

Smart city neighbourhood beyond branding

Dashnor Kadiri^{*}, *Morana Pap*¹ and *Bojan Baletić*¹

¹University of Zagreb, Faculty of Architecture - 10000 Zagreb, Kačićeva 26, Croatia

Abstract. The article aims to address strategies, and the innovation behind smart neighbourhoods in Europe by leveraging technology and data to make cities more efficient, livable, and sustainable as the current need of urban development. The article's focus point is the assessment of project cases in Aspern (Vienna), Brainport (Eindhoven), Santa Giulia (Milan), Harbor City (Oslo), Hafen City (Hamburg), and Nordhavn (Copenhagen), to showcase the most driven factors for planning and designing smart neighbourhoods. The study explores various literature for designing smart neighbourhoods that serve as a starting point of smart city initiatives for the urban development of smart cities and should continue beyond city boundaries to entail decentralized energy generation systems, electric charging stations, electric vehicles, and storage facilities which contribute on the neighbourhoods' development. Conversely, it was also apparent that all of the plans for smart neighborhoods are still being implemented, that there is a lot of experimentation going on, and that the neighborhoods are continuously being improved to better serve their communities. Overall, the included smart neighbourhoods have demonstrated several approaches to being intelligent and sustainable by continuously aiming to develop in higher smart levels such as providing a more sustainable and eco-friendly life for its citizens through a variety of projects. By combining these approaches, smart neighbourhoods can continue to progress, which will significantly improve the quality of life for those who live there.

1 Introduction

The smart city may seem like a revolutionary idea now; however, the concept has circulated long ago, even when it had no specific name. For example, Singapore, a city that uses telecommunication and information technology in its daily functions, had been named an “intelligent city” back in the 1990-ies [1]. The same source mentions how although digitalizing city processes is not a novel idea, interest and attention to the smart city has grown significantly from 2010 onwards. Nevertheless, urban planners and geographers have used quantitative and computational methods in order to better understand cities starting from the 1950-ies [2].

Thus, there was always interest in making the city smarter, however, today attention towards the topic has grown immensely. Such a trajectory, then, begs the question: what exactly makes a city smart? Smart cities share characteristics that help in defining them. However, there is no unified definition of a smart city because of its rapidly changing nature

* Corresponding author: dashnorkadiri@gmail.com

and the variety of aspects it includes. An EU report [3] defines a smart city as “*seeking to address public issues via ICT-based solutions on the basis of a multi-stakeholder, municipally based partnership.*” Thus, smart cities aim towards higher efficiency and functionality by incorporating data and technology to help create better solutions for their inhabitants. Moreover, smart cities include six areas to maximize impact: smart economy, smart environment, smart governance, smart living, smart mobility, and smart people. Smart economy crosses international borders and includes e-business and e-commerce with the main goal of advancing ways of doing business with information and communications technology (ICT) based solutions.

Next, a smart environment includes renewable energy, pollution monitoring and control, green buildings, and green spaces. A smart environment focuses on sustainability and aims to reduce pollution. Further, a smart government uses technology and data for improved decision-making by public institutions. It includes e-government and e-services. Smart living uses intelligent networking of people, services, and communities based on gathered information and data. Thus, such a combination should yield results that improve one's quality of life. Additionally, smart mobility includes transportation systems ranging from cars and buses to trams, trains, and metros by using information technology to share important notices (i.e., leaving times, and real-time updates). Lastly, smart people are those who can use ICT to their greatest advantage to help solve urban problems and create and maintain goods and services [4].

A smaller, yet equally important part of the smart city is the smart neighbourhood. A neighbourhood is a concept that may not have a fixed definition; however, people have a natural sense of what it is and can identify it upon encounter. Nevertheless, for more clarity moving forward, one definition dating from 2001 states that a neighbourhood is: “the bundle of spatially based attributes associated with clusters of residences, sometimes in conjunction with other land uses” [5].

The smart neighbourhood, in line with smart cities, aims on improving the citizens' lives by better managing the high population growth rates, inadequate housing, and aging infrastructure. [6] Smart cities function simultaneously with smart neighbourhoods, as intelligent solutions must first be applied in smaller chunks.

Smart neighborhoods consist of decentralized energy generation systems, electric vehicles, storage facilities, and electric charging stations that help create a sustainable environment. [7] Lastly, a smart neighbourhood should have equal accessibility to all its residents.

2 Mapping smart city neighbourhoods

In the article, Aspern, Brainport, Harbour City, Santa Giulia, Nordhavn, and HafenCity were all assessed on their project implementation of the smart neighbourhood. The following neighbourhoods were included as they have all received great investments in applying smart solutions, and have shown great drive, ambition, and success in their activity.

2.1 Case studies

The selected neighbourhoods for the promotion of urban developments are as follows:

1. An innovation leader in Vienna: Aspern Seestadt Vienna, Austria;
2. One of the world's smartest neighbourhood: Brainport Smart District (BSD), Netherland;
3. The best waterfront in the fastest-growing city in Europe: Harbour City Oslo, Norway
4. An innovative district in Milan: Milano Santa Giulia Milan, Italy;

5. A New City from an Industrial Past: Nordhavn Copenhagen, Denmark;
6. A floodproof neighbourhood with smart green solutions: HafenCity, Hamburg-Germany.

2.1.1 Aspern – an innovation leader in Vienna, Austria

Objectives:

1. People: >20,000
2. Land: 2.4 million m²
3. Workplaces: 20,000
4. Total Invest Volume: 5,000 mio €
5. Companies: 300+
6. Workplaces: 4,000
7. One of Europe's largest energy research projects
8. 50% green and open space

Partnerships:

Government: The City of Vienna Vienna Housing Fund Vienna Business Agency. A fund of the City of Vienna, and the Austrian federal property administration.

Businesses: Siemens AG Österreich (44.1%); Wien Energie GmbH (29.95%); Wiener Netze GmbH (20%); Wirtschaftsagentur Wien (4.66%); Wien 3420 Holding GmbH (1.29%); Vienna insurance group the building society of the Austrian savings bank group österreichische Sparkassen AG.

When we say urban development, we usually think about brushing up on existing aspects of a city – but ask yourself: what if we could design a whole new city (within a city) from scratch? The Seestadt Aspern district in Vienna is doing exactly that – and more. They're not just trying to be smart about what they're doing right now. In addition, they're also trying to find out how to become even smarter in the future – learning by doing.

Built on top of a former airfield in the far east of Vienna, the Seestadt Aspern makes for Vienna's current largest urban expansion plan. [8] As such, the new city within a city aims towards creation that is smart, affordable, and socially inclusive.

When one looks at the winning building projects in Aspern, it becomes clear that the design of the city is not only innovative but has also been constructed with the human element at its center because only the city's inhabitants are capable of transforming the city into a smart, livable, and sustainable city. For example, the city includes not only apartments but also a variety of facilities ranging from those focused on physical and mental health (i.e., sports facilities and therapy and counseling services), a library, a music school, kindergartens, etc. To promote economic growth, the city also has the See stern building, a cost-friendly shared space that can be used creatively by a variety of different businesses, and even as an alternative to the home office [9].

Aspern has incorporated many aspects of the smart city and neighbourhood design in its planning and realization. For instance, one of its buildings, the Greenhouse, a state-of-the-art dormitory for students, and a small power plant, produces more energy than it wastes, and the additional energy is ultimately used back into the power grid, making the building quite self-sufficient in this regard. [10] Additionally, other buildings include smart systems that track the energy usage of their users and allocate energy consumption based on their usage patterns.

Until 2030, the district will keep evolving into a city of its own, eventually offering homes for 20,000 residents and working places for another 20,000 people. Some of them will be part of an extensive research project: how to use resources as efficiently as possible – by

living inside connected building systems with intelligent power grids and interacting communication technologies.

The smart research project stands upon four pillars. (Smartbuilding, smart citizen, smart grids, smart ICT). These factors result in a comprehensive idea of how a town of 20,000 residents can be designed from scratch – as a sustainable, smart city of the future.

One of the development agencies for Aspern, Aspern Development ag, has shown its commitment to high- quality urban design and has integrated it into its work. Below, principles of high-quality urban design are presented and elaborated:

The size of this urban area is 240 ha and the realization of it is planned in three stages.

1. The first major phase of construction (2010-2017) comprises a mixed-use neighbourhood with at least 2,600 housing units (260 student units) as well as offices, retail units, service providers, and research and development institutions.
2. In the second phase (2017-2022), the rail station and efficient road link to the A 23 motorway and the S 1 Regional Ringroad will be completed. Further housing and mixed-purpose buildings are planned to be developed along with the quarter around the rail station and the office quarter.
3. In The third phase (2022-2028), the areas adjacent to the rail station, the shopping street and the underground/metro line will be densified and the mix of use optimized. (Aspern Seestadt, 2015)

The following are the dominant spatial features at Seestadt:

- The Lake
- The Lakeside Park and Lakeside Promenade
- Seeplatz (Lakeside Square)
- The underground line
- Network of green and open spaces

In spots where urban variety is the goal, the function and design of buildings must interlock closely with public space. Objectives such as vibrancy, short distances, and a balanced social tissue presuppose a high degree of mixed uses embedded in a sturdy, flexible spatial structure.

2.1.2 Brainport – One of the world's smartest neighbourhood in Helmond – Brandevoort, Netherland

Objectives:

1. People: 4,500
2. Business Park: 120,000 m²
3. Living Units: 1,500
4. Solar Panels: 73,000
5. Autonomous Vehicles: 300
6. Bio-intensive agriculture: 27,000 m²
7. Smart Mobility Loop: 1.5 km
8. Park: 125,000 m²

Partnerships:

Government: Municipality of Helmond Province of North Brabant Brainport Development.

Knowledge Institutes: Municipality of Helmond Province of North Brabant Brainport Development.

Businesses: Business Challenge Business Network.

The Brainport Smart District, located in the city of Helmond, is set to become the smartest neighbourhood in the world. Helmond is known as a city that is focused on innovation and technology, and in fact, the city credits the innovative technology initiative, Brainport Eindhoven, for its key assisting role in helping minimize impact and overcome the 90s economic crisis. [11] The Brainport region was consequently named the third main port in all of the Netherlands. Therefore, it is perhaps somewhat natural that a never-seen-before district focused on technologically-enabled sustainability takes place exactly in this region. The project is realized through a partnership between a variety of decision-makers, including the municipalities of Eindhoven and Helmond, and the University of Technology in Eindhoven, among others. On the other hand, the private companies that have been assigned the role of the project implementation for this smart future neighbourhood include UN Studio, and Felixx Landscape Architects & Planners [12].

Starting from 2018, the neighbourhood plans on developing over 1,500 new homes for all social classes in the span of the next 10 years. The new neighbourhood's building plans have all been awarded judging on how innovative they are. Thus, the neighbourhood is set to serve as an example for other countries and show what works and what doesn't. In fact, one of the project's future residents featured in a New York Times article shared how he knows that he will be living on an "experiment" and how some ideas "might not work out the way [they] expect".

The district is intended on including plenty of green space, low-rise passive buildings that aid in generating energy, and data-sharing technology. What is more, one Brainport Smart District report about the neighbourhood states that "A Suburban environment will be created where new technologies can be tested, concerning transportation, health, energy, and circular constructions" [13].

According to an article from Computer Weekly, [14] there are seven main program lines that guide the Brainport Smart District (BSD) projects, meaning that the projects are focused on the following district points:

1. **Circular and sustainable district:** The district aims to be a self-sufficient one where a combination of natural sources and technologies takes place.
2. **Resident participation:** As the neighbourhood is known to function as an 'experiment', resident participation is allowed, and even encouraged. Data is planned to be used in cooperation with set laws to maximize positive results.
3. **Social and safe district:** The neighbourhood's developers seem set on creating a space that is first and foremost safe, and it encourages healthy communication between its residents.
4. **Healthy district:** One aspect of health that BSD covers are their focus on planting the food themselves. [15] In this way, not only does the neighbourhood promote healthy living by reducing ecological waste, but it also sets an example of a modern plan with a rural component to it.
5. **Digital district:** By using data, the city is able to track the habits of its residents, making better decisions for their futures.
6. **Mobile district:** Innovative and new forms of technology are intended to get used as a means of increasing mobility.
7. **District with energy:** The neighbourhood is keen on using renewable energy to perform its daily functions.

UN Studio, the company in charge of helping develop the proclaimed smartest neighbourhood in the world, describes the work to be one in progress with a "flexible grid that is developed per the users' demand." [16].

2.1.3 Harbour City – The best waterfront in the fastest-growing city in Europe – Oslo, Norway

Objectives:

1. People: >13,000
2. Length: 9,5 km
3. Living Units: 1,500
4. Investment: 688 m €
5. Integrated into the urban structure; Diversity of public space; Contact with the water; Different types of traffic; Social meeting places; Biodiversity; An attraction in itself; Sustainable development; Comprehensive planning; Coherent and recognizable; Promenade for the people.

Partnerships:

Government: Oslo City Planning and Building Services

Oslo was named the European Green Capital in 2019 [17] highlighting the city's focus and success in offering smart solutions that are green-oriented. Oslo's harbor, also known as Havnepromenaden, currently includes a nine-kilometer promenade that has been materialized in 2013 under the Harbour Promenade project commissioned by the city of Oslo. What makes the promenade a more touristy attraction, meanwhile also fun for the locals, is the variety it offers. For example, the Harbor connects many interesting sites including the new National Museum, The Opera House, and the Munch Museum. Additionally, it offers many restaurants, cafes, and bars overlooking the harbor.

The plan for the Promenade has been realized by Rodeo and White Architects (SE) with the aim of connecting pivotal areas along the waterfront, whilst offering a pleasant experience for its visitors.[18] The same source shares how the project has also taken environmental sustainability into consideration and has tried to integrate itself into the city's contents.

The Harbour Promenade entails the fjord, the sea, and the city and is available for the public all year long, promoting various activities including walking, jogging, kayaking, and leisure fishing [19]. Moreover, according to the same source, the city council operates under the goal of having the project last for at least 22 years (from 2008 to 2030). The Harbor carries the delightful nature and sea on one side, and the contemporary architecture, culture, and food on the other, enabling the elements to merge exquisitely.

2.1.4 Santa Giulia – An innovative district in Milan, Italy

Objectives:

1. People: 20,997
2. More than 110 hectares in the southeast of Milan
3. Apartments: 3,251
4. Office: 91,000 sqm
5. Retail, Leisure, and arena: 75,000 sqm
6. Investment: \$4.2 billion
7. Aiming for zero carbon emissions, the project will create a more sustainable and well-connected neighbourhood for people to work, live and enjoy. Based on a biophilic design inspired by a green leaf, it will connect the built and natural environments.

Partnerships:

Government: Oslo City Planning and Building Services,

Businesses: Lendlease with PSP Investments, €2.5 billion Milano Santa Giulia project.

A city-within-a-city, Santa Giulia has the vision of retaining the city's values whilst being green and innovative in its approach. A former industrial area, the neighborhood is transformed as part of the city's restructuring and image renewal efforts [20]. Compared to other similar projects occurring in other districts, the investments made in the area surpass millions and ultimately reach over X billion [21]. The city is located in a dismissed industrial area, making its transformation quite noticeable and significant. What is also interesting about Santa Giulia is that compared to other projects with a similar scale of impact, it includes only a small number of public investments, making the private sector predominant in the project's actualization.

The retail part of Milan Santa Giulia is well thought out, integrating green elements in an open layout with restaurants, shopping centers, and other entertainment facilities. Throughout such a design, the spaces receive natural light, have multiple trees, and also include a nearby park and the Santa Giulia Gardens, all elements which make the neighborhood 'green' [22]. Santa Giulia also provides inclusivity - meaning, the co-existence of different social classes. This goal is reached by making the town's facilities accessible and increasing the number of buildings and spaces that are offered at decent prices. Santa Giulia is a work that is still in progress with the aim to be finished in 2034 [23] and both new and existing companies are in charge of making the necessary changes that lead to its successful implementation.

The space is defined by three main buildings: The Museum Plaza, The Arena Plaza, and the Market Plaza which form a triangle-like shape to the neighbourhood and act as unofficial borders for the area. The Museum Plaza will include two main components to it: innovation and technology; however, no definite plan seems to be present for its actual realization.

Set to be built in 2026, with the rendering of architect David Chipperfield, the Arena Plaza is expected to seat from 12,000 to as many as 15,000 people. With such a high capacity, the arena plans to be utilized for various events including shows, cultural events, indoor sports events, and national and international concerts. [24] Lastly, the Market Plaza will house many different markets that both residents and tourists can visit and enjoy. The area consists of a central shopping district that integrates retail, restaurants, and a cinema. Also, Hollywood Boulevard, an area with luxury shops, connects two city parts: The Arena Plaza and the Museum Plaza. The Gallery Walk is a street for pedestrians which links the residential area with the shopping district.

2.1.5 Nordhavn– A New City from an Industrial Past - Copenhagen, Denmark

Objectives:

1. People: 40,000
2. Workplaces: 40,000
3. New-Built: 3,5 mio sqm residential and commercial buildings
4. Investment: € 60-65 Mln
5. Located on the Øresund coast, the district will offer direct access to the sea, as well as a multitude of recreational urban spaces and public facilities.

Partnerships:

Businesses: DTU, City of Copenhagen, CPH City & Port Development, HOFOR, Radius, ABB, Danfoss, COWI, Nerve Smart Systems, Glen Dimplex, METROTHERM and the PowerLabDK facilities. The project was supported by EUDP (Energy Technology Development and Demonstration Programme).

Nordhavn is notable for its interesting architecture, gastronomy services, and design studios. Nowadays, Nordhavn is paving the way for a future successful smart city, by

integrating sustainable solutions in its newly devised design that is currently in its implementation phase. What is more, Nordhavn's efforts on sustainability have not only been recognized but they've also been rewarded as the city is the only new urban district to receive the DGNB's (Germany's sustainable building program) highest gold certification [25].

Another aspect of the city's development is operating under the name: "Energy Lab Nordhavn" which has been established to build the necessary knowledge for the operation of smart energy systems. Such energy systems are currently focused on smart electricity grids [26]. However, the goal is to expand this scope and ultimately include electricity, heat, and transportation in the sustainability plan of the future. The aforementioned source shares how the project also includes intelligent heating and has now heated over 85 apartments in total. This project of smart heating has shown considerable success, so much so that the idea has now been extended to another district with a project that is to include over 7,000 homes.

Nordhavn has shown great innovation with its building design and maintenance. For instance, the Copenhagen International School, and the UN City both incorporate smart energy usage [27], and set examples to be followed. To begin, the school's façade is made up of 12,000 solar panels that provide over half of the overall electricity that is consumed by the residents. On the other hand, UN City optimizes energy usage by making necessary cuts on energy utilization. Additionally, it also includes solar panels on its roof which save over 30% of energy. The project is set to finish in 2040, however, with all the aforementioned points the future looks bright for the remaining work.

2.1.6 HafenCity– A floodproof neighbourhood with smart green solutions Hamburg, Germany

Objectives:

1. People: 14,000
2. Residential units: 7,500
3. Workplaces: 45,000
4. Area: 2.4 million sqm
5. Investment: €10 billion
6. Nordhavn, a former industrial shipyard on the city's northern edge, is becoming the coolest place in town— and the future of urban planning.

Partnerships:

Businesses: GT Invest Ukraine, Hanseatisches Finanzkontor GmbH & Co. KG, Buss Investor Services GmbH, UP2INVEST GmbH.

Compared to some of the other aforementioned cities, what distinguishes this 'city-within-city' model, is its blue component, namely, the water that surrounds it. Thus, HafenCity has also been attributed to the name a "blue smart city". The blue aspect gives HafenCity the opportunity to utilize this water element, thus the river Elbe provides a means of transportation for both people and goods. However, the same element that provides the city's many advantages has also shown its risk and fatality in the past. Thus, the urban planners did have this in mind when building, as now all new buildings are built at a new height much higher than the one in the past (4.5 -8.3 meters higher) [28].

Hafen City is characterized mainly by its smart mobility and smart architecture; the latter being constructed so that it can be floodproof. HafenCity is a project that is still in progress, managed by Hafen City GmbH, a company that oversees all aspects of its development, varying from management to infrastructure development. Much like its other smart city

counterparts, HafenCity also aims to be a walkable neighbourhood, and if not entirely, the reduction of the utilization of private cars is a goal that the district has achieved.

The city offers many alternatives to driving, including a reliable and efficient public transport network, walkable and attractive promenades, cycling, and the so-called car-sharing services [29]. Especially for cyclists, Hafen City has invested and come up with various smart solutions. For instance, in March 2021, a pop-up bike lane was created between two locations, so that the cyclists using the pathway are safer in a known heavily frequented street [30]. Lastly, many parking spaces for bikes are being created, for example, in southern Ueberseequartier more than 3000 spaces of the kind are being constructed.

Additionally, one planned zero-emission building [31] which is set to be completed in 2024 will offer no parking spaces for cars, but instead 150 for bikes.

The plan to reconstruct HafenCity and take it away from its industrial past to a sustainable future has been named a "Masterplan" and was first approved by the State of Hamburg in 2000 [32]. According to the First Mayor of the city of Hamburg the Masterplan: "is the foundation of this project of the future, which can be developed in single phases with sensitive urban planning and economic rationality... due to its robust structure, the plan offers the opportunity to react, to vary and modify, during the realization process." The Masterplan then includes new buildings, around 7000, the creation of new jobs, and green spaces. Moving on to the cultural side, HafenCity is also trying to develop cultural events and give space for artists to express their talents. In an interview conducted with Ellen Blumenstein [33], she shared how her walk-in sound production "Das Traumschiff" is a work realized by a myriad of people including, game developers, actresses, graphic artists, sculptors, and choreographers to bring conflicts of co-existence in life, highlighting the city's focus on its culture as well. Overall, HafenCity and its development seem promising, having already achieved many of its goals, and showing a clear intention to achieve and do more through its ride-sharing services, urban planning, and other smart mobility offers it is currently either investing in or implementing.

2.2 Comparison

HafenCity, Nordhavn, and Harbour City are all similar in that they all have the sea included in their design. However, each of the cities has developed different smart neighborhood plans to best utilize their simultaneous advantage and disadvantage to other smart districts that are their water element. For instance, in Hamburg, after a disastrous experience with a flood that led to the death of many, HafenCity has included elements that make it 'floodproof', such as changing their whole building design and making taller buildings, so such events do not repeat themselves. On the other hand, both Harbour City and Nordhaven are known for their focus on green solutions and have been awarded different prizes for their efforts and successful realizations of smart, green projects.

Moreover, Harbour City has designed a nine-kilometer promenade for the mere purpose of making it an attraction for both locals and visitors, and various online reviews show that the project has been quite successful in being a great spot to spend time and partake in activities such as jogging, walking, and even leisure fishing. However, this is not to say that HafenCity has ignored smart solutions. In fact, HafenCity has shown great innovation by including pop-up bike lanes and encouraging using bikes instead of other vehicles by offering more parking spaces for bikes than for cars. Nordhavn is known for its smart usage of energy. For instance, the building of the Copenhagen International School is one that is made of solar panels that account for more than half of the overall electricity consumed by the building.

Overall, the three districts have shown innovation, sustainability, and creativity in their design, making them great smart neighborhood examples. Although all projects are still in their implementation phase, what has been achieved so far in each city seems quite promising

for the future. Moving on to smart districts that are land-based, Aspern, Brainport, and Santa Giulia are all neighborhoods that are currently implementing smart solutions to their city problems. What is more, the three neighborhoods have allocated large sums of investments towards their materialization, with the highest number of euros invested coming from Santa Giulia, Milan.

To begin, Aspern has completely transformed a former airfield into a district that will include different facilities from libraries to schools, sports facilities, and counseling services. Additionally, it has shown innovation by including shared spaces that can work as an alternative to home offices. Focusing on green solutions, the Greenhouse, a dormitory for students is one that produces more energy than it wastes, making it a very self-sufficient model. Out of the three, the Brainport Smart District is the most ambitious with an aim to become the smartest neighborhood in the world. Such a large-scale project is then implemented in cooperation with both private and public companies. The district shows a great emphasis on being highly experimental and self-sufficient meaning that they will be testing various smart methods with the goal of finding out what ultimately works best.

Lastly, the smart neighborhood of Santa Giulia is also currently in its implementation phase, however, its progress has somewhat stalled. Nevertheless, its plans for the future are grand. For instance, the district intends to incorporate open green spaces with lots of natural light in its urban design. Additionally, three main buildings are expected to define the area: The Museum Plaza, the Arena Plaza, and the Market Plaza; all unique in their design, they will offer both tourists and locals various activities to partake in.

The three districts then all focus on different aspects of being smart, yet set healthy examples of different smart neighborhood project implementations.

3 Conclusion

Smart cities today have not just one definition that incorporates all that they are and offer, as they, in essence, have an ever-changing nature. However, the pillars that have been largely agreed upon and identify smart neighbourhoods include all aspects of what makes a city smart: a smart economy, smart living, smart mobility, smart people, smart governance, and a smart environment.

An essential component of smart cities is also their smaller part: the smart neighbourhood. Much like the smart city, the smart neighbourhood also is a more recent ‘innovation’; nevertheless, it is one that is being applied in various countries across Europe with the goal of improving livability overall, and thinking of the future by designing smart and sustainable solutions that are affordable and accessible to people coming from all different social classes. To be more exact, smart neighbourhoods, then, entail decentralized energy generation systems, electric charging stations, electric vehicles, and storage facilities which help in the smart neighbourhoods’ goal of being eco-friendly, and economical. In the article, Aspern, Brainport, Harbour City, Santa Giulia, Nordhavn, and HafenCity were all assessed on their project implementation of the smart neighbourhood. It was ultimately found that each city included the aforementioned elements of smart solutions in its design. Conversely, what was also noticeable and goes in line with the very definition of the smart city is that all the smart neighborhood plans are still in their implementation phase and that there is a lot of experimentation present, and that the neighbourhoods are constantly improved through trial and error.

Aspern is notable for its complete transformation from a former airfield to a new smart neighbourhood. What distinguishes this neighbourhood from the others is its inclusivity as it includes various buildings, including sports facilities and mental health centers. Additionally, the neighbourhood also is known for being green, and applying smart solutions for energy consumption and conservation. Next, Brainport has proved to be incredibly ambitious and is

even a main port in all of the Netherlands. The region will entail large green spaces, low-rise passive houses, and data-sharing technologies to aid in constantly improving the applied smart solutions.

Harbour City is identified by its nine-kilometer promenade that joins many sites such as the National Museum, the Opera House, and the Munch Museum. Moving on, Santa Giulia has the goal of transforming an industrial area completely and includes many Milanese elements such as Plazas. The project is notable for its huge spending which nears billions; thus, its future looks promising. Moving on, Santa Giulia has the goal of transforming an industrial area completely and includes many Milanese elements such as Plazas. The project is notable for its huge spending which nears billions; thus, its future looks promising. Lastly, HafenCity is smart in that it offers many alternatives to driving cars, including cycling and ride-sharing, and in the fact that it has been designed to be floodproof.

All in all, the smart neighbourhoods included have shown different ways of being intelligent and sustainable in their approach, and through a combination of strategies that they have used, smart neighbourhoods can keep improving, and as a result, greatly improve the lives of their inhabitants as well.

References

1. Dameri, R. P. (2016). "Smart City Definition, Goals and Performance." *Smart City Implementation*, 1–22. DOI: 10.1007/978-3-319-45766-6_1.
2. Shelton, T., Zook, M., & Wiig, A. (2014). "The 'Actually Existing Smart City'." *Cambridge Journal of Regions, Economy and Society*, 8(1), 13–25. DOI: 10.1093/cjres/rsu024.
3. European Parliament. (2014). "Mapping Smart Cities in the EU." *Study*. Retrieved from here.
4. Lin, J., & Long, L. (2008). "What Neighborhood Are You In? Empirical Findings of Relationships Between Household Travel and Neighborhood Characteristics." *Transportation*, 35(6), 739-758. DOI: 10.1007/s11116-008-9167-7
5. Kumar, H., Singh, M.K., Gupta, M.P., & Madaan, J. (2018). "Smart Neighborhood: A TISM Approach to Reduce Urban Polarization for the Sustainable Development of Smart Cities." *Journal of Science and Technology Policy Management*, 9(2), 210-226. DOI: 10.1108/JSTPM-04-2017-0009.
6. Hein, T. (2021). "Smart Neighborhoods: Essential Building Blocks on the Way to a Smart City." *Journal of Science and Technology Policy Management*, 9(2), 210-226. DOI: 10.1108/JSTPM-04-2017-0009.
7. Wohnfonds Wien. (2019). "Aspern - The Seestadt of Vienna: Subsidized Living in a New Urban District." Wien. Unser Zuhause. Wohnen, Wohnbau und Stadterneuerung.
8. SeesternAspern. (2022). "Coworking. Wohnprojekt 'SeesternAspern'."
9. StudentenWohnen. (2021). "Student Residence Greenhouse."
10. Kerssens, L.C.A. (2020). "Brainport Smart District: A Suburban 'Smart' District Contributing to a More Sustainable Modal Split." Eindhoven University of Technology.
11. Myers, L. (2019). "UNStudio Unveils Plans for 'The Smartest Neighbourhood in the World' in the Netherlands." Designboom.
12. Brainport. (2018). "Brainport National Action Agenda."
13. Loohuis, K. (2019). "Smart Technology Will Transform Dutch Neighbourhood." Computer Weekly.

14. Harrouk, C. (2020). “UNSense Develops an Adaptive Neighborhood of 100 Homes, part of UNStudio Brainport Smart District Master Plan.” ArchDaily.
15. Martinez, A. (2019). “Brainport Smart District by UNStudio and Felixx Landscape Architects & Planners.” ArchDaily.
16. Williams, I. (2018). “36 Hours in Oslo.” The New York Times.
17. Architizer. (2022). Oslo Harbour Promenade.
18. Köstek, D. (2020). CONNECTING THE FJORD CITY FROM EAST TO WEST: A Qualitative Study of Temporary Urbanism in the Case of Havnepromenaden Project in Oslo, Norway. University of Oslo.
19. Stanghellini, S., Copiello, S. (2011). Urban Models in Italy: Partnership Forms, Territorial Contexts, Tools, Results. In: Dalla Longa, R. (eds) Urban Models and Public-Private Partnership. Springer, Berlin, Heidelberg 1.
20. Risanamento. (2015). Milan Santa Giulia, Our Project, Your Retail.
21. Lendlease. (nd). Milano Santa Giulia. Link to the project.
22. Columbus International. (nd). Arena – Milano Santa Giulia (via Onirism Studio). Link to the project.
23. C40 Cities Climate Leadership Group, Inc. (2019). Cities100: Copenhagen’s new Nordhavn neighbourhood is a centre of innovation for smart energy systems. Link to the report.
24. State of Green. (2022). Nordhavn: The smart urban area of the future. Link to the 360 virtual tour.
25. Eleftheriou, V., & Knieling, J. (2017). The urban project of HafenCity. Today’s Urban and Traffic profile of the area. Executive summary of methodology and traffic research conducted in the region. *Transportation Research Procedia*, 24C, 73–801.
26. Hales, R. (2015). HafenCity is Designed to Be Flood Proof. *Cortes Currents*. 1
27. HafenCity Hamburg GmbH. (n.d.). Smart Mobility as an Element of Sustainable Urban Development. Link to the source
28. HafenCity Hamburg GmbH. (2021). HafenCity Hamburg GmbH: New headquarters unveiled. 1
29. HafenCity Hamburg GmbH. (n.d.). Masterplan - Overview.
30. Blumenstein, E., & Etezadzadeh, C. (2020). Interview: Art and culture for HafenCity Hamburg. A vision becomes lived reality. In *Smart City–Made in Germany* (pp. 161-165). Springer Vieweg, Wiesbaden. 1