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The Role and Benefits of Intelligent Transport Solutions and Technology in Transforming Sustainable Transport for Tourism Purposes
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El rol y los beneficios de las soluciones y tecnologías de transporte inteligente en la transformación del transporte sostenible con fines turísticos

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Abstract: The role of technology in the transport sector in the field of tourism is becoming increasingly important. The topic is particularly relevant in the context of taking greater care to protect the environment and more sustainable travel. Adapting transport infrastructure to new technologies is a complex process that is essential to building more sustainable, efficient and safe destinations. The digitalization of bus transport has its advantages in the context of sustainability, which are expressed in greater accessibility, reduction of emissions, fewer traffic jams, the possibility of instant connection with other types of transport, greater awareness of tourists. By developing intelligent transport solutions - investments in intelligent transport systems, /ITS/, electromobility, automated vehicles and other innovative means, the future of society can be improved. Digitalization has changed the attitudes of modern societies, gradually weaning them from personal cars, leading to a new way of life.

Key words: technologies; transport infrastructure; intelligent transport solutions; electric bus transport; sustainable tourism

Resumen: *El papel de la tecnología en el sector del transporte dentro del ámbito del turismo adquiere una importancia creciente. Este tema resulta particularmente relevante en el contexto de una mayor preocupación por la protección del medio ambiente y la promoción de viajes más sostenibles. La adaptación de la infraestructura de transporte a las nuevas tecnologías es un proceso complejo, pero esencial para la construcción de destinos más sostenibles, eficientes y seguros. La digitalización del transporte en autobús presenta ventajas significativas en materia de sostenibilidad, las cuales se manifiestan en una mayor accesibilidad, la reducción de emisiones, la disminución de la congestión vehicular, la posibilidad de conexión inmediata con otros modos de transporte y una mayor concientización de los turistas. Mediante el desarrollo de soluciones de transporte inteligente —inversiones en sistemas de transporte inteligente (ITS), electromovilidad, vehículos automatizados y otros medios innovadores—, es posible mejorar el futuro de la sociedad. La digitalización ha transformado las actitudes de las sociedades modernas, alejándolas progresivamente del uso del automóvil particular y propiciando un nuevo modo de vida.*

Palabras clave: *tecnologías; infraestructura de transporte; soluciones de transporte inteligente; transporte eléctrico en autobús; turismo sostenible*

Introduction:

The purpose of this report, with the subject of researching the advantages of new transport technologies, in particular, the exploitation of "smart" tourist buses and intelligent transport solutions, is to evaluate the effectiveness of technological transport in tourism services and its impact on consumer satisfaction and the environment .

Defining the problem and the aims. Historical overview of the Transportation revolution

Modern technologies used in the transport sector are new solutions, but the foundations of transport were laid in ancient times, with the use of draft animals. One of the first technologies in transport dates back to the 4th century BC and it is the wheel, which at a later stage gave rise to the chariots that started the movement of people and goods. The medieval period saw the rise of shipping, which expanded trade and cultural ties. During the 18th - 19th century, the steam engine appeared, which represented a revolution in transport. The first public 'bus" line was launched in France in 1662 when Blaise Pascal developed a system of horse-drawn carriages that ran across Paris streets on schedule[1]. In the 20th century, the car, the bus and the plane appeared, thanks to which transport was completely transformed, becoming a fast and easily accessible means of transport and movement. Transport in the 21st century is becoming even faster, more accessible and more efficient, with the development of digital technologies and intelligent transport systems. The digitalization of bus transport has its advantages in the context of sustainability, which are expressed in greater accessibility, reduction of emissions, fewer traffic jams, the possibility of instant connection with other types of transport, greater awareness of tourists. Some of the disadvantages of bus transport compared to individual transport are limited free time during travel, adherence to routes and punctuality in group travel and adherence to timetables.

1. Methodology

Since the report is theoretical and based on a literature review and current trends, the most appropriate method is Descriptive Analysis (descriptive method), supported by Qualitative Content Analysis. The study is a Descriptive Analysis, which aims to describe and explain the role and impact of ITS on the sustainability of the transport sector in tourism, without performing new empirical or statistical measurements.

Secondary data were used, including academic publications, industry reports, government strategies (for digitalization and electromobility) and materials related to "smart" tourist buses.

The analysis is in the form of systematized information in the report and is in relation to the theoretical framework. It is clearly defined that the analysis is focused on ground (bus) transport in the field of tourism. The comparative analysis aims to compare traditional transport (diesel, private car) with technological transport (electric, ITS-driven) in terms of key sustainability indicators.

Methodology limitations - Although the methodology used implies a structured and logical analysis, the main limitation of this methodology is that it is based on theoretical statements and secondary sources. There is a lack of primary empirical analysis (e.g., surveying tourists or measuring emissions in a specific city), which would make the conclusions more rigorously scientific.

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[1] Glavatskikh, Polina, A Brief History of Buses, 05.08.2020, https://www.bus.com/blog/a-brief-history-of-buses, 05.08.2020

2. Intelligent transport solutions /ITS/. Defining of technologies –smart buses and electromobility.

The future of transport is in intelligent transport solutions, the development of which in the current year 2024 has increased sharply in the field of tourism, where they play a key role in improving tourist experiences. In quite large cities, electric buses are already used for tourist purposes, which are an alternative to traditional diesel buses. Given the growing need to protect the environment, the main advantage of electric buses is low carbon emissions. Fuels go up every year, and with an electric bus, operating costs are lower. Thanks to sensors and automatic control systems, this new breed of "smart" buses are reliable as they reduce risks in heavy traffic and create safe travel conditions. In the context of the advantages of electric buses, they represent intelligent transport solutions. They represent innovative ways to optimize traffic, improve safety and reduce negative impacts on the environment, which increases their role in modern society.

Table 1: Roles of the intelligent transport solutions.

Type of intelligent transport solution	**Trends**	**Main role**
Management system of traffic	Using sensors, cameras for real-time surveillance Traffic control devices	Regulation of traffic lights, optimization of routes, reduction of traffic jams.
Navigation system	Real-time traffic data Offering the fastest and most efficient route	Heavy traffic warnings, collision, automatic braking
Systems for sharing of cars and bicycles	Reducing the number of cars, reducing traffic jams	Shared transport services reduce harmful emissions, encourage the use of public transport, mainly electric vehicles.
Automated vehicles /self-driving cars/	Revolutionizing transportation, reducing accidents, improving efficiency	Strict compliance with travel rules, traffic warning
Intelligent parking systems	Using sensors to guide the vehicle to a free parking space	Efficient management of parking and optimization of urban transport

Source: Author`s compilation

3.1. The benefits of intelligent transport solutions

The benefits of intelligent transport solutions are many - reducing stress for drivers, reducing travel time, preventing accidents, reducing traffic jams, preserving clean air, facilitating the movement of disabled and elderly people.
Smart transport solutions not only improve the mobility of tourists, but also contribute to more sustainable and ecological travel. They are a key part of the

modernization of the tourism sector, giving tourists better access to different destinations and experiences. It is extremely important for tourists to be motivated to use sustainable modes of transport over the convenience of their own car, the satisfaction of their needs at the destination in the presence of transport infrastructure, the role of tourism companies in promoting and developing sustainable transport and using new technologies in planning and realization of the trip.

Citizens have long embraced innovation and become accustomed to apps – smart systems through which they find and book tickets in advance, compare prices, choose seats, pay online, change their tickets, which saves time and costs and provides flexibility. Whether it is about using transport individually or by booking a group trip through a tour operator, technological trends are present in both cases:

- Use of reservation systems to purchase tickets
- Payments without cash
- Information about delays and changes in routes and timetables
- Real-time navigation
- Individual offers for planned routes and services.

Technologies are necessary for the transformation of the transport sector because they improve the user experience by enabling easier planning and booking of trips, motivated travel decisions, provision of personalized services. Technologies make it possible to reduce fuel and maintenance costs, reduce harmful emissions, optimize routes, resulting in efficiency and sustainability.

Despite the past covid pandemic that claimed many victims, the population of the planet continues to increase and the need for transportation will increase, therefore environmental pollution continues to be a key topic. The problem of climate change and reducing emissions from vehicles has become a serious commitment for all world leaders. Therefore, many countries and large cities face the problem of sustainable transport and finding an optimal solution to minimize pollution in transport mobility. Electric buses called smart appeared In Europe, at the moment, in dozens of cities, more than 150 buses with fuel cells are running, which confirms the sustainability efforts in the transport sector[2]. Many cities will completely change their fleets by 2030.

Modern buses are in use at the moment, in line with the new trends - the Internet, choosing a place in advance, which improves the journey. On the other hand, the Internet and navigations are at the service of drivers, which allows presetting the route, continuous monitoring and tracking of the traffic situation, directing and choosing an alternative route, in order to bypass the traffic, reduce the waiting time in traffic jams and reach the destination on time. The digital navigation – the combined use of satellite positioning, digital mapping and route

[2]Modern technologies for bus operations in autonomous world, March 2022, https://www.techsciresearch.com/blog/modern-technologies-for-bus-operation/.

guidance – is in wide use for road travel yet its impact is little understood[3] .

The electric vehicles have found their place in recent years in tourist tours practiced in tourism destinations - for sightseeing, tourist attractions and resorts - amusement parks, eco-parks, fortress and castle complexes. Traditional fuel-powered tourist buses are also still in operation, although trends indicate that their use will decline considerably. Both types of buses have a crucial role for tourists.

3.2. The electric Vehicles as an Ideal Solution for Sustainable Tourist Transport: Challenges, Advantages and Future Prospects

The electric sightseeing vehicles have become an ideal means of transportation for many scenic spots, parks, communities, schools and other places due to their many advantages such as environmental protection, quietness, economy, comfort and convenience. They also play an important role in promoting green tourism and improving the quality of services.

As a percentage, the share of the number of electric buses engaged in the tourism sector in any European country cannot be determined, as this is a dynamic process. The number of electric buses changes every day, not all electric buses are operated only for the needs of tourism, some are used only as city lines, others as intercity lines.

Although there are no exact statistics regarding electric buses, their integration in public life and in the field of tourism is growing, /*See table 2*/, given the fact that more and more cities in Europe are imposing restrictions on harmful emissions and substances, and the reduction of battery prices make them in demand and competitive, against the background of expensive diesel prices.

Table 2: Integration of the electric buses in the tourism sector.

Integration	Benefit	Challenges and perspectives
Tourist lines	Creation of tourist lines to serve tourist destinations	High initial investment – purchase and construction of charging infrastructure
Transfer to hotels and airports	Hotel-hotel transfer Hotel - airport and vice versa Other transport connections	Limited battery mileage compared to diesel buses
Pedestrian zones	Service in pedestrian areas Tours of historical centers City tours	Lack of uniform standards for charging infrastructure

Source: Author`s idea

[3] Metz, D. (2022) “The impact of digital navigation on travel behaviour”, UCL Open Environment. 4(1). doi: https://doi.org/10.14324/111.444/ucloe.000034

Despite the limitations, related with investing in new technology buses, the high prices of batteries and the necessary charging infrastructure, the scale of electric buses is increasing, confirming their secure future in the field of tourism.

A complete study of the trends and attitudes towards the use of electric buses in tourism cannot be realized, as, in many of the countries, there is still a lack of data to compare the operating costs of electric and diesel buses, investment in charging infrastructure by region. In order to have encouraging policies regarding electric transport, it is necessary to use the experience of the cities and countries - pioneers in new transport technologies.

The demand for electric buses will continue in the long term, driven by the following advantages over the characteristics of fuel-powered buses: /*See Table 3/.*

Table 3: Characteristics of the electrical buses and fuel-powered buses.

Characteristics	**Electrical buses**	**Fuel-powered buses**
Practicality	Focusing on the landscape Slow motion	Higher speed Quickly browse or skip landmarks
Environmental protection and operating costs	Different driving method - drive by energy, battery and electric motor. No power loss when braking, Low carbon - no pollution, low operating costs, low energy costs	Requires frequent refueling which pollutes the environment, A lack of gas stations in remote areas, Requires manual handling High fuel costs
Noise	No noise, peace and mood in the bus	loud noise - harms the auditory, olfactory and the nervous system of people.
Saving time and maintenance costs	Relatively simple structure, modular design, low failure rate, routine electrical checks, lower maintenance costs, no filters and oil changes, time saving	Complex structure, inspection and regular change of oil, filters, etc., requires time and maintenance costs.
Convenience and comfort	Good design, easy charging, simplified logistics, smooth power output smooth driving, it does not cause unpleasant emotions to tourists, provokes pleasant experiences	Outdated design, time required and facilities and personnel to boot
Improving the image of the tourist experience	Environmental image when traveling - preserve the image of the environment, tourists with a conscience and an attitude towards the environment.	Separation of harmful emissions, tourists don't care

Source: Author`s compilation

The provision of electric sightseeing bus services not only facilitates the convenient movement of tourists within the scenic area, especially for those with weak physical strength or limited time, but also provides opportunities to rest and continue sightseeing during the tour, increasing tourists' preference for the scenic area[4].

4. State polices and financial Incentives for Sustainable Transport or the assistance of countries for the implementation of ITS.

A number of countries and regions are developing financial and regulatory policies to support the introduction of sustainable transport solutions, especially for the purchase of electric buses and vehicles.

4.1. European experience /Germany and Slovenia/

In Germany, experience shows that electric vehicles enjoy privileges such as free parking on public roads and access to roads normally restricted to certain vehicles. Germany is taking strict measures to improve air quality in urban areas. The German government has decided to grant additional privileges to vehicles that emit less CO2, such as electric cars, hybrid cars and hydrogen cars. The move is part of a wider initiative to promote green driving and reduce emissions[5].

A Balkan country like Slovenia also has well-developed public transport systems in many cities, including buses and trains, making it easy for tourists to get around without using their own cars. Regarding sustainable transport options for tourists, the country offers a number of eco-friendly options that reduce carbon emissions but also improve the overall travel experience. Cycle tourism is a popular and traditional starting point, as Slovenia offers numerous cycle tourism routes to see the country's beauty and explore more remote areas, electric vehicles are becoming increasingly available, which are a clean and safe way to travel and minimize the impact on the environment. Electric cars and bicycles reach different parts of the country, allowing tourists to explore different attractions through guided tours, maintaining the sustainability of individual destinations. By using these electric, sustainable transport options, tourists help reduce their carbon footprint, but also contribute to the preservation of Slovenia's natural beauty for future generations to enjoy[6].

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[4] Predimstvata na elektricheskite prevozni sredstva za razglezhdane na zabelezhitelnosti, /Предимствата на електрическите превозни средства за разглеждане на забележителности/, Jul 18, 2024, https:// bg.tricycleoem.com/news/the-advantages-of-electric-sightseeing-vehicle-795

[5]Germany: the electrical vehicles get more freedom /Germaniya: elektricheskite prevozni sredstva poluchavat poveche svoboda s E-Plakette/, May 13, 2024, https://www.pitane.blue/bg/2024/05/13 0

[6] eSIM and its role in the ecological tourism in Slovenia, /eSIM i rolyata mu v ekologichniya turism na Slovenia /, 02.07.2024, https://www.globalyo.com/bg/esim-and-its-role-in-slovenias-eco-friendly-tourism/

4.2. National policies in Bulgaria

The introduction of electric buses in Bulgaria is an important step towards sustainable transport, with the aim of reducing harmful emissions and creating a healthy urban environment. Not a few cities in the country are recognized tourist destinations, which, in order to develop sustainably, require commitment and policies for ecological transport. Long-term investments in electric buses and the construction of charging infrastructure are needed. The lack of uniform standards for charging infrastructure limits large-scale implementation of electric buses.

Although the process is still at an initial stage, in Bulgaria there are policies aimed at introducing electric buses in tourism, as well as projects for the purchase of such. Some Bulgarian cities are developing their own initiatives to introduce electric buses, which will provide new jobs and support the local economy.

In the current year 2024, more than BGN 126 million have been invested for the purchase of electric bus charging stations and infrastructure for safe urban mobility, allocated under the "Eco-friendly Mobility" program. They are aimed at municipalities in different regions of the country - Aytos, Asenovgrad, Velingrad, Vratsa, Gabrovo, Dobrich, Kazanlak, Lovech, Pazardjik, Pernik, Petrich, Samokov, Sliven, Haskovo and Shumen. 97 new zero-emission vehicles have been provided, 78 charging stations for public transport vehicles and 7 smart digital solutions for municipal transport will be implemented. As a result, an infrastructure for safe urban mobility is expected to be built, aimed at vulnerable participants in road traffic - pedestrians and cyclists[7].

Long-term investments are needed both in the electric buses themselves and in the construction of charging infrastructure. At present, the lack of uniform standards for charging infrastructure limits the large-scale implementation of electric transport.
In summary, for all three countries, it can be argued that the demand for electric buses will continue in the long term, driven by the following key advantages:

- Improving air quality by reducing harmful emissions in the destination
- Improving the comfort of tourists/passengers/ due to lack of engine noise.
- Charging an electric bus is definitely cheaper than diesel fuel.

These benefits define electric bus travel as a sustainable travel desired by tour operators, which is sure to boost their image.

These benefits establish electric bus transport as a sustainable choice preferred by tour operators, which inevitably improves their image.

[7] Sergeev, A. 15 towns in Bulgaria buy 97 new electrical buses, 29.05.024, https://dizzyriders.bg/post/14522/15-grada-v-bylgariya-kupuvat-97-novi-elektricheski-avtobusi

Conclusion

Key Findings from the Analysis

Technological Determinism as an Engine of Change: The report found that digitalization and Intelligent Transport Solutions (ITS) are the main catalysts for the transformation of tourist transport. ITS are not just innovations, but a strategic necessity that changes the mindset of society, directing it from the private car to shared and sustainable forms of mobility.

Achieving Sustainability Through Electromobility: The concrete example of electric tourist buses shows how ITS directly contributes to sustainable development by ensuring zero direct emissions during operation, improving air quality in destinations and increasing passenger comfort (through reduced noise).

Economic and Social Efficiency: ITS provide greater security through monitoring and tracking systems, which improves risk management. In economic terms, despite the initial capital costs, the lower operating costs of charging electric buses make them an economically attractive long-term investment.

The Crucial Role of State Support: The successful deployment of ITS, especially in countries like Bulgaria, depends on targeted state policies and financial incentives. The examples from Germany, Slovenia and the large-scale investments in Bulgaria in 2024 prove that state support (through subsidies, privileges and investments in charging infrastructure) is mandatory to overcome the initial barriers and achieve large-scale implementation of sustainable transport.

Transport is a capital-intensive industry, as it transports people and goods and absorbs a lot of capital. Its` economic and social development depends on its good organization and is extremely necessary for tourism, as it overcomes the spatial separation between tourists /consumers/ and tourist destinations. the land transport is still poorly digitized in many countries in Europe. The digitalization at all stages of a tourist tour is still completely lacking. However, for the future, it will be necessary to use systems that will facilitate tourists in planning the trip with the aim of maximum satisfaction.

Prospects

The digitalization of the tourism sector in 2024 represents huge opportunities for innovation and growth. Technological changes are shaping the way travel is discovered, booked and experienced, while contributing to more sustainable and green tourism. To reap the maximum benefits from this process, tourism operators must be ready to adapt to changing market demands and invest in modern technology and innovation[8] by adopting ITS as a key competitive

[8]Digitalizatsiya v turizma – priorotet na biznesite prez 2024 /Дигитализация в туризма - приоритет на бизнесите през 2024г./

strategy for achieving sustainability and maximum satisfaction of the modern tourist..
Technologies provide greater security through vehicle monitoring and tracking systems that improve risk management. The future of travel and tourism beyond 2024 will combine technological innovation, cultural authenticity, economic consideration and a strong emphasis on personal well-being[9].

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