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DIGITAL TOOLS FOR MANAGEMENT OF LOCAL TOURISM AND TRANSPORT NETWORKS

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ЦИФРОВІ ІНСТРУМЕНТИ УПРАВЛІННЯ МІСЦЕВОЮ ТУРИСТИЧНОЮ ТА ТРАНСПОРТНОЮ МЕРЕЖАМИ

У межах дослідження звернено увагу, що в сучасному світі цифрові технології є невід'ємною складовою управління різноманітними процесами в сфері туризму та транспорту. Це пов'язане з низкою факторів, серед яких швидкий розвиток технологій, зростання їх доступності, підвищення вимог споживачів, покращення ефективності, оптимізація бізнес-процесів, розвиток конкуренції. За допомогою цифрових інструментів можна ефективно керувати місцевими туристичною та транспортною мережами, забезпечуючи при цьому високу якість обслуговування туристів та пасажирів. Враховуючи наведену значущість, проведене дослідження цифрових інструментів управління місцевою туристичною та транспортною мережами. За результатами дослідження доведено, що цифрові інструменти управління місцевою туристичною та транспортною мережами сприяють поєднанню їх фізичних та цифрових складових. В результаті цього вони набувають специфічних властивостей. Серед таких властивостей: повсюдна доступність для туристів (які можуть швидко та зручно знайти необхідну інформацію, забронювати послуги); чітке планування та координація процесів надання туристичних та транспортних послуг та

можливість їх погодження у часі і просторі (цифрові інструменти дозволяють моніторити рух транспорту та розподіляти навантаження на дорогах та туристичних маршрутах); спрощена взаємодія з об'єктами мереж (цьому сприяє можливість відмови від паперових документів, бюрократичних процедур та фізичної взаємодії з працівниками туристичних підприємств); підвищення рівня безпеки туристів та мешканців міст (цьому сприяє орієнтування на сенсори транспорту, системи керування рухом транспорту та системи моніторингу транспорту, які дозволяють у єдності контролювати рух транспорту та попереджати аварійні ситуації швидше); створення нового рівня інтерактивності між туристами та місцевим населенням (оскільки цифрові інструменти можуть систематизувати та надавати інформацію про культурні та історичні пам'ятки, місця відпочинку, розваги, заклади харчування та транспорту інфраструктуру у режимі реального часу).

The study highlights that in the modern world, digital technologies are an integral component of managing various processes in the tourism and transport industry, which is associated with a number of factors including rapid technological advancements and increased accessibility, rising consumer demands, improved efficiency and optimization of business processes, and the development of competition. Therefore, digital tools can effectively manage local tourism and transport networks, providing high-quality service to tourists and passengers. Taking into account the significant importance presented, the study has been conducted on digital management tools for local tourist and transportation networks, including their characteristics and specific properties. According to the results of the research, it has been proven that digital management tools for local tourist and transportation networks promote the integration of their physical and digital components, resulting in specific properties, including universal accessibility for tourists (who can quickly and conveniently find necessary information and book services through mobile applications or electronic ticketing); clear planning and coordination of processes for providing tourist and transportation services and the possibility of their synchronization in time and space (digital tools allow monitoring of traffic and distribution of loads on roads and tourist routes); simplified interaction with network objects (this is facilitated by the ability to abandon paper documents, bureaucratic procedures and physical interaction with staff of tourist enterprises); increased safety for tourists and city residents (this is facilitated by orientation to transport sensors, traffic management systems, and transport monitoring systems that allow unified control of traffic and faster detection of emergency situations); creation of a new level of interactivity between tourists and the local population (since digital tools can systematize and provide information about cultural and historical landmarks, recreational areas, entertainment, dining establishments, and transportation infrastructure in real-time mode).

Ключові слова: цифрові технології; туризм; транспорт; операції в Інтернеті; мережі.

Key words: digital technologies; tourism; transport; online transactions; networks.

PROBLEM SETTING (DESCRIPTION OF THE PROBLEM BEING ANALYZED IN GENERAL AND ITS CONNECTION WITH IMPORTANT ACADEMIC OR PRACTICAL TASKS)

In the modern world, digital technologies are an integral component of managing various processes in the tourism and transport industries, which is associated with a number of factors, including rapid technological development and increasing accessibility (more and more people are using smartphones and other devices, which allows for quick and convenient online operations, including booking tourism services and transportation tickets), rising consumer demands (customers are becoming increasingly demanding and reliant on technology, thus they require services that can be obtained through digital tools), improving efficiency and optimizing business processes (the use of digital tools allows for increased work

efficiency and reduced costs in managing service delivery processes, improving the quality of customer service), and developing competition (competition is quite intense in the tourism and transportation industries, so companies must be prepared for rapid changes that require the implementation and/or updating of new technologies to maintain competitiveness). Therefore, digital tools (including various software, hardware, and other means used for collecting, processing, storing, and transmitting information in digital form) can effectively manage local tourism and transportation networks, while providing high-quality service to tourists and passengers.

THE ANALYSIS OF THE LAST RESEARCH AND PUBLICATIONS IN WHICH THE SOLUTION TO THIS PROBLEM IS BEGUN

Currently, among the studies dedicated to exploring digital tools for managing local tourist and

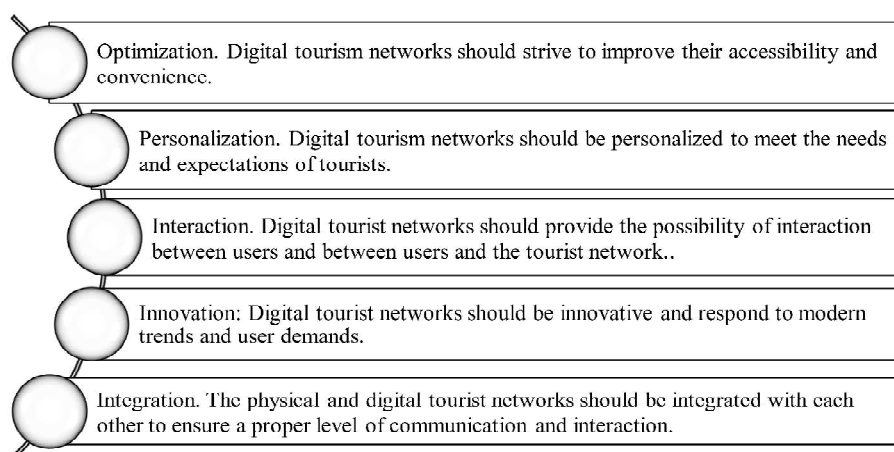


Fig. 1. General principles of combining physical and digital tourist networks

Source: formed based on [1; 2].

transportation networks, the work of Mashika H., Zelich V., Kizyun A., Maslyhan R. stands out (as scientists play a primary role in identifying the components and specifics of forming a local tourism network, which contributes to creating the best and most diverse tourist offerings) [1], as well as Sikharrenko K.O., Tokmakova I.V., Cherednichenko O.Yu., Voitov I.M., Palamarchuk Ya.S. (as scientists play a primary role in identifying the components of the local transportation network) [2; 3]. However, these works, while identifying the components of such networks, do not provide sufficient data for determining the content and composition of the digital management tools that shape them. This has led to the selection of the topic and direction of research, as well as its overall relevance, considering the decisive role of such tools in the accessibility and functionality of local tourism and transportation networks.

Table 1. Characteristics of objects in the physical tourist network

Tourist network objects	Types of Tourist Network Objects	Characteristics of Objects	Specifics of Use
Temporary accommodation places	Hotels, hostels Camping sites, RV parks Sanatoriums, resorts	Placement	May be of varying comfort and service levels, located in different areas of the city or resort. Provide temporary accommodation for tourists during their travels.
Food establishments	Restaurants, cafes, fast food joints, coffee shops, bars, pubs	Food	May offer a variety of cuisines, located in different areas of the city or resort. Provide food for tourists during their travels.
Tourist attractions	museums, galleries parks, squares zoos, aquariums	Objects overview	Attract tourists and are the object of their exploration and relaxation. These objects may have natural, historical, cultural, architectural, or entertainment characteristics.
Tourist routes	Walking routes Cycling routes Water routes	Walking	Defined routes with resting points, viewpoints, etc. Require development, maintenance, and promotion.
Excursions	Walking tours Bike tours Car tours	Objects acquaintance	Provide an introduction to the history and culture of the region with the help of a professional guide.

Source: formed based on [1; 2].

FORMULATING OF ARTICLE PURPOSES (THE PURPOSE OF THE STUDY)

The purpose of this scientific article is to investigate digital tools for managing local tourism and transportation networks, including their features, principles, and specific properties.

THE PAPER'S MAIN BODY WITH FULL REASONING OF ACADEMIC RESULTS

Within the scope of this study, the authors focus on the specific characteristics that tourism and transportation networks acquire when combined with digital management tools that ensure the continuous collection, processing, storage, and transmission of information about their functioning in digital form. Accordingly, this is a rather specific combination that is not just provided by specific types of software and hardware tools, but also satisfies the principles of integration, optimization, personalization, interaction, and innovation.

As for the local tourism network, the implementation of digital tools forms a physical-digital complex of tourist objects and transportation between them, services, and local infrastructure, providing the satisfaction of tourists' needs, tourism development, and more efficient use of resources in accordance with the principles outlined in Figure 1.

So, the physical tourism network can include hotels and other temporary accommodation, restaurants and other food establishments, museums, parks, tourist routes, excursions, and other tourist attractions. The characteristics of the physical tourism network objects are presented in Table 1.

Digital tourism network is connected to the Internet and may include websites of travel agencies and online portals, mobile applications for tourists, booking

Table 2. Characteristics of objects in the digital tourist network

Tourist network objects	Characteristics of Objects	Specifics of use
Websites of travel agencies and Internet portals	These objects contain information about local tourist attractions, hotels, restaurants, museums, and other places of leisure.	The objects may include online booking functions for tourist services and transport tickets.
Mobile applications for tourists.	These objects contain information about local tourist attractions, offer routes for excursions and walks.	These objects can provide recommendations for restaurants and places to relax.
Booking system	These objects contain information and the possibility to book tourist services online, which provides a more convenient and faster booking process	These objects can be connected to the websites of tourist agencies and internet portals.
System of data analysis	These objects are capable of processing large volumes of data collected about the tourist network.	These objects allow to obtain valuable information about the demand for tourist services, needs and preferences of tourists.

Source: formed based on [1; 2].

systems and data analysis systems. The characteristics of digital tourism network objects are presented in Table 2.

The combination of physical and digital tourist networks is achieved through a range of digital tools (including databases, maps and navigation, GPS technologies, business analytics tools, forecasting systems, social media monitoring systems, etc.). The characteristics of the tools that enable the combination of physical and digital tourist networks are provided in Table 3.

The main purpose of these tools is to ensure the coordinated operation of the outlined tourist networks, their interaction with potential tourists, and assistance in the efficient use of physical tourist network resources. For

example, tourism agency websites can be connected to hotels, restaurants, or tourist attractions through databases, maps, and navigation, allowing tourists to make online reservations for accommodations and meals. Mobile applications can be integrated with physical tourism network facilities using GPS, allowing tourists to plan routes and find the nearest tourist attractions. Data analysis systems, including business analysis tools, forecasting systems, and social media monitoring systems, help tourism agencies and hotels analyze data about tourist demand and preferences, allowing them to adjust their services and offerings to meet the needs of their customers. Digital tools can also help ensure the safety

Table 3. Characteristics of tools that enable the combination of physical and digital tourist networks

Tools	Function of the tools
business analysis tools	allows tracking trends and customer behavior to understand which tourism services are popular and what may attract new customers
forecasting systems	allows predicting demand for different tourism services in different periods, helping to plan network work and resources
social media monitoring systems	allows tracking network and service mentions on social media, helping to find new customers and maintain the network's reputation.
marketing campaign tracking systems	allows tracking the effectiveness of marketing campaigns and finding out which marketing methods are most effective in attracting customers.
review management systems	allows tracking customer feedback and responding to them quickly and efficiently, increasing customer satisfaction and helping to maintain the network's reputation
databases	allows storing and obtaining information about places of rest, tourist routes, services and other tourist objects (in the form of photo and video materials, descriptions, reviews, and ratings.)
maps and navigation systems	helps tourists navigate in an unfamiliar place and find what they need
GPS tracker	allows determining the location of an object anywhere in the world using signals received from satellites orbiting the Earth.

Source: formed based on [1; 2].

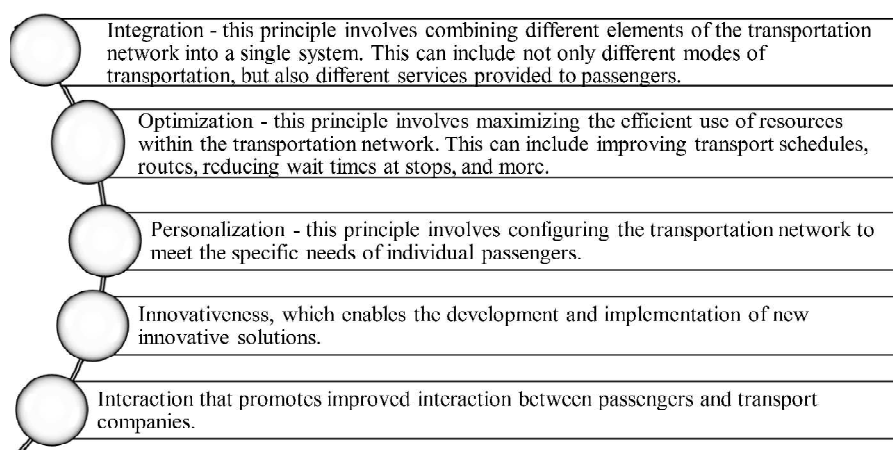


Figure 2. General principles of combining physical and digital transport networks

Source: formed based on: [5; 6].

and convenience of travel. Electronic ticketing systems, for instance, can avoid queues and provide a faster and more convenient boarding process. Additionally, digital maps can help tourists easily navigate a new city and find the most convenient route to a particular tourist attraction.

In such tourist networks, it is possible to create personalized tourist routes based on the analysis of user behavior [1; 2].

As for the local transport network, the implementation of digital tools forms a physical-digital complex that ensures the operation of means of transportation and infrastructure within a certain territory, meeting the needs of passengers, promoting the development of flexible transport services, and efficient use of resources in accordance with the principles outlined in Figure 2.

So, the physical transport network can include roads, railways, trams, buses, metros, and other types of transportation that move passengers within a city or region.

The digital transport network is connected to the Internet and can include transportation sensors, transportation monitoring systems, information systems, transportation management systems, electronic ticketing and payment systems, and communication devices. The characteristics of objects in the digital transport network are listed in Table 4.

The combination of physical and digital tourism networks is achieved through a range of digital tools, including GPS, accelerometer, gyroscope, pressure and temperature sensors, communication nodes, software, and other components such as GPS trackers, video surveillance cameras, cards, or mobile applications. The characteristics of the tools that enable the combination of physical and digital tourism networks are presented in Table 5.

The main purpose of these tools is to ensure coordinated operation of the aforementioned transportation networks, their interaction with passengers, and assistance in the efficient use of physical transportation resources. For example, transport sensors can be linked to

vehicles through the latter's various sensors (such as GPS, accelerometers, gyroscopes, pressure and temperature sensors), allowing for the collection and transmission of data on movement, speed, road conditions, and weather. Digital transport monitoring systems can be linked to various types of vehicles, including cars, buses, trucks, trains, and others, using GPS trackers, video surveillance cameras, specialized software, pressure and temperature sensors, and more, enabling the tracking of vehicle movement and the collection of data on their location, speed, and other parameters. Information systems can be connected to transportation vehicles through their

equipped technical devices (including sensors, video surveillance cameras, communication nodes, GPS receivers, and other devices) that can be used for collecting, analyzing, and processing data about transportation and passengers. These systems can also provide information on transportation schedules and other important data. Digital traffic management systems can be connected to various transportation vehicles through different sensors, communication nodes, software, and other components, which can help in traffic distribution on roads, planning optimal routes, reducing waiting times at stops, and ensuring passenger safety. Digital electronic ticketing and payment systems can be integrated with urban

Table 4. Characteristics of objects in the digital transport network

Transport network objects	Characteristics of Objects	Specifics of use
Sensors of transportation	Various sensors that provide data collection and transmission on traffic movement, speed, road conditions, and weather.	In road safety systems, traffic and route analysis. In systems for tracking vehicle movement and determining arrival at stops.
Transport monitoring systems	Comprehensive systems used for tracking and controlling the movement of vehicles on roads.	To optimize traffic flow, reduce idle time, track adherence to schedules, lower fuel costs, increase traffic safety, and improve passenger service quality.
Information systems	Comprehensive systems that may include various technical means for collecting, processing, and transmitting information.	They can provide information about transportation schedules and other important data, improve road safety, reduce vehicle downtime, optimize routes, and ensure more efficient use of resources.
Transportation management systems	Comprehensive technical solutions for managing traffic flow and distribution on roads, planning optimal routes, reducing waiting time at stops, and ensuring passenger safety.	They are used to increase the efficiency of transportation, reduce idle time, track schedule compliance, decrease fuel costs, improve traffic safety, and enhance passenger service quality.
Electronic ticketing and payment systems	Comprehensive technical solutions that allow for contactless payment of fares, account recharge, and receiving discounts and privileges.	This allows passengers to conveniently pay for transportation and use it without the need to use cash.
Communication devices	Communication devices of digital devices.	They can be used to access information about transport movements and schedules, as well as to communicate with other passengers and transport operators.

Source: formed based on: [5; 6].

and intercity transport ticket offices through software designed for installation and use on mobile devices such as smartphones and tablets, enabling passengers to conveniently pay for their fares and use transportation without the need for cash. Communication devices can be connected to information displays at stations, various types of transportation vehicles, and passenger stops (including smartphones and tablets) via Wi-Fi, Bluetooth, NFC, and 5G networks. This allows network users to access information about transportation traffic and schedules, as well as to communicate with other passengers and transportation operators.

Based on these features, it is possible to create local digital transport corridors [5].

CONCLUSIONS FROM THIS STUDY AND PROSPECTS FOR FURTHER EXPLORATION IN THIS AREA

The research has shown that digital tools for managing local tourism and transport networks facilitate the integration of their physical and digital components, resulting in specific properties, including:

- Universal accessibility for tourists (who can quickly and conveniently find necessary information and book services using mobile applications or generate electronic tickets);
- Clear planning and coordination of processes for providing tourist and transport services and the ability to coordinate them in time and space (digital tools allow monitoring of transport movement and distribution of loads on roads and tourist routes);
- Simplified interaction with network objects (this is facilitated by the possibility of abandoning paper documents, bureaucratic procedures, and physical interaction with employees of tourism enterprises).
- Increased level of safety for tourists and city residents (which is facilitated by orientation on transport sensors, traffic control systems, and transport monitoring systems that allow controlling the movement of vehicles and detecting emergency situations faster).
- Creating a new level of interactivity between tourists and local population (since digital tools can systematize and provide information about cultural and historical landmarks, recreational areas, entertainment, dining establishments, and transport infrastructure in real-time).

The prospects for further research lie in the possibilities of using the obtained results to create a project for the development of local digital transport corridors for tourists. In this case, transport networks are integrated with tourist networks and allow tourists to conveniently move between different tourist attractions and visit them at a time that is convenient for them.

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Table 5. Characteristics of tools that enable the combination of physical and digital tourist networks

Tools	Function of the tools
Accelerometer	Measurement of acceleration and detection of movement
Gyroscope	Measurement of orientation and direction of tourists' movement
Pressure and temperature sensors	Measurement of weather conditions and altitude
Communication nodes	Providing access to the Internet for information and communication
Software	Creation and management of digital networks and information systems
GPS tracker	Ensuring accurate determination of their location, as well as collecting and transmitting data on speed, direction of movement, and other parameters.
Wi-Fi, Bluetooth, NFC, 5G networks	Allowing users to connect to the Internet, exchange data, communicate with each other, and stay connected and communicate in real time.
Video surveillance cameras	Tracking the movement of vehicles on the streets and in parking areas, as well as recording traffic violations.
Cards or mobile applications	Storage of electronic tickets and information about tourists' routes, contactless payment for services.

Source: formed based on: [3—4; 1; 6].

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