Mobility as a Key to the Livable City

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As a result of the mobility revolution, urban spaces and transportation infrastructure need to be adapted in the coming decades. Changes in drivetrain technology, vehicles, transport modes, user behavior, and road traffic regulations have consequences for urban environments. These necessary conversions will be costly and fundamentally alter the character of cities in the long term. It is not yet entirely clear which transportation modes and types of mobility will predominate in the future, but it is highly likely that our cities will become more differentiated and more distinct from one another in this respect than they are today (Klinger et al. 2013). Factors from very different fields will influence the development of our cities in the process. The question of affordable housing, the transformation of inner cities, and strategies for adapting to changing climatic conditions are all important factors driving the discourse on livable cities. The European mission statement of the New Leipzig Charter (BMI 2020), based on the three pillars of sustainability, strongly emphasizes the topics of a city oriented toward the common good, a green city, and a productive city as target parameters. Mobility design is a central theme in this context. However, sociopolitical considerations will determine the concrete factors that will shape urban planning measures and affect the role that environmentally friendly mobility will assume in the competing demands for space.

Dystopias associated with the climate crisis, such as traffic collapse and inhospitable urban wastelands, are of little help in the search for new solutions. But what are the desired models and visions of a livable city that has safe, inclusive, and sustainable spaces? Images that anticipate desired scenarios (Rittel 2013: 123ff.), as well as high-quality design projects already implemented that serve as model solutions, can inspire and provide a basis for discussion, thus shaping the future course of urban redevelopment. However, determining which solutions can be successfully implemented in which places depends on a multitude of reciprocal influences. In this respect, the question of »What to do?« initially takes a back seat to the question of »How to proceed?« Which methods and processes must be established in order to transform the car-friendly city into a livable one? Who are the key players and how do they work together? What are the first steps toward mobility concepts for the livable city?

The Example of Copenhagen

In the discussion below, we will consider the transformation of urban spaces in the city of Copenhagen, which as the »Green Capital of Europe« stands for ambitious sustainability goals and high-quality living standards (Bolik 2019: 139). The methodology used here is based on literature and media analyses, site visits, and photographic documentation, as well as interviews with experts involved in the transformation process in different capacities; these interviews were conducted in May 2019.

At a very early stage, Copenhagen set itself the goal of becoming the world's first climate-neutral city by 2025 (Climate Plan 2009; Copenhagen City 2009: 3) and is considered a pioneer in innovative projects, most of which have been implemented within the existing urban fabric. Environmentally friendly mobility is a focal point (Copenhagen City 2009: 5). Cycling conditions have already been improved across the city through a convenient, continuous network of paths. Copenhagen is therefore often cited as a model for the bicycle-friendly city (Kords 2020). Although numerous Dutch cities are just as far along as Copenhagen in terms of bicycle use in relation to the modal split and associated infrastructure (Copenhagenize Index 2019; Statista 2021; BMVI 2021), the origins and the leading figures behind the Danish capital's development into a bicycle metropolis are unique.

At the beginning of the 1970s, Copenhagen was as much of a car-oriented city as most other European cities. Public spaces were occupied by parked cars, the streets were reserved for motorized individual transport, and a large highway through the city center was planned from 1958 as part of the »City Plan Vest,« which was not implemented. In 1972, even the streetcar network was abolished. Then came the oil crises and with these, by necessity, a new way of thinking. The transformation of the city into a bicycle metropolis, however, did not pick up speed until the 1980s. Today's situation is arguably the result of various factors that ensured success, as outlined below.

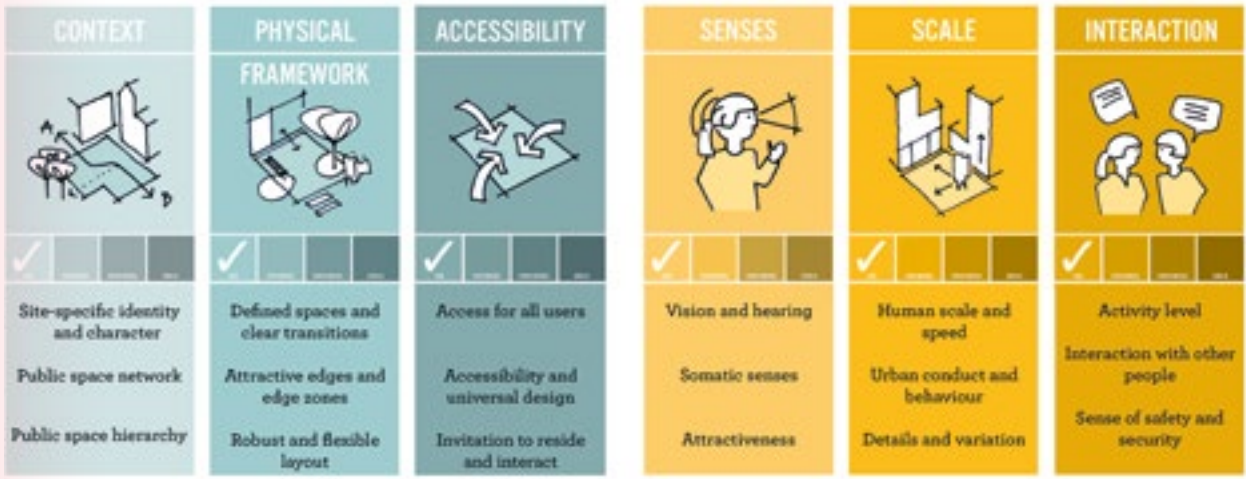

Fig. 1 Planning toolboxes: implementation of sustainability targets for Copenhagen (Source: Schulze + Grassov, Copenhagen)

Back in the early 1980s, the city already had a progressive head of the municipal transportation department in the person of Jens Kramer Mikkelsen. He was subsequently elected mayor of the city in 1989 and remained in office until 2004. The city's vision of making Copenhagen more family-friendly and strengthening public transport was reflected in the construction of the new subway. This focus was continued under the former minister and European Commissioner Ritt Bjerregaard, who was elected mayor in 2006 (Bondam 2018). Together with her director of technology and environment, Klaus Bondam, she implemented plans to make Copenhagen the most bicycle-friendly city in the world. In order to gain acceptance among city policymakers as well as the citizenry for this project, which aimed to significantly reduce air and noise pollution, two documents were given a central role: »The Environmental Metropolis« and »The Metropolis for People.« Both publications were strongly influenced by the thinking of the Copenhagen architect and urban planner Jan Gehl (Bondam 2018:154).

According to the urban planner Oliver Schulze, who supported the City of Copenhagen in embedding sustainability goals within municipal urban land use plans, the continuity of personnel and expertise in transportation planning at the highest level was certainly beneficial for the long-term objective of realizing bicycle-friendly urban redevelopment (Schulze 2019). The political-administrative sphere was enriched by inputs from academia, primarily Jan Gehl, who made a substantial contribution through his empirical research and design proposals (Gehl 2010, 2012). His central tenet that urban space should be experienced at the speed of pedestrians as a »city at eye level« has informed urban redevelopment as a guiding design principle; this included many practical planning cues calling for a human scale for streets, squares, and neighborhoods. The resulting redevelopment strategy focuses neither on neighborhoods nor on traffic types, but rather takes a holistic view of the city as a totality. Open space design, parking management, and expansion of bicycle infrastructure, for example, were synchronized across the entire urban area in Copenhagen. This was done in such a way that there was never a parking shortage, and every parking space eliminated made an immediate contribution to the realization of high-quality bicycle infrastructure design (Schulze 2019; ↳Fig. 1).

As far as possible, the planning culture was designed to be fault-tolerant. Not every intervention endured; there were missteps and misplanning, learning processes and corrections. This fault-tolerance not only helped to optimize the infrastructure, but also gave the urban community a knowledge edge (Schulze 2019). This is reflected,

Fig. 2 Cykelslangen
(Source: Björn Hekmati)

among other things, in the global consulting activities of the Copenhagenize Design Company and the media presence of its founder and CEO Mikael Colville-Andersen, as well as in Jan Gehl's international visibility.

The City of Copenhagen closely monitors and documents traffic conditions; since 1996, bicycle-specific data has been collected and published in the biennial »Bicycle Account« (Cycling Embassy of Denmark 2020). On the one hand, these and other statistical sources help the city to make the right decisions and to identify and correct undesirable consequences at an early stage. On the other, a good data base helps objectify public debate and even generates acceptance for supposedly unpopular measures (State of Green 2020).

But in addition to the protagonists and processes involved in redevelopment, another factor has played an essential role: good design that can be experienced in everyday life. The built transportation infrastructure in Copenhagen is functional, a pleasure to use, and of high design quality. The inhabitants identify with it, are proud of it, and have developed their own specific mobility culture (Schulze 2019). Function, performance, and appearance are not mutually exclusive, because good design does not favor one of these aspects over the others.

One example of this kind of design is the Lille Langebro bicycle bridge by Dissing+Weitling Architekten (2014), also known colloquially as Cykelslangen (↳Fig. 2). This steel bridge, measuring 190 meters in length and only 4 meters in width, has lighting integrated into the railing and an orange road surface. It bridges a secondary harbor basin adjacent to the Fisketorvet shopping center and connects to another bicycle bridge that crosses over the water to the Vesterbro district. It has an S-shaped curve; this extension of the path, which might seem unnecessary, allowed for a slight gradient reduction. It is great fun to roll down this snake; the challenge posed by the curve requires some concentration and thus may also enhance safety for oncoming traffic on this narrow structure. In addition, the shape of the bridge serves another function that is not apparent from the cyclist's perspective: it increases the amenity quality of the bankside along the basin through its shape and the materiality of its underside. A dead-straight structure at this point would certainly have come under the final construction costs of around 5.1 million euros (Dissing+Weitling 2021); however, this presumably would only have fulfilled the function of closing the gap, without contributing to the other aspects noted above. Notably, the design of this piece of technical infrastructure was the result of a competition (Eckart and Vöckler 2022: 206), where the quality of different solutions for this planning problem was discussed via the visual design presentation. These not only illustrated the requirements of the competition program, but also represented the urban development vision. The process of selecting the best solution is both an appropriate means of ensuring quality planning and of promoting architectural culture. The high number of awards won by this project

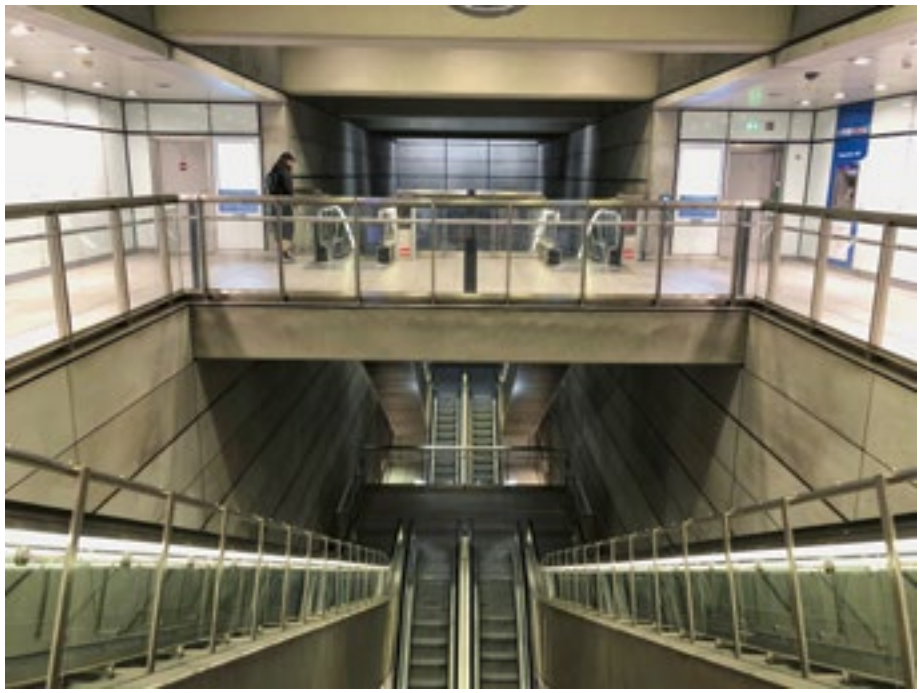

Fig. 3 M1 metro station (Source: Björn Hekmati)

over a five-year period (2013–2018) speaks for itself (Dissing+Weitling 2021). With Cykelslangen, an integrated solution was realized that enriches the urban space in multiple ways.

Equally noteworthy is the approach taken by the city's driverless metro network (operations began in 2002) (↳Fig. 3+4). The stations were designed to function smoothly and to have as timeless an appearance as possible (Colville-Andersen 2018). As a result, their designs are very similar to one another. Advertising or even commercial uses within the stations were avoided entirely. Underground stations are lit with daylight down to the platform (as far as technically feasible). The Copenhagen Metro can be used very efficiently, since there are no orientation problems in the stations, the digital ticketing system works in a straightforward way, and the very high frequency facilitates rapid travel without a fixed timetable (Copenhagen Metro 2017). It is fascinating to sit at the very front of the driverless trains and look in the direction of travel into the tunnels or down onto the tracks. The functional minimalism of the high-quality station architecture and furnishings, which scarcely allows individual stations to be distinguished, represents a radical statement for public transport

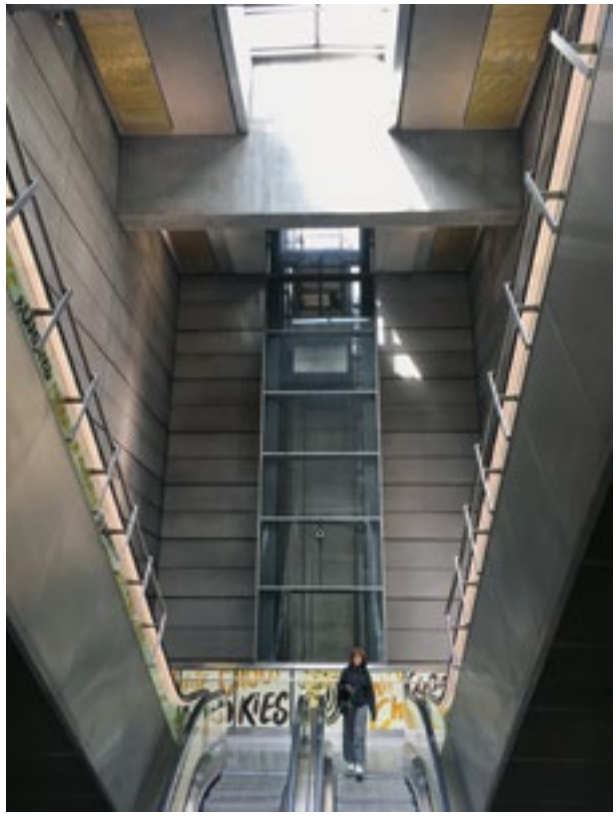

Fig. 4 M1 metro station (Source: Björn Hekmati)

Fig. 5 Ørestad: transit-oriented development, metro M1 (Source: Björn Hekmati)

and »A-to-B-ism« (Colville-Andersen 2018). Users have in fact criticized the rigorous design concept of Line M1, which subsequently led to differentiations being made within the system as part of a comprehensive color scheme for Lines M2, M3, and M4, in keeping with the minimalist concept. This strategy does not focus on the individuality or recognizability of stations in the urban context, but rather interprets the station as part of the rail network and the transport system, making it recognizable as a coherent infrastructure system.

The M1 line of this system also connects the district of Ørestad south of the city center. This area, which has been in planning and construction stages since 1992, extends as a fixed rectangle measuring roughly 600 meters wide and 5 kilometers long along the straight elevated railway tracks and an accompanying road flanked on both sides by wide bicycle highways (↳Fig. 5). A first for Denmark, the M1 line was the initial construction project within the the urban development plan for this district. Workers on the major construction

Fig. 6 Ørestad: built transition in the landscape (Source: Björn Hekmati)

sites that followed were soon able to travel to work via public transport. Ørestad is a radical strip city design for about 20,000 inhabitants whose scale was oriented to transportation infrastructure capacities. Accordingly, on its southern edge, Ørestad borders directly on the Pinseskoven nature reserve, where there is a metro terminus and buildings of up to eight stories forming a dense urban fabric. In this way it makes a clear statement against urban sprawl (Jordan 2002: 398; ↳Fig. 6).

Several buildings in the district were designed by renowned national and international architects, including Bjarke Ingels, or BIG, (8 Tallet, MTN the Mountain, VM Houses), Jean Nouvel (DR Koncerthuset), Adept (Cubic Houses), and Cobe (Karen Blixens Plads). The design program, which includes master plans from 2014 and 2017 (by Daniel Libeskind and Cobe, among others), infrastructure planning, and multistage competitions for major buildings as well as square and landscape designs (see competitionline), ranges from integrated access and mobility concepts to details such as bicycle parking facilities. Bjarke Ingels's (or BIG's) residential project MTN the Mountain, a kind of terraced housing complex built on top of a parking garage, makes a statement about the use of motorized individual vehicles by means of a wall relief: a bellowing stag stands atop a stack of high-performance cars, ironically holding up a mirror to parking garage users(↳Fig. 7). Ørestad is not yet finished nor fully occupied, so it remains to be seen whether this planning approach may be considered sustainable. As a model for courageous planning and consistent integration, however, the Ørestad district already serves as an exemplar.

In respect to climate change adaptation, the City of Copenhagen has taken a bold step forward. After the heavy rainfall of July 2011, the City of

Copenhagen decided to implement an initial demonstration project for city-wide climate adaptation based on the Climate Adaptation Plan (City of Copenhagen 2011) and the strategic Cloudburst Management Plan (City of Copenhagen 2012). The landscape architecture firm Tredje Natur of Copenhagen won the Europan 11 competition with its vision for a diverse neighborhood in the Sankt Kjelds quarter. They were commissioned to translate the competition entry into a comprehensive vision for Denmark's first climate-friendly neighborhood (Rafn 2015). This resulted in a workable concept that could serve as a guide for further development of the neighborhood. In parallel, the Sankt-Kjelds quarter was approved as a neighborhood renewal project (2012–2016). This facilitated development synergies and allowed for a generous project budget consisting of financial support for urban renewal, climate adaptation, and wastewater management. According to the planner and project manager in charge at the City of Copenhagen, René Sommer Lindsay, in 2014 Tåsinge Square was realized as the first high-visibility pilot project, thanks to significant political pressure and a willingness to clarify legal obstacles in the development process (such as the water company's investment in public space, street surface drainage, and the fee schedule—see Lindsay 2017; Copenhagen City 2016: 10). The example of this plaza makes it clear that it is not primarily a matter of universal applicability, but of setting an example at the citywide level (Lindsay 2017). At the same time, a competition was held for Saint Kjelds Square and Bryggervangen Street, which was won by the landscape architecture firm SLA in cooperation with ALECTIA (City of Copenhagen 2015: 15). Their design greatly reduces the size of the existing traffic circle and edges it with four large green zones (↳Figs. 8+9).

This has resulted in a model neighborhood for a climate-resilient residential quarter in Østerbro, which will be used to develop methods and expertise to advance climate protection and flood prevention in Copenhagen over the next twenty years. The first climate-change-resilient neighborhood is set to become Copenhagen's greenest city center neighborhood—which can also withstand intense rainfall. Green streets, blooming courtyards, diverse fauna, and landscaped drainage areas and ditches will provide the new building blocks for the neighborhood. The City of Copenhagen is working closely with the Copenhagen utility HOFOR, as well as the Østerbro Environmental Center and neighborhood residents, who are leading their own initiatives through community gardens and urban farming (e.g., the ØsterGro rooftop farm, the Pavement Garden on Bryggervangen Street, and the Green Entrance). According to political scientist Torkil Lauesen, who is responsible for community involvement within the municipality, special attention has been paid to participation from the beginning since much of the land is privately owned. Information workshops and events were held in public spaces as a means of reaching as many residents as possible (Lauesen 2015). A specially established and funded committee not only assisted in planning

Fig. 7 Ørestad: wall relief in the parking garage of the MTN housing project, BIG. (Source: Björn Hekmati)

Fig. 8 Sankt Kjelds Quarter: Tåsinge Square (Source: Third Nature's Climate District design, https://www.tredjenatur.dk/en/portfolio/the-first-climate-district/)

Fig. 9 Sankt Kjelds Quarter (Source: Third Nature's Climate District design, https://www.tredjenatur.dk/en/portfolio/the-first-climate-district/)

and realization, but also initiated social campaigns following completion. Financial support was also granted to civic engagement for the realization of neighborhood gardens in public spaces (City of Copenhagen 2015: 23, 30, City of Copenhagen 2014b: 8). The initial design by landscape architects Tredje Natur was modified during the process in response to user perspectives; this diminished its striking design concept as a flowing space with soft forms (Bolik 2019: 197). However, according to the principle »the community is the expert« (PPS 2000, 2017), the desires and ideas of users are given a high level of priority in Copenhagen to ensure that the everyday spaces created are widely accepted (↳Fig. 10).

In the Sankt Kjelds neighborhood, scalable climate adaptation solutions have been created for the urban spaces of the future, right down to the careful detailing of the Copenhagen-style water-permeable paving and retention filters. Areas for water-sensitive urban design and biodiversity enhancement naturally come at the expense of transportation space. The previously oversized streets (City of Copenhagen 2015: 9) have been reduced to one lane, which is now shared by cyclists and motorized

Fig. 10 Bryggervangen (Source: Third Nature's Climate District design, https://www.tredjenatur.dk/en/portfolio/the-first-climate-district/)

traffic at reduced speeds. The few remaining parking spaces are unpaved. Of course, this is only possible by reducing traffic space as well as through radical traffic calming. With the climate-friendly city in mind, clear priorities were set for the blue-green infrastructure. The process of removing paving to unseal the soil was underpinned by citizen engagement and active communication; this was realized in a playful way using umbrellas that collect rainwater as well as creating a water playground where water can be pumped by hopping. The bicycle city of Copenhagen is facing up to the requirements of the climate-friendly city concept and is once again reorienting itself. Its plan to become the best bicycle city in the world was extended in 2009 by a City Council resolution; now Copenhagen wants to become the best city for people (Gehl 2017: 174). The »Climate Quarter« in Copenhagen is a radical statement along these lines, which has deliberately been allowed time to prove itself (↳Fig. 11).

Learning from Copenhagen

The example of Copenhagen along with the complexity of the planning processes and projects provides an answer to the question of strategies for transforming the car-oriented city into a livable one. Whether it is a bicycle bridge, a metro station, a planned city, or a »climate quarter«—Copenhagen's transformation into a livable city is being conceived and implemented holistically at all scales. Sustainable forms of mobility are not just enabled and encouraged: they are positively imprinted in cultural consciousness via architecture as a »heavy social medium« (Delitz 2009). Through the involvement of its inhabitants, urban space is transformed and enhanced, upgraded, or reinterpreted. Solutions are not conceived in purely technical terms nor optimized for only one aspect, but rather are realized to a high design standard in respect to the urban context.

Copenhagen's transformation shows that this requires a long period of time and multilayered processes involving multiple phases and diverse scales. These are long-term developments, combined with extensive investments and clear political objectives. They have not triggered a sudden turnaround, but rather a decades-long transformation and with it, sustainable changes in urban spaces and transport modes.

The case of Copenhagen clearly demonstrates the importance of committed actors who play a critical role in the development of objectives for the entire city and for dealing with land usages. These actors have a strategic vision of the scope for future action that must be safeguarded and executed. They are also able to initiate processes and move projects forward with determination. This is where the importance of the interface between science and politics becomes clear, as the collaboration with Jan Gehl attests. His image of the »city

Fig. 11 Climate adaptive design (Source: Climate Tile by Third Nature, https://www.tredjenatur.dk/en/portfolio/climatetile/)

at eye level« has informed urban decisions in Copenhagen and many other cities.

The first steps in implementation differ greatly but are always based on holistic planning approaches, an integrated administrative approach, and a deep understanding of the unique characteristics of the city and its inhabitants. From temporary individual measures intended to have a stabilizing effect, to hierarchical master planning and model projects, these activities all involved actors at various political levels (Wulfhorst et al. 2013: 257). Copenhagen's experience clearly shows that the recipe for success is not the mere accumulation of isolated measures; rather, what is needed are integrated concepts that define quality standards for the entire city and generate solutions geared to the location and users (Hoor 2020). The multistage competition and planning procedures that start with a concept competition, such as Europan, and end with a design competition, open up opportunities for testing the efficacy of proposed solutions through visual aids. Qualities cannot be conveyed abstractly, but only through the depiction of the actual project. It is therefore less individual solutions and more the special planning culture that distinguishes Copenhagen.

When looking at other cities and municipalities whose transportation and mobility design are considered exemplary, such as Barcelona, Amsterdam, Paris, or Karlsruhe, it becomes evident that design solutions offering high urban spatial quality respond in specific ways to urban contexts and their residents (Hofmann 2019; Eckart and Vöckler 2022). This contextual integration is a key to successful urban planning concepts, both in terms of urban design and in the organization of the planning and implementation processes.

Clearly, even highly differentiated transportation planning models that address the various modes of mobility have their limits when it comes to meeting the demands of a climate-friendly city. Driving on paved surfaces stands in the way of the necessary unsealing of the soil, which is where

the competition for space in the European city becomes particularly obvious. The search for new concepts, however, also leads to great opportunities for urban development, as evident in model projects. For example, the reassessment of climate adaptation requirements and green space provision was initially the starting point for the Superilles (superblocks) in Barcelona (Eckart and Vöckler 2022: 156). Today, these superblocks are also celebrated as a sustainable transportation concept offering a new kind of urban environment, because they foster greater acceptance of a reduction in motorized individual vehicle usage (Ajuntament de Barcelona 2020).

The exciting developments in Barcelona, Amsterdam, Paris, and Karlsruhe are specifically designed for these cities and their inhabitants. The objectives and concepts of these individual initiatives aimed at promoting environmentally friendly mobility differ just as much from each other as do the procedural steps involved in their implementation. What these best-practice examples have in common is that they generate added value in terms of urban spatial quality that goes far beyond the issues of modal split or traffic flow optimization. Successful urban planning concepts are measured by their demonstrable contribution to the reduction of motorized individual vehicles, the high share of pedestrian and bicycle traffic, the contribution to climate protection and climate adaptation, and, last but not least, the living and amenity qualities in inclusive urban spaces. The interplay between science and politics determines their respective quality, as can be seen in the example of Copenhagen and more recently in that of Paris. The vision of the fifteen-minute city became the guiding principle for urban transformations in Paris and is currently being taken up by many other cities, such as Hamburg, where they are being further developed according to local urban needs (Moreno 2020, 2021). If future developments can only be determined through hypothetical scenarios, then scientific expertise in dealing with complex issues is crucial for the evaluation of options for action in the political decision-making process (Mitchell 2008).

The process of reassessing the spatial demands of road users within available areas seeks a balance between different usage demands and traffic speeds, with the goal of designing safe, inclusive, and healthy streets and squares. The issue at stake here is the establishment of spatial equity in the process of negotiating socially oriented objectives in urban space.

Ways toward the Livable City

The reassessment of traffic and mobility in the social process of the transportation revolution creates opportunities for rethinking public space. In this context, the discourse on equitable land use in the sense of a livable city can have integrating effects and avoid the excess ideological baggage accompanying the narrative of abstaining from and banning automobile use. This can be achieved by incorporating goals that can be consensually agreed upon such as amenity quality, climate adaptation, and environmental protection. For example, climate-adaptive urban planning, which aims at reducing local heat islands and closing hydrological loops, offers tangible added value to quality of life through climate adaptation measures and expanded blue-green infrastructure (Bolik 2019; Winker et al. 2018).

Professional urban planning is faced with the challenge of preserving and further enhancing the respective existing qualities in cities. The transformation of our cities and communities involves, by definition, spatial parameters that pose design challenges. These are highly complex fields of activity that can no longer be mastered using narrowly focused, linear, or sectoral solutions. For example, the need to achieve intermodal efficiency in the design of transfer hubs and to adopt a systemic perspective on intermodal mobility systems (Eckart and Vöckler 2022: 25) increases the complexity of the urban design challenge. A sensible site development concept is just as important as the amenity qualities of the public spaces that benefit the entire neighborhood.

Design concepts aim to address these complex challenges by reinforcing existing qualities and intrinsic potential, mitigating risks, and securing future room for action. Examples of integrated strategies of high design quality can already be found worldwide in projects for climate change

adaptation, flood protection, or participatory planning. The diversification of transport infrastructure and mobility cultures is determined by technological possibilities but requires design integration into the urban space and site-specific adaptation if these are to be implemented successfully. This represents a great opportunity for our cities to articulate their own concepts and use these to develop local identities.

As the example of Copenhagen clearly illustrates, the promotion of inclusive and healthy urban development is not only a question of the quality of the architecture but is also an expression of holistic planning that involves all urban stakeholders. It is important to take advantage of the opportunities offered by expert urban planning: in the further development of mobility concepts, in the design of public spaces, and in the development of new typologies and site qualities that will be achievable in the future as a result of new technologies and changing social demands. In addition to the close cooperation between disciplines at different urban scales, it will also be necessary to moderate ongoing social negotiations among different objectives. Only in this way will innovative paths based on research and science develop, as well as have a chance of being accepted and successful in their implementation. Integrative processes, holistic approaches and, last but not least, good design are the keys to a livable city.

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