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Corridor Planning–Sustainable Planning?

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Abstract: Climate change and accelerated development that threaten the survival of humankind require an urgent review of planning approaches to achieve sustainable development, including transport systems, since the quantity of motorised traffic and GHG emissions is increasing yearly. Urban planning of post-industrial cities, the digital age, climate change—all this requires that urban planning is not only the planning of settlements where residents will meet their functional needs, but also for cities to be leaders in the fight against climate change. The question arises as to which planning approach is the most suitable for planning sustainable cities in the 21st century. After a literature review and research of the authors, urban corridor planning is suggested as one of the possible planning strategies. When planning new or revitalising existing intra-city corridors within urban areas, to take into account their spatial, environmental, social and economic sustainability is necessary. After an analysis, indicators of urban corridor planning were extracted, and the article highlights the advantages and priorities. The contribution of the article is in determining the ten basic principles of urban corridor planning. It is concluded that implementation of urban corridor planning principles in the planning of intra-city corridors achieves the result of urban sustainability.

Keywords: sustainable city; urban corridor planning; intra-city corridor

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1. Introduction

Recent research raises the question of redefining the approach to spatial planning of cities, which for the last 70 years was based on the so-called zonal planning, i.e., dividing the city into areas of the same purpose, in order for the population to meet their functional and lifestyle needs: zones of residence, work, recreation, city transport and protected cultural architectural heritage [1]. During this period, humankind became capable of influencing and modifying natural systems, resulting in climate change. As large consumers of all resources (energy, water, food), cities become key factors in the fight against climate change. Consequently, city planning and the tools used by planners can no longer be the same because city planning outgrows the functional (local) needs of its inhabitants, and (global) issues of environmental protection and climate change resistance become crucial for urban planning. It is essential to predict the urban growth and address urbanization-induced issues (land use, anthropogenic greenhouse gas emissions, energy consumptions, urban heat) for future urban sustainable development. Monitoring and modelling urban dynamics are essential for understanding the urbanization process and environmental consequences in the changing world [2]. Urban life has been transformed with the development of smartphones, 5G networks, GPS and electromobility, so new technologies cannot be avoided, even as a planning tool. At the same time, the forms of the city are being researched, that is, which form of the city is the most sustainable and the most suitable for resistance to climate change (linear city, compact city, core city, star city, monocentric city, polycentric city) [3,4]. Different authors state different properties of a sustainable city: intensive land use, population density, compactness, diversity of uses and reduction in individual car traffic, improvement in public transport performance, availability of public transport [5–9]. Regardless of the form of the city, all concepts advocate good transport connections within

the city and the intensification of activities along transport routes. Transport systems affect the economy, social conditions, quality of life, the environment and the amount of pollution in cities. Motorised traffic (CO_2 traffic) is expanding especially in countries with accelerated urbanization (South-East Asia, South America); the parking problem is spreading from traditional hot spots to the entire city, influencing driving distance in the urban traffic networks [10]. We can conclude that the future sustainable urban development of cities cannot be achieved without sustainable development of transport. The question arises: what approach to city planning will reconcile the transport requirements of motorised traffic and the requirements of reducing GHG emissions while strengthening pedestrian and bicycle traffic, greening the city and improving the quality of life in the city? New principles and methods of city planning are needed to redefine urban planning goals according to the global goals of environmental protection and sustainability. The concepts of urban planning of post-industrial cities, the digital and energy age and climate change—all of these require that city planning is not only a settlement where residents will meet their functional needs, but also for cities to be leaders in the fight against climate change and, simultaneously, to achieve the resistance to it. New approaches, methods and goals should take into account economic welfare, social justice, quality of social life, good urban governance, cultural issues and urban standards [11].

In the paper, we explore the possibilities, advantages and limitations of urban corridor planning as a possible approach to sustainable planning of the cities or parts of the cities in the 21st century. Transport corridors form the primary communication links within a country or region, between settlements (cities, villages) and within parts of settlements, between cities and suburbs. The function of transporting people or goods occurs within them, and within themselves, they unite the space of the transport system and the surrounding area. The scale of the corridor can be local (urban, rural), regional, national or transnational (continental); the means of transport within the corridor can be different; and the corridors can have different degrees of importance and levels of influence [12]. The simultaneity and integrality of planning the use of the city and the region are consistent with integral traffic planning [13]. Some authors argue for the simultaneous urban planning of the city and its surroundings (region or metropolitan area) in order to achieve sustainable development in the planning solution of the immediate urban–rural relationship [3,4]. It can be concluded that corridor planning within the city is important for the region only if it is a corridor with a rank of importance for the region (or national).

Considering the importance of sustainable city planning, the topic of the article is intra-city corridors with different types of transport. We focused our research on intra-city corridors since they pass through built-up parts of the city. Regional, national and transnational corridors are not the subject of this article because the sustainability settings for them are different since they mostly pass through unbuilt areas. For the purpose of our research, we distinguish the terms and meanings of "street" and "intra-city corridor". The street is traditionally defined as a longitudinal traffic area through a populated settlement; it includes different types of traffic, together with buildings and other facilities on both sides of it. The intra-city corridor is defined integrally and consists of an artificial or natural transport system (river, canal, railway, subway, road) and the surrounding built or unbuilt space of various uses, as shown in Figure 1, and integrates economic, social, environmental and cultural aspects. For the purposes of this article, the intra-city corridor is understood three-dimensionally; that is, it includes all above-ground and underground parts. The intra-city corridor consists of all its above-ground and underground parts. Planning and layout of underground space in cities also take into account factors such as economy, technology and culture [14].

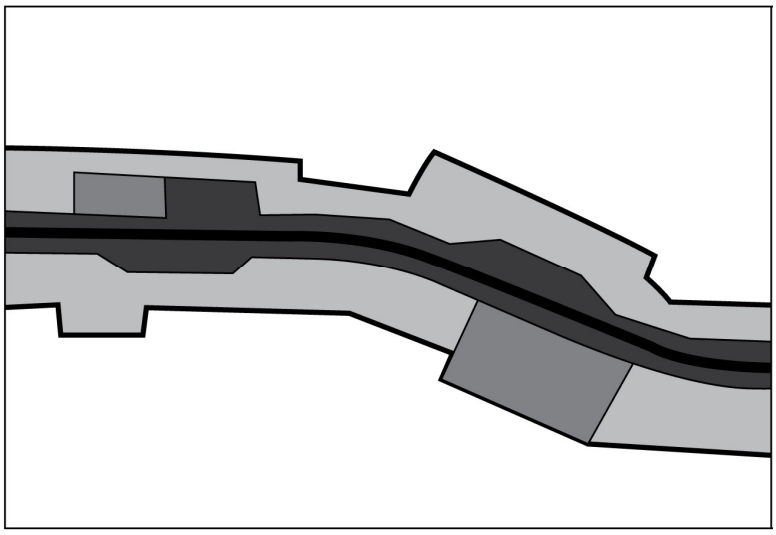

Figure 1. Scheme of an intra-city corridor consisting of a transport system and the surrounding area.

The integrated planning of the linear transport system and the surrounding land, i.e., corridor planning, as an applicable model of sustainable spatial development of cities is pointed out by various authors [15–17]. The purpose of urban corridor planning is simultaneous multidisciplinary planning, whether it is the planning of a new corridor or the reconstruction of an existing one. Corridors can become the axes of urbanisation, depending on their size, influence and importance [18–20]. When building new corridors or revitalising existing corridors within urbanised areas, it is necessary to consider their environmental, social and economic sustainability. The intra-city corridor is not only a means for the fastest and shortest transport route between the starting point and the destination. Although it has a linear geometric structure, it is spatially three-dimensional and significantly affects the surrounding area and the population living in its surroundings.

The research question is whether corridor planning is a desirable strategy for planning the sustainable development of the city? The research method is based on the research and analysis of the literature and on the basis of the synthesis of the authors' research; the principles of corridor planning were determined, and research conclusions and recommendations for further research were given. The basic hypothesis of the article is that urban corridor planning can be a sustainable planning strategy for cities in the 21st century. The article aims to analyse urban corridor planning according to sustainability settings, determine the advantages and limitations of corridor planning and identify when it is suitable as a planning approach. A contribution of the work is the determination of 10 principles whose planning implementation will result in sustainable urban corridor planning. The flowchart of research methodology is presented in Figure 2.

This paper is divided into five sections, each with a specific focus. Following this introduction, Section 2 focuses on a literature review, theoretical framework and comparison of corridor planning with different theoretical and practical approaches to city planning. Section 3 gives the results and provides insight into the advantages, priorities, limitations and main principles of corridor planning. Section 4 focuses on discussion; this section provides insight into the practical applications of the research and demonstrates how they can be implemented. The research questions the paper aims to answer are also discussed in this section. The last section focuses on the conclusions of the research and recommendations.

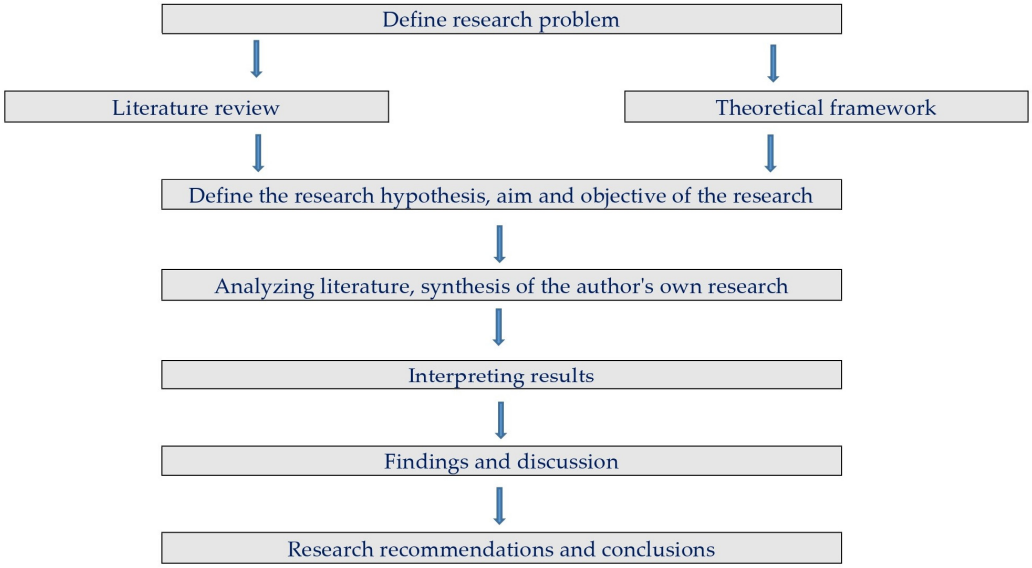

Figure 2. Flowchart of research methodology.

2. Materials and Methods

2.1. Theoretical Framework on Urban Corridor Planning

Land transport corridors (roads, railways, bike lines) are or tend to be as linear as possible. Underground means of transport do not have to strive for linearity with regard to the depth of infiltration and the technical design parameters. The concept of linearity can be identified in the mental images of the city as a visual identity—visual linearity. Kevin Lynch establishes that the mental image of a city consists of paths, edges, areas, landmarks and hubs [21]. Roads are an element of linearity in the mental image of the city (streets, promenades, coasts, railways and roads). Corridors are spaces where transport, economic and demographic processes are linearly articulated [22]. Corridors integrate infrastructure, urbanisation and economic development [19]. They can be of different scales intended for different means of transport, with different degrees of importance and level of influence [12]. Corridors are perceived as areas of infrastructural development [23], transport networks and urban development [24,25]. Urban corridors are primary spaces of urban mobility. Built environment, land use, infrastructure, mode accessibility and socio-demographic factors have significant influence on mobility behaviour [26]. Intra-city corridors can be understood both as spaces of linear urban dynamics and as spaces of intense night lighting (night images) [2].

The planning concept of corridors within cities is not new. Settlements have sprung up spontaneously along natural (rivers, canals) or artificial (roads, railways) transport routes. The corridor concept as a planning concept is known as corridor design, corridor-type urbanisation and corridor-style town planning. Corridor planning is the integration of the planning of the transport system and surrounding area where the corridor is the infrastructure axis and the axis of urbanisation aimed at the sustainable composition of the city (determination of purpose along the main traffic routes, development of public transport within the corridor, reduced use of cars).

The general goals [15,20] of urban corridor planning are as follows:

- the development of public transport within the corridor—encouraging sustainable mobility and public transport;
- the determination of land use along the main traffic routes—a variety of sizes and scales of urban and architectural interventions;
- the satisfaction of most of the needs of residents without the use of cars—a variety of land uses;
- solving traffic conflict points and bottlenecks.

The specific goals [15,20] of urban corridor planning are as follows:

- pedestrian and passenger safety;
- building new public and business facilities next to transport stations and transport hubs;
- planning new public areas;
- restoration and revitalisation of brownfield areas;
- creating a new identity of intra-urban corridor, corridorscape and cityscape.

2.2. The Most Important Strategies for Urban Sustainable Planning

The literature review tried to identify the most relevant data sources, aiming to find important characteristics of different contemporary strategies for sustainable planning. It demonstrates that several strategies of sustainable spatial planning of cities in the 21st century are developing. The presentation of the most important methodological and strategic planning approaches is summarised in Table 1. Other approaches to sustainable city planning, such as Eco-District, Complete Streets, Complete Communities, Garden City and Pedestrian-Oriented Design (POD), are also mentioned in the literature, but this article highlights the diversity of approaches and strategies by discussing the most important ones.

The TOD, 15-min City and Walkable City concepts are primarily radial; Superblock is a compact spatial concept, while the corridor planning concept is linear. Like TOD, 15-min City and Walkable City, corridor planning includes walking distance to public transportation hubs and walking distance to public and business amenities needed by residents. Corridor urban planning can be integrated or superimposed with other planning strategies. For example, TOD and corridor urban planning focus on the transport system and spatially distribute public and business use around the focus of urbanity radially (TOD) or linearly (urban corridor planning). TOD, like urban corridor planning, promotes high-density mixed-use development in a pedestrian-oriented layout around major transit nodes. Corridors that are the boundaries of Superblocks can also be inner-city corridors of linear extension, tangential to Superblocks.

Table 1. Comparative analysis of the most important strategies for urban planning.

Planning Strategy Author, Year	Characteristics	References
TOD Transit Oriented Development Peter Calthrope, 1993	TOD is a planning strategy for managing public transport and high land utilisation. Key factors of TOD strategies are Public transport (maximising ridership and passenger), Land use efficiency (mix-use and compact developments), Accessibility (pedestrian-oriented development with 10 min walking distance from the transportation hub) and Environmental impact (minimising traffic congestion).	[27–29]
Walkable City Jeff Speck, 2012	Walkable City is an alternative form of urban mobility. Transport should be suitable not only for drivers but also for other people, environment and health. A Walkable City is a city suitable for pedestrians. The basic principle is to create public urban spaces that are available and friendly for pedestrians.	[30–32]
15-min City Carlos Moreno, 2020	15-min City is a polycentric city. The six essential social functions—life, work, food, medical treatment, education and personal development—must be available within a 15-min radius.	[33–35]

Table 1. *Cont.*

Planning Strategy Author, Year	Characteristics	References
LUTEI Land Use, Transport and Energy Integration	LUTEI is a multidisciplinary approach to improving urban resilience. LUTEI is an extension of a traditional LUTI model and includes Energy Integration in sustainable planning.	[36–38]
KBUD Knowledge-Based Sustainable Development	Sustainable urban planning requires knowledge-based development strategies. Knowledge is a local, regional and global resource. Cities can better move towards sustainable urban development founded on the principles and standards of knowledge.	[39–41]
Superblock	Superblock design reduces space assigned to cars, enabling alternative uses for improving liveability. Superblocks are designed to discourage cut-through traffic and promote multiple uses of street space. A superblock consists of, for example, nine (3 × 3) urban blocks, including streets. For cities, a street network is potentially suitable for integrating superblock or miniblock design, providing opportunities for city-scale transition towards more sustainable cities.	[42–44]

Regarding its multidisciplinary nature, the LUTEI concept is similar to the concept of corridor planning. KBUD, also Smart City and Smart Sustainable City strategies, can be in all planning strategies. Micro-mobility and shared micro-mobility services can also be implemented in all planning strategies. Built environment, infrastructure, accessibility, land use as well as socio-demographic factors have significant influence on mobility behaviour and on micro-mobility [28].

2.3. Transport Priorities and Urbanity Priorities

For urban corridor planning, quality planning that will integrate transport (traffic) requirements and the requirements of shaping and composing the city and street (urbanity) is essential. For this research, we analysed the mutual relationship between transport priorities ("vehicle friendly") and spatial priorities ("pedestrian friendly") indicators and their mutual intensity. The set of indicators was narrowed down to 15 that are most often highlighted in the literature [27,30,33,42,45]. From the researched literature, it can be concluded that priority indicators for urbanity are related to the human scale, safety and comfort ("pedestrian friendly"). In contrast, transport priorities are related to speed and technical solutions of the transport system ("vehicles friendly"). Common indicators of the same intensity are related to safety, land use and environmental protection.

Transport is not only the result of economic and social processes but also the other way around: both interact with each other and shape the spatial development of cities. Areas of cities that are next to traffic routes have more opportunities for economic growth because there is a higher concentration of business (trade, catering, tourism, public sector). The goals of urban corridor planning are the determination of purposes along the main traffic routes, development of public transport within the intra-city corridors, composition (shaping, image) of the city and that residents meet most of their needs without using a personal car [17]. Improving and encouraging public transport operations (bus, train, tram, subway) is important because more people can be moved within limited road space. This could lead to a more sustainable urban transportation system in the long run [46,47].

We can conclude that these indicators and their balanced intensity are a prerequisite for a compromise of urban corridor planning. The result is presented in graphic representation (Figure 3) [45,48–51].

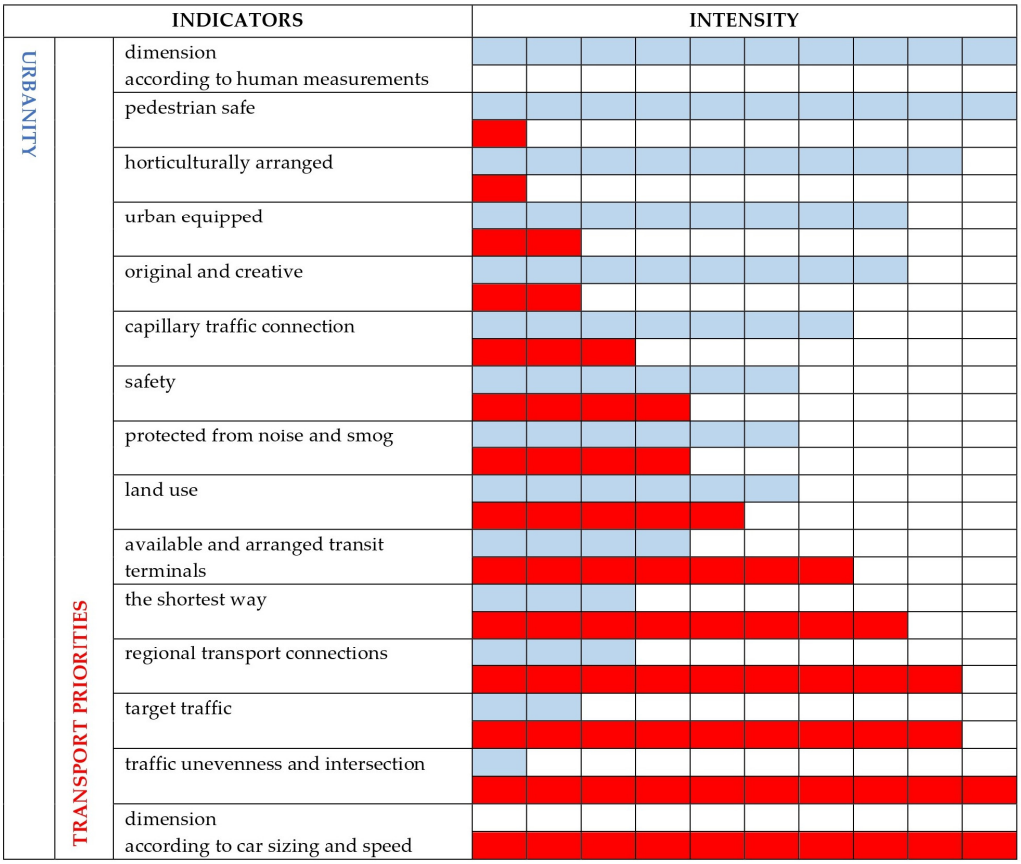

Figure 3. Relationship between urbanity and transport priorities.

2.4. Sustainable Transport within Cities

It was already emphasized earlier that there is no sustainable development of cities without sustainable transport and sustainable mobility.

Sustainability integrates economic, environmental and social aspects (three pillars of sustainability). Traditional planning methods for urban transport were focused on economic progress and efficiency (cost–benefit), and less on environmental issues, social justice and inclusivity. Environmental issues were considered through the reduction in motorized traffic (CO_2 traffic), and the increase in electromobility and public transport. Micro-mobility and shares of micro-mobility services have become increasingly popular in the last decade. They play an important role in sustainable transport because they support environmentally friendly travel, reduction in car usage, less noise, less air pollution and less occupied road space in cities [26]. The third pillar of sustainability includes social justice, equality and accessibility. A sustainable public transport system should be affordable and accessible for all citizens, including members of society of a low-income level, other socially vulnerable populations and people with physical abilities [52]. As for mobility in general, micro-mobility has the potential to increase social justice, can create mobility opportunities for groups with reduced access to other transport modes and can contribute to the distribution of mobility opportunities [26].

Strategies for increasing transportation sustainability include demand management, operations management, pricing policies, vehicle technology improvements, clean fuels and integrated land use and transportation planning. Land use and transportation strategies emphasize compact development, mixed use development, higher development densities and transit, as well as pedestrian- and bike-friendly development [53]. It is in this integral approach of simultaneous planning of the transport system and the surrounding area that the components of corridor planning are recognized. Sustainable transport should be economically viable and provide long-term benefits, but should also be environmentally

friendly, socially sustainable, should contribute to the reduction in social inequalities and should promote inclusion and equality. One of the powerful tools in achieving this goal is the use of mobility and micro-mobility services.

2.5. Examples of Good Practice

As examples of good practice, different approaches of corridor planning have been selected.

The company "Gehl" carried out a series of projects to humanise and culturally transform the existing traffic corridors and transport points. Thus, Market Street in San Francisco (USA), a significant transit corridor that was perceived as an abandoned, uninteresting and dangerous space for socialising, was transformed into an area with many alternative transportation activities (bicycles, pedestrians) along with the cultural transformation of public life and the creation of an exemplary main street of the 21st century. The transformation came about as a result of population surveys, public debates and workshops. Design ideas were tested, and 300,000 people were engaged and had the opportunity to experience new ways of using the street in real-time. With efficient transportation options and relevant programming, the efforts of urban designers have transformed Market Street into a civic, cultural and economic centre, bringing a vibrant public life to the street and offering new opportunities for various amenities on this San Francisco street [51,54]. The common goal of these projects was to transform transport corridors/streets and their intersections/crossings into spaces for pleasant living, turning monofunctional spaces into multifunctional–sustainable, more humane ones. Urban designers gave the streets multiple functions by introducing bicycle and pedestrian traffic, removing conflict points and, at the same time, ensuring unhindered pedestrian and bicycle flows. They defined typologies of public space and provided functionality. Streets become accessible, safe and diverse longitudinal public spaces that favour the movement of people of all ages and cultures, as well as a space for presentations of social, cultural and natural heritage.

The model of the spatial structure of Krakow was designed such that the axis of the traffic corridor and smaller corridors is perpendicular to the main corridor and nodal areas of traffic and activity. Areas of new building interventions and greening were identified along the traffic corridor. The clarity of the planning strategy is visible, and the traffic corridor is the axis of urbanization. Land use in the corridor is for various purposes, including green areas. Nodal spaces are identified, and areas of conflict are also revealed [55].

The city of Hamilton (USA) issues its corridor planning guidelines [56]. Corridor planning principles and design guidelines and where these principles and guidelines apply are outlined in the guidelines. These principles and guidelines provide guidance for new development, public realm investments and future planning studies along primary and secondary city corridors. Corridors are defined in the Urban Hamilton Official Plan (2011) as areas of street-oriented uses, which incorporate a mix of retail, employment and residential uses, developed at overall greater densities, and located along arterial roads serving as major transit routes. Corridors link nodes and important areas of activity within the city and are intended to be key locations for residential intensification. Corridors may form the boundaries of residential neighbourhoods, but should act as a linear focus for activities and uses within the community. The city's corridors provide an opportunity for creating vibrant pedestrian places through investment in infrastructure, residential intensification, infill and redevelopment [56]. One of the keys to reaching densely populated urban centres is using our public transport corridors to their full potential, especially through mixed-use development where appropriate [57].

For more efficient delivery of services that the public demands, comprehensive plans for Lacey, Olympia, Tumwater and Thurston County (USA) all envision vibrant, dense urban centres and moderately dense suburbs within long-term urban growth. Thurston Regional Council in the report Revitalization of city transport corridors-The strategic thinking of corridor development introduces the term "Corridor District". Though they

will have different features and identities, successful Corridor Districts will have certain things in common: busy, lively sidewalks oriented around pedestrians and activities, multi-story architecture, different types of uses—residential, retail, services, civic—adjacent to each other or "stacked" vertically, abundant public amenities like plazas, pocket parks and street features (benches, trees, fountains), high-quality transit service, minimal surface street parking and people–lots of people—all day long, engaged in different kinds of activities.

It can be concluded that the corridor as a linear axis of spatial development and urbanization is sustainable if the amount of individual car traffic is reduced and public transport is increased, if the diversity of uses is realized and the stay of people in a public space that is "pedestrian friendly", pleasant and green is increased.

3. Results

Arguments in favour of urban corridor planning as a sustainable concept emphasise the integral planning of the transport system and the surrounding land and the spatial, traffic, economic and institutional levels of the corridor. The integral approach, inherent in corridor planning, ensures a functional synergy of transport and other uses, which provides additional development value for the city [20].

The spatial and planning specificity of urban corridor planning is in its linearity. To make corridor planning a sustainable planning strategy for cities in the 21st century, advantages, priorities, limitations and principles of corridor planning are identified.

3.1. Urban Indicators

Due to its comprehensiveness, corridor planning is also applicable in the processes of urban renewal (urban rehabilitation) of cities. Sustainable growth and development of cities are also based on the renewal and reconstruction of the city, the introduction of new uses or the conversion of existing uses into new ones (for example, industrial uses into public ones—brownfield). Urban corridor planning, like urban renewal, is a multidisciplinary process that implies that an individual intervention in space (for example, construction or reconstruction of the transport system) is part of a broader, more complex plan for the renewal of the city or part of the city. In urban renewal, as well as in corridor planning, the local implementation of measures that address the needs of the local population is valorised [19]. This research analysed the influence of indicators on urban corridor planning (Tables 2 and 3). The data presented in Tables 2 and 3 are the result of the literature research, the research of examples of good practice and the synthesis of the authors' research. The influence of indicators on the planning of urban corridors was analysed and presented. We singled out the general spatial planning indicators and defined how they are implemented in urban corridor planning.

Table 2. The implementation of urban planning indicators in urban corridor planning.

Urban Planning Indicators	Implementation of Indicators
density	building density (m^2/ha), housing density (inhabitants/ha), proportional to the area of the corridor and the purpose of the building
land use	different land use (ha), mixed, mandatory public services
public services	proportional to the number of users (inhabitants/public service), local, adequately distributed, adapted to walking distances
traffic	number of vehicles/hour, pedestrian and bicycle traffic and public transport are preferred

Table 2. *Cont.*

Urban Planning Indicators	Implementation of Indicators
parking	number of parking and garage lots, underground or otherwise separated from the pedestrian parterre
transport connections	connections of all types of transport without conflicting points and bottlenecks, planning of transport terminals and additional facilities, reducing the length of journeys

Table 3. The implementation of urban design indicators in urban corridor planning.

Urban Design Indicators	Implementation of Indicators
public place	creative, attractive, urban equipped, safe, comfortable, multifunctional, motor-traffic-free and functional, ease of movement ensured, horticulturally arranged
scale	humane scale (m), adapted to the movement of pedestrians
image of the intra-city corridor	adapted to the purpose, green, urban equipped, different purposes in the contact zone of the ground floor, passable, safe, illuminated

Urban indicators are partly subjective and refer to the design of the entire space or individual elements of the intra-city corridor. The main indicators that contribute to social sustainability are highlighted, because well-designed public spaces of a humane scale can contribute to the quality of life in the city [58].

High-quality public spaces and streets that support the social, cultural, economic and environmental well-being of communities are crucial to developing competitive and efficient cities and towns. The perception of the concept of a street changes after considering who the streets serve and how they can be adapted to users' needs following the ideas of sustainable development.

The corridor planning process includes many stakeholders. It is necessary to involve the public and users through surveys, interviews, workshops, etc. If possible, it is required to conduct public urban planning or architectural competitions for the best solution [59]. During the planning process, it is necessary to organise public insights into all planning stages, forums and public debates.

3.2. Advantages and Priorities

Based on the research of the literature presented in Sections 1 and 2 and the synthesis of the authors' previous research [15,20], the advantages of implementing the planning of urban corridors were determined:

- adaptable for every form of the city

(linear, compact, core city, star city, monocentric city, polycentric city);

- adaptable for different transport system

(train, tram, bus, car, canal, bike);

- applicable for different dimensions of the corridor

(different lengths and different corridor widths);

- applicable for various interventions in spaces for urban renewal of the city

(reconstruction of existing corridors and for the construction of new ones);

- takes into consideration the transport system and the surrounding area

(surrounding area can be built, partially built or unbuilt);

- takes into consideration local and regional traffic peculiarities

(existing means of transport, mobility habits);

- gives the possibility of various urban and architectural intervention

(buildings of different purposes and different sizes);

- gives the possibility of forming a new spatial identity of the city

(intra-city corridor landscape).

Priorities, goals and spatial situations suitable for the implementation of urban corridor planning have been determined, based on the research of the literature presented in Sections 1 and 2 and the synthesis of the authors' previous research [15,20]:

- planning the development of public transport within the intra-urban corridor or expanding existing public transport

(reducing GHG emissions);

- planning new or expanding existing bicycle or pedestrian routes in the intra-urban corridor

(making citizens more active);

- need for diversity of purposes or activities

(more public places and public spaces—squares, plazas, parks, walkways—and public purposes—health, education, culture, recreation);

- resolving the security aspect of various transport

(eliminating traffic conflict points and bottlenecks);

- the intra-urban corridor is partially or completely greened

(horticulturally arranged).

The research found that not all corridors are suitable for urban corridor planning. For urban corridor planning to have the characteristics of sustainable planning, it is a pre-requisite that public city traffic takes place in it, that the corridor is not too short (e.g., shorter than two public transport stops, cca 800 m) and that it has the possibility of greening in its width and possibility of bicycle and pedestrian routes. Corridor planning is less applicable for underground means of transport (subway), which depend on the provision of transport lines under the built structure of the city. Corridor planning is more applicable to planning parts of the city than to its entire area. Corridor planning is more applicable to the planning of parts of the city than to its entire area, since the question arises of what about the planning of the area between the corridors?

3.3. Ten Principles of Urban Corridor Planning

Based on the research presented, we identified ten principles of corridor planning. The primary hypothesis of the paper that corridor planning can be sustainable planning of cities or parts of them in the 21st century is thus confirmed: applying most of these planning principles will result in sustainable corridor planning (Table 4). For each of the ten principles of corridor planning, we determined its characteristics and contribution to sustainable development: economic sustainability, environmental sustainability, social sustainability (three pillars of sustainable development).

Table 4. Ten principles of urban corridor planning.

Principle	Characteristics
simultaneity	simultaneous planning (of the transport system and the surrounding area) ➔ economic sustainability
intensity	intensive use of land (increase in building density and housing density) ➔ economic sustainability
GHGs (greenhouse gases)	reducing greenhouse gases (by introducing or improving public transport electro-mobility-only streets, low-carbon mobility solutions, green transport technologies, autonomous vehicles, micro-mobility, shared micro-mobility services) ➔ environmental sustainability
inclusion	involvement of all stakeholders and citizens (citizens, city or regional authorities, transport system managers) ➔ social sustainability
safety	resolution of conflicting traffic points (ensured access for people with reduced mobility) ➔ social sustainability ➔ economic sustainability
public	introduction of public places and spaces (contents of the ground floor of the building are for public purposes) ➔ environmental sustainability ➔ social sustainability
greening	partial or complete greening of the corridor (planting indigenous trees and plants) ➔ environmental sustainability
three-dimensionality	planning the proportion of the corridor (dimensions of buildings in relation to the width of the corridor) ➔ social sustainability ➔ economic sustainability
various scenarios	the possibility of different uses of the corridor (for different events in different seasons) ➔ social sustainability
quality	quality of spending time in the corridor (all ten principles applied raise the quality of life in the city) ➔ environmental sustainability ➔ social sustainability ➔ economic sustainability

4. Discussion

Climate change and accelerated development that threatens the survival of people in cities have caused an urgent need to rethink streets and transport systems (corridors) as traffic rates, CO_2 emissions and road injuries increase yearly. The subject of corridor planning is a layered linear space that includes the communication corridor and the space (land) around it. This layering enables numerous possibilities of use.

One of the principles of sustainability is the fair and efficient satisfaction of human needs in everyday, simple living within cities. Cities are the most populated human environment; they are considered essential factors in the fight against climate change. How can cities achieve spatial, ecological and economic sustainability in the digital and energy age, and thus the sustainable development of humankind? The economic forces that shape

the city in the 21st century are different than in the 1950s of the 20th century when zonal planning of cities was developed. The city's communication networks (primary streets) form the city's skeleton and make up about 30% of the total urban area. The role of transportation is one of the most important roles of urban life. The goals of sustainable mobility are ensuring the accessibility of all parts of the city, improving traffic safety, reducing greenhouse gas emissions and energy consumption and increasing the attractiveness and quality of mobility. In the developed world, passenger vehicles (USA with 250 million) create traffic jams and unattractive road corridors. As a result, cities have become congested, and unsafe, and time spent in public spaces is extremely poor.

The comparative analysis of the most important planning strategies shows that the urban planning of sustainable cities should be based on public transport and less on individual vehicles, be pedestrian- and people-friendly, be land-use- and transport-integrated, be promoting social equity and inclusivity, be based on knowledge and be multidisciplinary. The common goal of all strategies, including urban corridor planning, is to improve the quality of life in cities while at the same time reducing greenhouse gas emissions. All strategies have in common that they propose environmentally friendly transport solutions; they try to find a "recipe" for reducing the length and duration of trips within the city, while at the same time meeting the daily needs of residents, reducing the length of trips and trying to reduce the areas needed for car traffic (including areas for parking).

Transport strategies emphasize an integral approach: simultaneous planning of the transport system and the surrounding area, in which we can recognize the settings of corridor planning. In order to distinguish corridor planning from other planning strategies, the article defines the general and specific objectives of corridor planning, which partly derive from the geometric linearity of the corridor as its spatial characteristic.

A more detailed description is given for each of the identified ten principles of corridor planning, and it can be concluded that the summary application of all principles equally meets the requirements of environmental, economic and social sustainability.

5. Conclusions

Urban planning of cities in the 21st century implies a systematic approach based on the principles of sustainability of all its parts and shared public traffic and public facilities. Compact urban neighbourhoods with rationally planned and implemented transport corridors (road, rail, river, canal, pedestrian) have a significantly smaller ecological footprint on the environment. Planned urban development positively affects economic, social, cultural and ecological sustainability.

Corridors are spaces where transport, economic and demographic processes are linearly articulated. The planning concept of corridors within cities is not new; settlements have sprung up spontaneously along natural (rivers, canals) or artificial (roads, railways) traffic routes. The corridor concept as a planning concept is known as corridor design, corridor-type urbanisation and corridor-style town planning. Quality corridor planning will integrate transport (traffic) requirements and the requirements of shaping and composing the city and street (urbanity). The corridor planning process should include many stakeholders. Urban corridor planning is the integration of the planning of the transport system and surrounding land where the corridor is the infrastructure axis and the axis of urbanisation aimed at the sustainable composition of the city (determination of purpose along the main traffic routes, development of public transport within the corridor, reduced use of cars).

General and specific goals of corridor planning are identified. The most important is the development of public transport within the corridor because it encourages sustainable mobility and solving traffic conflict points, pedestrians and passengers' safety and building new public areas and public and business facilities next to transport stations and transport hubs. The advantage of applying corridor planning is that this planning is adaptable for every form of the city and every traffic system. It is applicable for various interventions in spaces for urban renewal of the city, considers the traffic system and the surrounding

area and gives the possibility of various urban and architectural interventions and the possibility of forming a new spatial identity of the city. Priorities in applying the planning approach of corridor planning are planning the development of public transport within the corridor or expanding existing public transport, the need for diversity of purposes or activities and resolving the security aspect of various traffic.

This paper concludes that corridor planning is more applicable to planning parts of the city than to its entire area. Corridor planning can be applied in corridors of different lengths and widths. Nine indicators were extracted and explained in more detail. Based on research presented in this article, ten principles of corridor planning were identified: simultaneity, integrality, GHGs, inclusion, safety, public, greening, three-dimensionality, various scenarios and quality. The basic hypothesis of the article that corridor planning can be a sustainable planning of cities or their parts in the 21st century is thus confirmed. Applying most of these planning principles will result in sustainable corridor planning.

For further research, it is suggested to investigate in more detail the limitations of corridor planning in a qualitative and quantitative sense. It is also suggested to investigate the urban dynamics of the intra-urban corridors in more detail in order to be able to better monitor the success of the corridor planning. Ten basic principles of corridor planning are given in the article. In further research, it is proposed to grade them by importance, that is, to determine which principles are the most important for achieving the maximizing benefits of sustainable corridor planning.

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