Despite their frequent invocation in policy rhetoric, these values rarely materialize in practical urban design strategies.

By dissecting the dominant smart city concepts and strategies - particularly the six-dimension model espoused by the European Union - this research explored the inherent tension between collective theory, in which numerous concepts can emerge to provide similar explanations for smart cities as a contemporary phenomenon, and where the value of top-down frameworks is acknowledged alongside their failures. These strategies often emphasize systems-level thinking and efficiency but neglect the fine-grained, everyday realities of urban life that determine whether a city feels safe, welcoming, inclusive, and flexible.

To counter this challenge, the research was undertaken in direct relation to building examples, covering 20 smart neighbourhoods across varied European contexts, thus providing a bottom-up angle on how to gauge real-world implementation. These projects gave insight into smart principles materialized within architecture, public space, infrastructure, and policy. The comparison method identified both leading practices and persistent omissions, particularly in the fields of mental health, privacy, social function, and scales of architecture.

To deepen this analysis, five of these neighbourhoods were selected as detailed case studies. These were examined through architectural drawings, planning documents, policy frameworks, and on-site observations, allowing for a spatially grounded understanding of smart city principles in action. The case studies functioned as testbeds to evaluate how design decisions align with or diverge from proclaimed smart objectives, exposing gaps between vision and execution.

Consequently, this research articulated and validated a suite of planning and design criteria by synthesizing established frameworks with novel proposals. The criteria proposed touch on not only the technical and digital aspects of smart neighbourhoods but also emotional, social, and ethical aspects.

This includes all of the social inclusion and accessibility, digital literacy, mental well-being, and the responsible use of data. There is also a strong emphasis on human-scaled design, temporal adaptability, and co-created public space - features that are often lacking in dominant planning frameworks but which are foundational to long-term livability and resilience.

This synthesis reinforces the significance of facilitating human-centric processes in planning, thereby establishing the theoretical framework for smart urbanism. Methodologically, it contributes a set of offerings for smart neighbourhoods evaluation by integrating measurable performance and qualitative human experience. In practical terms, this means providing urban planners, designers, and policymakers with a framework that balances specificity and flexibility to achieve not just technologically advanced neighbourhoods but neighbourhoods that are truly responsive to the pulses and realities of urban living.

Ultimately, smart neighbourhoods need to be more than networks of sensors and digital systems, they need to be neighbourhoods people can actually live in: spaces that promote well-being, create connection, adapt to change, and embody the diverse needs and values of their communities. By advancing this vision, the research lays the groundwork for a new ethical, inclusive, and human-centered paradigm for smart cities - one that navigates technology through empathy, equity, and design.

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List of abbreviations

5G – Fifth Generation (mobile network)
AI – Artificial Intelligence
AIOT – Artificial Intelligence of Things
AR – Augmented Reality
CCTV – Closed-Circuit Television
CPI – City Prosperity Initiative
DH – District Heating
EIB – European Investment Bank
ETSI – European Telecommunications Standards Institute
EU – European Union
GA – Genetic Algorithm
HDB – Housing and Development Board
IBM – International Business Machines Corporation
ICT – Information and Communication Technology
IEC – International Electrotechnical Commission
IEEE – Institute of Electrical and Electronics Engineers
IoS – Internet of Services
IoT – Internet of Things
ISO – International Organization for Standardization
IT – Information Technology
ITU – International Telecommunication Union
LSC – Large-Sized Cities
M2M – Machine to Machine
MaaS – Mobility as a Service
MSC – Medium-Sized Cities
NZEB – Nearly Zero Energy Buildings
PPP – Public Private Partnership
SDGs – Sustainable Development Goals
SEM – Structural Equation Modeling
SEN – Smart Environment
SLI – Smart Living
SPE – Smart People
SSC – Small-Sized Cities
SUTD – Singapore University of Technology and Design
TES – Thermal Energy Storage

TMS – Traffic Management System

UC – Ubiquitous Computing

UCL – University College London

ULI – Urban Land Institute

UN – United Nations

USDOT – United States Department of Transportation

WEF – World Economic Forum

WSN – Wireless Sensor Network

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Biography of the author

Dashnor Kadiri, March., is a graduate architect, a PhD candidate, and a lecturer at the University of Prishtina, Faculty of Civil Engineering and Architecture. He specializes in architectural design, Building Information Modelling (BIM), and the integration of artificial intelligence (AI) in architecture and urban planning.

He graduated with a Master of Technical Science in Architecture from the University of Prishtina in November 2014. Since 2016, he has served as a lecturer at the University of Prishtina, where he teaches courses in architectural design, Revit, BIM, 3D printing, and architectural sketching. From 2010 to 2021, he played a key role in transitioning architectural firms from CAD to BIM-based systems through his specialized Revit and BIM training programs.

Dashnor has been involved in international academic and professional circles, completing further doctoral research at the University of Zagreb, Faculty of Architecture and Urbanism, with a dissertation focused on "Criteria for Planning and Designing City Neighbourhoods in the Context of the Smart City Platform."

He has actively contributed to journals and conferences, including the *Journal Prostor*, *Places and Technologies*, and *IPAU Future Frames*. His work ranges from smart city strategies and digital inclusion in urban planning to AI integration in architecture. His projects have been featured in renowned architecture platforms such as *Archdaily, Dezeen, Design Boom, Superarchitects, amazing architecture, etc.*

As a Design Technology Lead with over 14 years of professional experience, Dashnor Kadiri has led innovative architectural projects and driven digital transformation in design studios. Alongside his academic work, he collaborates with the renowned Viennese architecture firm COOP HIMMELB(L)AU.

His academic and professional achievements are complemented by numerous publications, international workshops, and a strong commitment to advancing inclusive and technologically adaptive city neighbourhoods for future urban generations.

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