

A Review: Eco-Friendly Technologies and Sustainable Development of Urban Friendliness Spaces Toward New Urbanism Design Approach

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ABSTRACT

Ecologically conscious technology is a fast-developing domain centring around novel scientific and technical approaches that bring advantages to the planet. Commonly known as “sustainable technology”, this field is committed to conserving our natural resources. Therefore, urban Friendliness spaces are essential to all users as it stands as a public space which provides a sustainable environment for a more walkable, safe, and green environment. The problem statement of this study is imperative to enhance the sustainability and eco-friendliness of urban Friendliness spaces. Thus, this paper aims to incorporate both the development of new technologies and the improvement of existing ones to physically and functionally enhance the Friendliness spaces. The methodology involved a systematic literature review of new urbanism design approaches, which was achieved through a structured review of existing literature. Our results indicate that many key design elements, inventions, improvements, and scientific developments can have an impact on the ecosystem of urban spaces, subsequently affecting the people on an individual level. The findings of this study hope to contribute to the body of knowledge on how to improve urban development toward producing an eco-friendly and sustainable built environment.

Keywords: Eco-friendly technology; green technology; sustainable; new urbanism; friendliness.

INTRODUCTION

Sustainability has become a crucial concern for governments, research institutions, and the general public in recent years. This has led to a rise in studies and initiatives aimed at promoting education for sustainable development and identifying the factors that have the most significant impact on the environment. To acquire environmental awareness, it is necessary to develop principles, values, and processes through planning while also integrating engineering practices that prioritise environmental respect Top of Form Bottom of Form (Khalaf & Ja'afar 2020; Spadaro et al. 2022).

Creating a balanced distribution, adopting environmentally sustainable designs, and guaranteeing well-designed public spaces are critical elements of urban renewal plans that align with the established objectives for sustainable development and address urgent health crises (UN 2015; OECD 2020a). The transformation of public space is a significant catalyst for the shift toward resilient, inclusive, and environmental-friendly cities. It also promotes the enhancement of sustainable transportation options and ecological connectivity (EC 2013). Aside from promoting social and cultural connections, public space transformation has been identified as a key aspect of urban regeneration. Additionally, it is important to consider

strategies that take into account social distancing measures during pandemic emergencies (Un-habitat 2020).

In today's world, the development of smart cities that rely on technology has become a priority and a necessity. At the heart of every society are its citizens who serve as the foundation for all decision-making and infrastructure design. The ultimate goal of modern cities is to enhance the quality of life for their residents by providing better services and amenities. New urbanism is a movement in architecture and planning that promotes design strategies based on traditional urban forms to combat issues such as suburban sprawl and urban decay, with the aim of constructing and revitalising neighbourhoods, towns, and cities (Brown et al. 2016; Iovene et al. 2019). As a result, transforming these neighbourhoods into appealing spaces for social interaction among local communities has been a key focus for various stakeholders. Furthermore, many research has thoroughly investigated how the built environment affects walking behaviour with the goal of improving the overall health and well-being of individuals worldwide (Forsyth et al. 2009). This has led to an exploration of the physical (such as the shape and design of pedestrian networks) and functional (such as the availability of activities) characteristics of urban spaces that influence the walkability of a particular neighbourhood or region, which refers to "the degree to which the built environment supports and encourages its residents to engage in walking for leisure, exercise, or recreation" (Khalaf et al. 2021; Liao et al. 2020).

Urban renewal projects present an occasion to create a sustainable city model, which involves improving the design of public spaces, mobility of infrastructure, and enhancing accessibility for pedestrians and cyclists to local public services. The urban street plays a crucial role in a city's social life and interaction since it is used by people to conduct their economic and social activities and is considered a public and democratic space (Piras et al. 2022).

Rapid urbanisation and increasing population density have resulted in a growing demand for transportation within cities. However, the existing transport infrastructure is incapable of handling the current traffic level, leading to a variety of mobility issues. Many transportation systems were designed for a different era and are now facing capacity constraints, maintenance challenges, and a lack of resources for expansion. Additionally, these systems often impose an inequitable cost burden on different road users. As a result, there is a pressing need to upgrade and modernise urban transportation infrastructure to meet the demands of the present and future. The existing transportation infrastructure is plagued by prolonged congestion periods, air pollution, and greenhouse gas emissions from transports, subsequently having a

significant environmental impact. Continuous reliance on fossil fuels for transportation undermines the global efforts to reduce greenhouse gas emissions. These issues also carry various social consequences such as wasted time in traffic, financial costs, road accidents, and increased stress levels in urban areas. To address these challenges, policymakers, engineers, entrepreneurs, and other stakeholders are working together to find innovative technology-driven solutions. In recent years, transportation data has become a valuable resource for developing these solutions. The advancement of technology and increased exchange of information between countries have brought about a common focus on sustainability, inclusivity, and accessibility in green technology systems across both developed and developing countries. Moreover, emergencies such as the COVID-19 pandemic have created challenges for the transportation system, leading to a greater acceptance for change. Cities around the world are recognising the importance of urban streets in accommodating local traffic, public transportation, and active travellers at lower speeds, which is essential for ensuring efficiency, safety, and comfort for all road users. However, managing curb space and allocating road space can become a significant challenge due to the presence of different modes of transportation, user types, and needs such as retail activities, residents, and recreation. To create more sustainable and liveable urban environments that improve public health, security, and economic activity, many cities are prioritising active travel modes over motorised transport on urban streets. Policymakers, city authorities, and private companies have utilised the pandemic as an opportunity to create more resilient and intelligent transportation services, including the development of smart transportation infrastructure (Khalaf et al. 2022).

This article presents innovative methods for generating and assessing alternatives to allocate street space for pedestrians in busy urban areas. The proposed options allow planners to specify conditions regarding the prioritisation of street uses, maintaining current usage standards, and meeting policy goals. Urban streets have diverse uses that require space, such as the movement of people and goods using various modes, stationary vehicle-based activities like parking and loading, stationary people-based activities such as waiting for buses or socialising, providing green space, and facilitating surface water runoff. Satisfying all these needs can assist cities in achieving economic, social, and environmental sustainability. The main objective of this paper is to identify options that can optimise societal advantages by prioritising pedestrians and promoting a transition from private cars to sustainable modes of transportation (Khalaf et al. 2022).

This paper initially shows a theoretical framework that links new urbanism visions to adaptive sustainable planning, thus defining eco-friendly technologies. The theoretical approach is supported by a literature review driven by the most related studies and the implemented methods in developed countries.

LITERATURE REVIEW

Public spaces and streets are key design elements of new urbanism in the built environment that encourage street life, promote a sense of place, and strengthen community

bonds (Middleton 2018). Street friendliness is related to the new urban design since the focus of the built environment and travel behaviour is a strong reflection of new urbanisation, which encourages community-oriented behaviours such as walking and social interactions (Khalaf et al. 2021; Middleton 2018).

Meetiyaogoda (2018) suggested that new urbanism is to combat urban sprawl and ought to focus on reducing automobile dependence. The principles of new urbanism include connectivity, walkability, mixed housing, mixed uses and diversity, urban design and quality architecture, green transportation, traditional neighbourhood structures, increased density, quality of life, and sustainability as described in Table 1.

TABLE 1. New urbanism principles needed to establish equitable landscapes for friendly walkable streets (Meetiyaogoda 2018)

Key concepts	Physical attributes
Walkability	<ul style="list-style-type: none"> - Most places should be within a 10-minutes walk from houses or work offices. - Pedestrian-friendly streets should be free from vehicles in certain cases. - Pedestrian-friendly street designs (buildings closer to streets, windows, doors, and porches; trees should be lined on streets; streets should have parking, garages near lanes, hidden parking lots, narrow, and low-speed streets).
Connectivity	<ul style="list-style-type: none"> - Street connectivity and easy networks and nodes. - A hierarchy of boulevards, narrow streets, and alleys. - Streets networks and the realm of walking should be exciting.
Traditional neighbourhood structure	<ul style="list-style-type: none"> - Discernible edges and centres. - Centres with public spaces. - Public open spaces should be designed with high-quality civic arts. - Transect planning to ensure high density at town centres and less density at edges of cities. - Creating high-quality streets that support human habitat and the viability of nature.
Mixed-use and diversity	<ul style="list-style-type: none"> - A mix of offices, shops, homes, and apartments on-site. - Mixed-use within blocks, neighbourhoods, and buildings. - Diversity of people across different incomes, ages, races, and cultures.
Increased density	<ul style="list-style-type: none"> - More residences, buildings, shops, and services nearer to each other make walking more efficient and resourceful and create a more convenient and enjoyable place to live in. - New urbanism design principles are implemented to the full range of densities from small to large cities and towns.
Mixed housing	<ul style="list-style-type: none"> - A range of sizes, types, and prices in closer proximity.
Quality architecture and urban design	<ul style="list-style-type: none"> - Emphasis on aesthetics, beauty, human comfort, and creating a sense of place. - Special civic uses and sites among the community. - Human-scale architecture and beautiful surroundings nourish the spirit of people.
Smart transportation	<ul style="list-style-type: none"> - A high-quality network of trains to connect towns, cities, and neighbourhoods. - A pedestrian-friendly design that encourages greater use of scooters, bicycles, walking, and rollerblades as daily transportation.
Sustainability	<ul style="list-style-type: none"> - Minimum impact of the environment on operation and development. - Eco-friendly technologies, the value of the natural system, and ecology. - Efficient energies, limit uses of fuels, encourage local productivity, less driving, more walking.
Quality of life	<p>Taken together, these add up to a high-quality life well worth living and create places that enrich, uplift, and inspire the human spirit.</p>

Based on the above discussion on the concept of friendliness streets and the associated proportions and dimensions that make a street eco-friendly to its users, Table 2 summarises the benefits of user-friendly streets in increasing the quality of urban environment to achieve liveable and sustainable cities.

Sustainability is a crucial approach to the new urbanism trend where it encourages eco-friendly technologies in increasing the value of the natural system and ecology. Sustainable development is one that has a minimal environmental impact on operation and urban development.

Most scholars concur that connectivity, convenience, and pleasantness are part of the physical characteristics

influencing walking activities. Street furniture, amenities, pedestrian crossings, and green areas are positively linked to walking behaviour. Public spaces and streets play a crucial role in promoting community bonds and enhancing street life to increase walkability in

urban environments. Thus, a systemic approach should be taken considering the localisation and distribution of services and open spaces, network characteristics, and the needs of the population. Built environment interventions that increase access, attractiveness, safety, and comfort can lead to increased walking and change attitudes and perceptions about walking (Ali et al. 2019; Gaglione et al. 2022).

TABLE 2. The role of street friendliness in increasing the quality of urban environment (Hussein 2018)

Environmental importance	Definition	Role
Preventing pollution and activating people	Most contemporary cities are automobile-oriented, which leads to fewer activities and high pollution risks.	The role of physical and mental health
Decreasing fuel consumption, traffic congestion, etc.	Pedestrian streets affect economic issues seriously and cause citizens' interaction with financial land use.	Economic role
Increasing public control of the environment and preventing harms	Pedestrian streets are beds of social interactions that increase public control and lower crime and disorders.	Social role
Increasing good exchange between pedestrians and façade shops in the street	Pedestrian streets are beds for commercial exchange, eating, drinking, etc.	Commercial
Comfort, vitality, exhilaration, linked natural and human-made environment	Pedestrian streets pave the way for social interactions, which create memories. It strengthens people's image of the city.	Perceptual role
Decreasing unsustainable energy consumptions and CO2 production, increasing greeneries	25% of pollution rise from automobiles while transportation system energy consumption is approximately 12% in different countries.	Ecologic role
Decreasing pollutants, conserving land, optimising the transportation system	Using non-motorised vehicles affects the quality of life severely.	Non-motorised vehicles
Compatibility with ecology, being inclined to walking, reduce the use of cars	Walking is healthier and the cheapest way of moving in cities, in harmony with the environment.	Proper spaces for walking
Using clean energies, meeting needs by walking, decreasing trips and contamination	Vehicles need to be environment-friendly, have low energy consumption with no sound pollution, and be safe for the users. Optimised management is necessary for a cash city designed for human activities.	Trip management using pedestrianisation
Preventing pollution and activating people	Most contemporary cities are automobile-oriented, which leads to fewer activities and high pollution risk.	The role of physical and mental health

Artificial Intelligence (AI) plays a significant role in the development of smart cities and smart mobility, with the automotive industry being a prominent example of this technology entering the market. Improving urban vitality is also a key attribute of walkability (Liang et al. 2021).

Car manufacturers have utilised car-sensing devices, such as radars and sensors, to develop Advanced Driving Assistant Systems (ADAS) that improve driving safety and efficiency. As defined by the Society of Automotive Engineers, these systems have now progressed to the point

of providing Level 2 autonomous driving. This suggests that the shift toward fully autonomous driving is currently taking place (Miani et al. 2022).

However, the development of fully autonomous driving requires the ability to understand and predict the intentions of other traffic participants. A study has demonstrated that a Deep Learning system can predict changes in the severity of encounters between vehicles and pedestrians. The proposed system uses a gradient-

descent optimiser to learn from individual driving characteristics. It can also recognise hazardous interactions and improve vehicle and pedestrian safety in inner-city traffic. While the prediction quality decreases over time, the system can still provide satisfactory results for managing autonomous driving and enhancing the current ADAS systems (Miani et al. 2022).

The UN's 2030 Agenda emphasises sustainable urban mobility, specifically through Goal 11 "Sustainable cities and communities". Many cities have developed Sustainable Urban Mobility Plans (SUMPs) based on European guidelines to address this issue in urban planning (Pellicelli et al. 2022).

Active mobility, including walking and cycling, has gained prominent attention from citizens and policymakers. In recent years, many European cities have expanded the pedestrian areas and cycling paths while also offering incentives to promote active transportation (Ali et al. 2020; Sayuti & Khalaf 2019).

Autonomous Vehicles (AVs) are expected to have a significant impact on society, culture, space, and the environment; however, its interaction with humans and the physical environment will pose many challenges. To help conceptualise these experiences and enhance public understanding, innovative visualisation approaches can be used to anticipate possible scenarios and open a dialogue with potential end users.

AVs are expected to be prevalent on European roads by the 2030s, potentially changing travel behaviours and impacting spatial planning, society, culture, and the environment. Several European cities have begun testing AVs, thus highlighting the importance of integrating new mobility solutions on public roads (PAV 2020). The concept of fully automated vehicles is often seen as a distant future possibility (Wolf, 2016). With this technology, passengers could potentially work, socialise, use their mobile devices, or even sleep during a drive (Habib & Lynn 2020; Kun, Boll, & Schmidt 2016). Nevertheless, the general public currently has limited knowledge about autonomous vehicles and its potential impact over our living environments. The interplay between humans, autonomous vehicles, and the physical environment will present challenges and significant research hurdles. The acceptance

and integration of new technology into everyday life can be met with initial scepticism (Brooks, 2017) and to involve all stakeholders, including citizens and policymakers, in the planning and design of urban spaces. This will require a multidisciplinary approach that incorporates engineering, urban planning, sociology, psychology, and human factors research. It is important to anticipate the potential challenges and benefits that AVs may bring to urban areas and to ensure that it is integrated in a sustainable, equitable, and safe manner (Belkouri et al. 2022).

The move toward a fleet of fully-electric buses can have significant positive impacts on the environment, particularly in reducing emissions associated with the transportation sector. The Full Electric project implemented by ATM in Milan, which aims to have a fleet of 1150 fully-electric buses by 2030, can help to improve air quality and reduce carbon dioxide emissions. This is particularly important given that transportation is responsible for a significant portion of carbon dioxide emissions, second to electricity production and heating. By reducing emissions, the Full Electric project can help to mitigate climate change and improve the overall sustainability of Milan's transportation system. Increasing the collective transport demand can be achieved by improving the quality of service, increasing the frequency and capacity of public transport, and reducing ticket prices. On the other hand, increasing the share of electric vehicles in the system can be achieved by promoting the use of electric vehicles among citizens, incentivising the purchase of electric vehicles, and providing adequate charging infrastructure. The ATM plan also includes the implementation of a smart energy management system to optimise the use of renewable energy sources and reduce energy waste. These measures are expected to significantly reduce emissions and improve air quality in Milan, making it a more sustainable and liveable city. It also supports the decision-making about e-mobility planning policies (Borghetti et al. 2022).

To reduce car traffic on local roads, many cities are implementing policies such as efficient parking management, congestion pricing, access restriction measures, low-speed zones, increased public transport accessibility, and bus-only lanes. Improving walkability involves the installation and improvement of crossing facilities, clearly marked crosswalks, longer green time, traffic signals that prioritise pedestrians, wider sidewalks with proper lighting, and mixed traffic zones with low speeds. Meanwhile, cycling infrastructure requires building new facilities for safe and efficient transportation, including exclusive bicycle lanes or roads, lanes shared with car traffic, and pop-up bicycle lanes. The COVID-19 pandemic has highlighted the benefits of protected bike lanes in increasing bicycle mode share (Yannis & Chaziris, 2022).

Public spaces are integral to cities and undergo constant evolution due to expanding or shrinking over time. An ideal public space should be publicly owned and controlled, provide equal access to all individuals, and serve the public interest (Belge & Ercan, 2022).

Resilience design can be understood as the ability of a system to absorb and recover from external shocks and stresses while maintaining its essential functions and structure. In the context of cities and neighbourhoods, a resilience system is one that can adapt to natural and climate-related hazards, economic and social shocks, and technological disruptions in a sustainable manner. It can also address long-standing challenges such as traffic, air, and noise pollution while promoting equitable and inclusive development. A study by Fior et al. (2022) focuses on a Masterplan proposal that aimed to transform a basic infrastructural project into a well-designed urban space. The priorities of the urban design were to create a visually appealing, easy to maintain, ecologically functional, culturally significant, and sustainable space for mobility (Fior et al. 2022).

Eco and sustainability development involve a collaborative and responsible approach to managing soil, water, and biological resources from an eco-systemic perspective. This approach also includes the construction and networking of new resilient urban spaces, green infrastructures, and sustainable mobility solutions. Creating a network of green spaces, waterfronts, and cycle paths is a resilient response to urban regeneration as it enhances the contribution of ecosystem services to improve health, well-being, and adaptability toward climate change. This involves the construction and networking of new resilient urban spaces, green infrastructures, and sustainable forms of mobility, which promote responsible, inclusive, and sustainable strategies for collaborative planning and integrated management of soil, water, and biological resources from an eco-systemic perspective (Ja'afar et al. 2012; Khalaf et al. 2021; Khalaf & Ja'afar 2020).

Street design guidelines that prioritise pedestrians often fail to consider the impacts on other street users, such as cyclists and bus users, or the environmental outcomes of different design options. To address this, new tools have been developed to generate and evaluate options for reallocating street space to pedestrians in busy urban areas. These tools allow planners to specify conditions and environmental outcomes in order to generate sustainable options (Ja'afar et al. 2017; Saja, Ja'afar, & Mohd Husini 2018).

Studies have shown that well-designed urban streets can have a range of benefits like facilitating access to jobs and shops, providing opportunities for interaction and socialisation, and reducing flood risk by allowing water to

infiltrate into the ground. Many cities are shifting toward a new transport and urban policy paradigm that prioritises health, equity, liveability, and well-being, subsequently creating more space for pedestrians (Anciaes & Jones, 2022). Redesigning streets to prioritise pedestrians has positive effects on the local economy, communities, and the environment. While there is a growing trend toward prioritizing pedestrians in street design, the existing guidelines often fail to consider the wider impact of such changes and the trade-offs involved, such as the potential reduction of bus lanes. This is a significant issue as urban street space is becoming more constrained due to increased mobility demands and new forms of transportation (ITF 2018; Schocke et al. 2020). The tools introduced in this paper were created by a consortium comprising universities, international associations of street user groups, and the governments of five European cities. These tools aim to fill the gaps in street design guidelines that fail to consider the impact of different street designs on other users and sustainable mobility. The goal of these tools is to find options that prioritise pedestrians while promoting a shift from private cars to sustainable modes of transportation. These tools can be found at www.roadspace.eu (Anciaes & Jones, 2022).

The development of urban planning and mobility strategies should prioritise actions aimed at sustainability and resilience to mitigate possible catastrophic events such as climate change and pandemics like COVID-19. Scholars suggest that the level of pedestrian service can be influenced by quantitative and qualitative measures, including the width of the pavement, on-street parking, green space, and buffer from vehicles. On the other hand, negative elements that decrease the value of pedestrians' level of service include the speed of vehicles, the number of lanes, vehicle traffic, and the presence of medians (Campisi et al. 2022).

Sustainable urban mobility aims to reduce the impacts of people and goods mobility on the environment, society, and economy (Iiritano et al. 2022). Improving sustainable mobility in urban areas is crucial for enhancing the quality of life, promoting economic development, reducing pollution and greenhouse gas emissions, and improving accessibility and road safety. The 2030 Agenda signed by UN countries outlines 17 goals for sustainable development, which can be monitored through 169 targets and 244 indicators to measure the level of sustainability (UN, 2015). The Paris Agreement is the first legally binding global climate agreement aimed at limiting the average global warming (UN 2015; Iiritano et al. 2022).

Among the common development issues in historic city centres are dense urban blocks, narrow traffic corridors, and low pedestrian and cyclist mobility. Modern solutions

to these issues include smart traffic control systems, parking restrictions, speed limitations, and dynamic yellow lanes (Majstorović et al. 2022).

The article emphasises the importance of sustainable mobility strategies and decarbonisation policies in promoting sustainable urban mobility. It also describes the characteristics and planning of spaces for implementing parklets, which can improve sustainability and support post-pandemic recovery. The parklets serve as an experiment for reclaiming car parking space on urban streets (Campisi et al. 2022).

RESEARCH FRAMEWORK

Past literature has proposed a set of tools and methods to achieve eco-friendly technologies that are used through specific strategies to ensure sustainable development for urban friendliness spaces.

One of the approaches to new urbanism is adopting environmental-friendly technology that can contribute to the success of spatial planning, which is represented by walkability, transportation, and landscape. This will be the main scope of this paper. To ensure the sustainable development of our cities, it is imperative for us to move toward urban resilience that relies on the basic principles of economic, community, and vitality sustainability.

The discussion thus far enables this paper to build a theoretical framework on the establishment of eco-friendly technologies that can contribute to the supply of scientific knowledge in the production of environmental friendliness spaces in a way that suits the requirements of our current and future development:

TOOLS, METHODS, AND STRATEGIES

To define a 15-minute city, various urban characteristics need to be considered, including geomorphological, physical, functional, socio-economic, and settlement factors. These factors include the layout and accessibility of pedestrian and cycle networks, the distribution and location of services, the demographics of the population, and the overall urban form (Gagliione et al. 2022).

The global pandemic has prompted cities to develop new strategies and actions to address climate adaptation, promote age-friendly environments, foster social cohesion, and enhance public health (Lai et al. 2020).

Urban regeneration processes can promote a sustainable city model by redesigning public spaces and mobility infrastructures to improve pedestrian and cycle accessibility to local public services (Pellicelli et al. 2022).

The Supermanzana (SM) model, developed by the Barcelona Urban Ecology Agency, aims to transform public

spaces at the neighbourhood level and reorganise existing urban structures in a sustainable way (Staricco & Vitale Brovarone, 2022).

Cities can enhance the walkability in urban streets through different measures like installing new and improved crossing facilities, creating clearly marked crosswalks, widening sidewalks with proper lighting, and introducing mixed traffic zones with low speeds. To encourage utilitarian cycling, new facilities should be built along segments and intersections (Yannis & Chaziris, 2022).

Fourkiotis et al. (2022) investigated pedestrian behaviours and the use of Intelligent Transport Systems to improve safety, particularly at intersections with Countdown Signal Timers (CST). The research aimed to gather information on pedestrian behaviours to improve road safety for pedestrians. The authors also noted the potential of technology to change modern people's reality.

Another study utilized GIS-based analysis to evaluate walkability scenarios in an urban regeneration project in Brescia. The study mapped pedestrian permeability and used an algorithm to measure access time. The analysis was conducted before and after the project, demonstrating the importance of considering people and climate in public space regeneration strategies (Carra et al. 2022).

Furthermore, active commuting, such as walking and cycling, has become increasingly popular in recent years. Policymakers have recognised the benefits of promoting these modes of transportation as it can improve public health, reduce congestion and air pollution, and increase social interaction. As a result, many cities across Europe have invested in infrastructure to support active mobility, such as bike lanes, pedestrian zones and public bike-sharing programmes. Financial incentives, including subsidies for purchasing bicycles or tax credits for employers who support active commuting, have also been introduced to encourage citizens to adopt these modes of transportation (Piras et al. 2022).

In recent years, cycling has become a preferred mode of transportation that can provide numerous benefits, such as reducing traffic congestion, air pollution, and transportation costs. Additionally, cycling infrastructure is less costly to build and maintain than other modes of transportation. The past few years have seen a growing interest to study cyclists' behaviours as policymakers and city planners seek to encourage more people to choose cycling as a sustainable and healthy form of transportation (Poliziani et al. 2022).

From the context of eco-friendly transportation, the possibility of another health crisis has led to a shift in urban transformation choices in promoting sustainable transportation options and the availability of public spaces and services at the neighbourhood level. This has resulted

Therefore, efforts to think spatially can enhance the resilience of cities, technology, and transportation systems (Belkouri et al. 2022).

Many scholars have proposed the “SafeMob” methodology, which is a human-centred interdisciplinary approach to evaluate the experiential and environmental performance of mobility solutions. The methodology considers data from both the individual (physical and psychological aspects) and the environment (road, vehicle, and surrounding contexts) to provide a holistic assessment. It combines Objective Safety (OS) with Perceived Safety (PS) to evaluate automotive performance and aims to provide a “Decision Support System” for stakeholders in the mobility field (Boffi et al. 2022).

In a study on smart planning and mobility, Battarra and Mazzeo (2022) defined Usability as the ability of spaces to enhance human capabilities like autonomy, active mobility, bodily health, environmental control, and social connectedness. It encompasses the aspects of utilitarian, leisure, and social activities, and can be evaluated using a combination of space syntax and spatial analysis techniques (Garau & Annunziata, 2022)

In terms of landscape, Level of Service (LOS) is a crucial factor for evaluating pedestrian facilities mainly by considering the effective width of sidewalks and pedestrian flow. Several quantitative and qualitative measures affect the level of pedestrian service with four elements positively impacting pedestrian level of service (PLOS): pavement width, on-street parking, green space, and buffers from vehicles. Meanwhile, negative factors that affect PLOS include vehicle speed, number of lanes, vehicle traffic, and medians. Although PLOS can be measured empirically, it is important to also consider how users perceive its value when using a particular road segment (Campisi et al. 2022).

CONCLUSION

New urbanism is an architectural and planning movement that promotes traditional urban design strategies to combat suburban sprawl and inner-city decline while creating better neighbourhoods, towns, and cities (Brown et al. 2016; Iovene et al. 2019). One of its aspects is technology, which involved all friendly technical possibilities that can be employed in the sustainable development of urban structures, particularly environmental-friendly spaces. The latter represents an important approach and stands as an effective element in providing a green urban environment for users based on three important factors: walkability, transportation, and landscape.

The existing literature posits that new urban design policies must consider the walkability strategy of a

in an increased focus on soft mobility, such as walking and cycling (Laio et al. 2020). Reducing traffic, creating safe and enjoyable walking and cycling areas, and providing affordable public transportation are the primary strategies for cities to protect themselves against the COVID-19 pandemic and future epidemics. Other measures include making main urban streets car-free, increasing the availability of open public spaces and pedestrian pathways, and utilising temporary infrastructure or underutilised spaces to alleviate crowds and lines for essential services, such as local food procurement (Liao et al. 2020).

As cities continue to grow, their transportation systems are facing more challenges. The infrastructure and policies that were developed in the past are no longer sufficient. Therefore, there is a need for a shift in the paradigm that supports public transportation and active modes of travel. However, such shift often struggles to keep up with the evolving personal choices related to urban transportation, which is becoming increasingly dominated by car-oriented modes (Yannis & Chaziris, 2022).

In addition, recent research has utilised the Automatic Vehicle Location (AVL) technology to implement real-time tactics aimed at controlling vehicle movement and maintaining transfer synchronisation at the operational level. However, little attention is paid to retrospectively check if transfers are well-designed and/or effectively delivered using archived AVL data during the monitoring phase. This monitoring phase is crucial for the efficient operational planning of well-connected spatial and temporal routes (Mozzoni et al. 2022).

Advanced Driver Assistance Systems (ADAS) have the potential to improve the technological development of car-sensing devices. This is achieved through the use of Deep Learning algorithms that enable the prediction of future events based on current driving parameters. Such prediction will allow autonomous or semi-autonomous vehicles to make appropriate decisions in advance, such as adjusting its trajectory or refraining specific actions (e.g., overtaking) to avoid a potential collision with other moving road users (Miani et al. 2022).

Autonomous Vehicles (AVs) are expected to bring about significant social, cultural, spatial, and environmental changes. The interaction between humans, AVs, and the physical environment presents a range of challenges. To help conceptualise human experiences with AVs and anticipate possible scenarios, innovative visualisation approaches can be used to enhance public exploration and understanding of complex human-machine associations. By the 2030s, AVs are expected to be widespread on European public roads and hold the potential to significantly change people’s travel behaviours, which will have an immediate effect on spatial planning as well as numerous societal, cultural, and environmental implications.

15-minute city along with the geomorphological, physical (concerning both the spaces and the paths, such as the geometry of the pedestrian and cycle networks), functional (distribution and location of services), socio-economic (of the population), and settlement aspects.

Furthermore, eco-transportation based on the privileges of new technologies like Automatic Vehicle Location (AVL), Advanced Driving Assistant Systems (ADAS), Autonomous Vehicles (AVs), “Safe Mob - Safe Mobility”, and Usability should be heightened more in providing eco-friendliness.

Finally, the present paper highlights the urgent need to have new inventions regarding the use of eco-technologies for the urban friendliness landscape.

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