

## SMART MOBILITY IN A SMART CITY CONCEPT

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**Purpose:** The purpose of this publication is to present the most important features with which the smart mobility approach is characterized.

**Design/methodology/approach:** Critical literature analysis. Analysis of international literature from main databases and polish literature and legal acts connecting with researched topic.

**Findings:** In a smart city, smart mobility also plays an important role in environmental protection. Modern modes of transportation, such as electric cars and urban bicycles, reduce greenhouse gas emissions and air pollution. Thus, smart mobility contributes to improving air quality and the health of residents. As part of the smart city, smart mobility is also seen as part of improving traffic safety. Smart traffic monitoring systems and rapid response to dangerous situations, such as collisions or accidents, can help minimize accidents and collisions. Smart mobility is also one of the key elements of a smart city, which contributes to improving the quality of life for city residents by increasing mobility, reducing air pollution, improving road safety and introducing innovative transportation solutions.

**Originality/value:** Detailed analysis of all subjects related to the problems connected with the smart mobility in smart city.

**Keywords:** smart mobility, smart city, quality of life, biking.

**Category of the paper:** literature review.

### 1. Introduction

The smart city concept is an approach that aims to use modern technologies and innovative solutions to improve the quality of life in cities and increase their efficiency and sustainability (Herdiyah, 2023). The smart city concept is divided into several areas among which one is smart mobility (Jonek-Kowalska, Wolniak, 2021, 2022; Jonek-Kowalska et al., 2022; Kordel, Wolniak, 2021; Orzeł, Wolniak, 2021, 2022; Ponomarenko et al., 2016; Stawiarska et al., 2020, 2021; Stecuła, Wolniak, 2022; Olkiewicz et al., 2021). This area is important from the point of view of the functioning of modern cities enabling them to organize transportation systems in a modern way.

The purpose of this publication is to present the most important features with which the smart mobility approach is characterized.

## 2. Smart city

The smart city concept refers to a comprehensive approach to urban development that uses advanced technologies and innovations to improve the quality of life of residents and the efficiency of city operations. The main areas of the smart city concept are (Ploeger, Oldenziel, 2020; Tahmasseby, 2022; Rahman, Dura, 2022):

- **Transportation:** Optimization of transportation systems, including innovations in public transportation, alternative modes of transportation, smart traffic and parking management, and integration of transportation systems.
- **Energy:** Use of renewable energy, smart energy management, monitoring of energy consumption in buildings, smart grids and energy storage.
- **Environment:** Air and water quality monitoring, nature conservation, green technologies and sustainable development.
- **Education:** Using modern educational technologies in schools and universities, creating e-learning platforms, creating innovative curricula and making knowledge accessible to everyone.
- **Health:** Use of telemedicine technologies, development of innovative health services, population health monitoring and disease prevention.
- **Security:** Use of intelligent monitoring and control systems, including video surveillance systems, alarm systems and early warning systems for threats.
- **Urban services:** Improving the efficiency and accessibility of urban services, such as waste, water, gas, and public lighting, through the use of IoT (Internet of Things) technologies.
- **Public administration:** Using advanced information technology to improve the efficiency and quality of public services, automating administrative processes and improving inter-institutional communication.

A smart city is the concept of a modern city that uses advanced information and communication technologies to improve city management and the quality of life for residents. The goal of the smart city is to ensure the sustainable development of the city, in which public infrastructure, transportation, energy, water and waste management are optimized, while contributing to environmental protection and improving air quality (Wolniak, 2016; Czerwińska-Lubszczyk et al., 2022; Drozd, Wolniak, 2021; Gajdzik, Wolniak, 2021, 2022; Gębczyńska, Wolniak, 2018, 2023; Grabowska et al., 2019, 2020, 2021).

The smart city concept applies solutions such as smart lighting, air quality monitoring, waste management systems, smart buildings, transportation systems, and many others. As a result, residents can enjoy more convenient and efficient services, and city authorities can better plan development and spending (Tahmasseby, 2022).

The smart city also aims to improve the quality of life for residents by increasing safety, communication, accessibility to services and sustainability. Through the use of technology, the smart city can help better manage the city during emergencies, such as pandemics and natural disasters (Sulkowski, Wolniak, 2015, 2016, 2018; Wolniak, Skotnicka-Zasadzień, 2008, 2010, 2014, 2018, 2019, 2022; Wolniak, 2011, 2013, 2014, 2016, 2017, 2018, 2019, 2020, 2021, 2022; Gajdzik, Wolniak, 2023).

In the smart city concept, it is important to involve residents in the decision-making and development processes of the city. This creates a participatory model that allows for a better understanding of the needs and expectations of residents and better adaptation of technological solutions to their needs (Rahman, Dura, 2022).

### **3. Smart mobility**

Smart mobility, also known as intelligent transportation, is the use of technology to improve the efficiency, safety and sustainability of transportation systems. As the world becomes more urbanized and the number of vehicles on the road increases, smart mobility is becoming a key component of modern life (Prajeesh, Pillai, 2022).

Smart city and smart mobility are two concepts that are closely related. Smart city is the overall concept of a smart city that uses advanced technologies and innovative solutions to improve the quality of life for residents. Within the smart city, smart mobility is one of the key elements that relates to smart and sustainable transportation (Boichuk, 2020).

Smart mobility introduces innovations in transportation that enable better use of road infrastructure, thereby improving the mobility of residents. Through the use of advanced technologies such as autonomous vehicles, intelligent traffic management systems or mobile applications, residents have access to faster, more efficient and convenient transportation methods (Ku et al., 2022).

In a smart city, smart mobility also plays an important role in environmental protection. Modern modes of transportation, such as electric cars and urban bicycles, reduce greenhouse gas emissions and air pollution. Thus, smart mobility contributes to improving air quality and the health of residents (Benevolo et al., 2016).

As part of the smart city, smart mobility is also seen as part of improving traffic safety. Smart traffic monitoring systems and rapid response to dangerous situations, such as collisions or accidents, can help minimize accidents and collisions.

Smart mobility is one of the key elements of a smart city, which contributes to improving the quality of life of city residents by increasing mobility, reducing air pollution, improving road safety and introducing innovative transportation solutions (Kunyska et al., 2023).

One of the key elements of smart mobility is the use of data to optimize transportation systems. This involves collecting data from a variety of sources, including sensors on vehicles, GPS devices and traffic monitoring cameras, and using this information to make decisions about traffic flow, routing and planning. By analyzing this data in real time, transportation authorities can make changes to reduce congestion and improve overall system performance (Wolniak, Sulkowski, 2015, 2016; Wolniak, Grebski, 2018; Wolniak et al, 2019, 2020; Wolniak, Habek, 2015, 2016; Wolniak, Skotnicka, 2011; Wolniak, Jonek-Kowalska, 2021; 2022).

Another important element of smart mobility is the use of connected vehicles. This refers to vehicles equipped with sensors and communication technology that allows them to communicate with other vehicles and the infrastructure around them. Connected vehicles can provide real-time information about traffic conditions, weather and road hazards, which can help drivers make more informed decisions about routes and driving behavior (Orlowski and Romanowska, 2019).

One of the most promising applications of smart mobility is in the area of autonomous vehicles. These are vehicles capable of driving themselves without human intervention. Autonomous vehicles have the potential to revolutionize transportation, reducing accidents, increasing efficiency and reducing the environmental impact of transportation. However, many technical and regulatory challenges need to be solved before autonomous vehicles can be put on the road.

Smart mobility also includes the use of alternative modes of transportation, such as bike-sharing programs, electric scooters and ride-sharing services. By providing a variety of options for commuting, smart mobility can reduce traffic congestion and improve the overall quality of life in cities.

Some of the key advantages of using smart mobility include (Prajeesh and Pillai, 2022, Boichuk, 2020, Rahman and Dura, 2022, Benevolo et al., 2016, Kunyska et al., 2023):

- Improving the efficiency and effectiveness of transportation systems.
- Reducing traffic congestion and travel times by optimizing routes and schedules.
- Improving road safety through the use of advanced monitoring and control systems.
- Reducing the environmental impact of transportation through the use of cleaner modes of transportation, such as electric vehicles.
- Improving the quality of life in cities by reducing exhaust and noise emissions.
- Being able to make better use of existing road infrastructure through traffic optimization.
- Increasing accessibility and convenience for travelers through a variety of transportation options, including alternative modes such as bicycles and electric scooters.

- Improve trip planning by providing real-time information on traffic conditions, weather and road hazards.
- Reducing operating costs for transportation companies by optimizing routes and schedules.
- Improving public transportation management through data collection and analysis to better tailor services to passengers' needs and preferences.

However, the implementation of systems based on the smart mobility concept may encounter numerous problems that cities must overcome to achieve their full effectiveness. These can be mentioned here (Prajeesh, Pillai, 2022; Boichuk, 2020; Rahman, Dura, 2022; Benevolo et al., 2016; Kunytska et al., 2023):

- High costs: The implementation of smart mobility systems requires the investment of significant financial resources. Many cities and transportation companies may not be able to meet these costs.
- Lack of standardization: Many smart mobility technologies are still in development and lack standards and norms, which can make it difficult to integrate different systems and technologies.
- Requirement to adapt infrastructure: The introduction of new smart mobility technologies and systems may require infrastructure adaptation, which can be costly and time-consuming.
- Limited public acceptance: New technologies and systems may face resistance from the public, which may hinder their implementation.
- Privacy and data security issues: The introduction of smart mobility systems may result in the collection and processing of large amounts of data, which may create privacy and data security risks.
- Regulatory challenges: Many smart mobility technologies, such as autonomous vehicles, require regulatory and legislative alignment, which can be time-consuming and complicated.
- Technical complexity: Smart mobility systems require complex technology and infrastructure, which may require high technical skills and IT experience.
- Labor market impact: The introduction of smart mobility systems may lead to the automation of many processes, which may affect the labor market and require employees to be trained in new skills.

The implementation of smart mobility solutions can positively affect the quality of life of residents in smart cities. With the introduction of modern transportation solutions, such as autonomous vehicles and smart traffic management systems, it is possible to reduce traffic jams and the time it takes to get to work or school.

As a result, the city's residents gain more free time, which they can use to relax, meet with family or pursue their passions. In addition, improved road capacity reduces exhaust emissions and air pollution, which has a positive impact on residents' health. Smart transportation solutions can also increase road safety by monitoring traffic and responding quickly to dangerous situations. As a result, the number of accidents and collisions can be reduced, contributing to a greater sense of security for city residents (Dudycz, Piatkowski, 2018).

Smart mobility also affects the city's economic development by making it more attractive to investors and tourists. The availability of modern means of transportation, such as urban bicycles and car-sharing, can attract new people and businesses to the city. Smart mobility has a positive impact on the quality of life of the city's residents, improving their mobility, safety and comfort of travel, and influencing the city's economic development.

The use of bicycles as a means of transportation is one of the elements of smart mobility, as it introduces an innovative and sustainable solution to urban transportation. Bicycles as a means of transportation are not only environmentally friendly, but also allow people to move around quickly, cheaply and conveniently.

As part of smart mobility, urban bicycles are increasingly being introduced into cities. Bike sharing is a system of renting bicycles for short distances, usually at the city or neighborhood level. City residents can rent a bicycle from one point and return it at another point, allowing them to move around freely without having to own a bicycle (Wawre et al., 2022; Wolniak, 2023).

In addition, more and more cities are introducing modern bicycle systems that combine city bikes with intelligent traffic management systems. This allows cyclists to use dedicated bike lanes, gaining a safe and fast way to work or school.

Cyclists also have access to a variety of mobile apps that help them plan their route, find the shortest and safest route, and monitor their health and physical activity.

The introduction of urban bicycling and other innovative cycling solutions to the city is part of the smart mobility concept, as it contributes to improving the quality of life for city residents by increasing mobility, reducing air pollution and improving health through physical activity (Simonofski et al., 2023; Wolniak, 2023).

#### **4. Conclusion**

Smart mobility, also known as intelligent transportation, is the use of technology to improve the efficiency, safety and sustainability of transportation systems. As the world becomes more urbanized and the number of vehicles on the road increases, smart mobility is becoming a key part of modern life.

Smart city and smart mobility are two concepts that are closely related. Smart city is the overall concept of a smart city that uses advanced technologies and innovative solutions to improve the quality of life for residents. Within smart city, smart mobility is one of the key elements that relates to smart and sustainable transportation.

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