SOCIOLOGICAL ASPECTS OF TOURISM DIGITALIZATION

Kateryna Vovk[1]

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Abstract. The rapid digital transformation of the tourism sector is redefining operational processes and reshaping consumer interaction with tourism products. This study explores the sociological dimensions of tourism digitalization, emphasizing how digital technologies affect tourist behavior, social communication patterns, and the preservation of cultural identity in a digitally mediated environment. It also addresses the growing tension between technological innovation and the authenticity of the tourism experience. *The research subject* is investigating the sociological implications of tourism digitalization, focusing on the transformation of consumer behavior, tourism experiences, and cultural representation under the influence of digital technologies. The study integrates theoretical perspectives with empirical analysis to examine the intersection of social interaction and technological change in tourism. The first section lays the conceptual foundation, presenting major sociological paradigms and their relevance to the digital evolution of tourism. It synthesizes academic literature that highlights the growing role of virtual interactions, social media influencers, and personalized digital communication in shaping travel decisions and experiences. *The objective* of this research is to analyze how digital technologies influence the structure and dynamics of tourism from a sociological perspective, with special attention to social sustainability, cultural continuity, and evolving patterns of human interaction. The second part of the study identifies both the opportunities and risks posed by tourism digitalization. These include increased accessibility and efficiency of services, but also rising concerns over emotional disconnection, cultural commodification, and the weakening of traditional tourist communities. Environmental impacts, such as digital carbon footprints, are also examined in this context. *Methodology.* A mixed-methods approach was employed.

[1] Doctor of Philosophy in Tourism,
Senior Lecturer at the Department of Entrepreneurship, Trade, and Tourism Business,
Simon Kuznets Kharkiv National University of Economic, Ukraine

The theoretical component included a literature review of sociological frameworks related to tourism. The empirical component applied the Principal Component Analysis (PCA) using the NIPALS algorithm to assess the level of digitalization in 23 European countries. A cluster analysis was conducted to classify countries based on digital maturity and to examine their influence on tourism processes and social interactions. The research results is finding reveal a significant correlation between high levels of digitalization and shifts in social dynamics within the tourism sector. Countries with advanced digital infrastructure exhibit more intensive changes in communication patterns, emotional engagement, and consumer expectations. The cluster analysis uncovered distinct groups of countries, highlighting differences in digital readiness and their socio-cultural impact on tourism development. *In conclusion,* the study underscores the necessity of developing strategies that integrate technological innovation with cultural preservation. The results provide practical implications for stakeholders aiming to foster socially sustainable tourism in the digital age.

Introduction

The modern development of tourism is accompanied by active digitalization, which transforms consumer models and the requirements for tourism products. The global integration of information technologies opens new opportunities for innovative strategies. At the same time, it leads to information overload and emotional exhaustion for individuals, creating a range of challenges for the industry. In the competition for consumer attention, companies actively use personalized digital communications, and the role of digital influencers is growing, affecting decision-making regarding the purchase of tourism services. The result is the standardization of the tourism experience through personalization algorithms and the commercialization of culture. The use of digital technologies offers advantages in terms of significant time savings and reduced costs for developing and selling tourism products. However, there is a decrease in the duration of direct communication between people, which gradually lowers the level of emotional engagement and complicates the formation of long-term relationships with clients. As a result, traditional forms of tourism communities are weakening, and short-term communications based on

social networks, online forums, etc., are on the rise. Thus, the digitalization of tourism leads to both increased comfort and accessibility of services and social challenges related to changes in communication models, trust, and social interaction. Considering the above, analyzing the sociological consequences of tourism digitalization and exploring mechanisms for preserving social authenticity in the digital age is particularly relevant today.

In this context, it is important to focus on how digital technologies can simultaneously contribute to the development of tourism products while preserving the social authenticity of places, cultural traditions, and identity. Digitalization of tourism opens new opportunities for the industry's development, particularly through the implementation of innovative technologies. However, the growing use of digital technologies in the tourism sector requires a detailed study of the mechanisms that allow for the combination of innovations with traditional social values and cultural heritage. Thus, **the goal of the study** is to analyze the sociological aspects of tourism digitalization and determine the impact of technological innovations on social relationships, the interaction of tourists with local communities, and the cultural, economic, and environmental processes in regions. In accordance with the set goal, the following research tasks were formulated: the study of the directions of tourism as a phenomenon through the lens of sociological approaches, the analysis of the sociological consequences of tourism digitalization, the assessment of the impact of technologies on the development of tourism products, the preservation of social authenticity and cultural traditions of places, the study of mechanisms for preserving cultural identity in the context of global digitalization, the analysis of the level of digitalization of European countries, and the cluster analysis of European countries based on their level of digitalization and its impact on tourism processes. **To achieve the research goal**, a comprehensive approach was applied, within which the following actions were taken: the analysis of modern technological trends in tourism, the examination of event tourism organization practices, the evaluation of the social and environmental consequences of tourism digitalization based on statistical data, the analysis of the level of digitalization of European countries using the Principal Component Analysis (PCA) method with the NIPALS algorithm to identify the main factors influencing tourism digitalization, and the cluster analysis to define groups of countries with similar levels of

digitalization and assess their impact on the tourism experience and social interactions.

The introduction of this study outlines the key issues and challenges associated with the digitalization of tourism, justifies the relevance of the topic, and defines the goal and research tasks. The first chapter is dedicated to theoretical approaches to analyzing the sociological aspects of tourism digitalization. It presents the main sociological approaches and paradigms for studying the phenomenon of tourism. The conclusions of scholars who examine the issue of digital development in tourism are also provided. The chapter explores tourism development trends and examines changes in social interaction models within the tourism context under the influence of digitalization.The second chapter analyzes the social consequences of tourism digitalization, identifying its advantages and disadvantages. The focus is on social development issues in countries undergoing digitalization, as well as the environmental consequences of digital transformation. The third chapter presents the results of the analysis of the level of digitalization in 23 countries of the European region using the Principal Component Analysis (PCA) method with the NIPALS algorithm. Additionally, a cluster analysis of European countries was conducted based on their digitalization levels. The conclusions summarize the results of the research.

1. Theoretical Aspects of Sociology of Digitalization in Tourism

Tourism is a multidimensional sociocultural phenomenon that is in the focus of various disciplines, including economics, geography, psychology, cultural studies, and sociology. Its interdisciplinary nature necessitates a comprehensive approach to its study. Economic research focuses on the impact of tourism on regional development and the creation of economic added value, geographical studies examine spatial patterns of tourism activity, cultural studies explore processes of cultural exchange, and psychological research investigates travel motivation and the impact of tourism on individuals. Tourism has become one of the main forms of economic activity worldwide, which has made it evident that the study of not only its economic and ecological aspects, but also its social and cultural consequences, is necessary (Calvo, I., 2023) [1]. In this context, the sociological approach becomes particularly relevant, as it allows for

the exploration of social interactions, practices, identities, and forms of communication related to tourism. In the era of digitalization, the sociological aspects of tourism are taking on new forms, requiring updated approaches to their theoretical understanding. Tourism is a complex sociocultural, economic, and political phenomenon that interacts with all levels of society. There are several sociological theories through which it is appropriate to analyze tourism as a social phenomenon. In particular, the theory of symbolic interactionism (Mead, 1934; Blumer, 1969) allows for considering tourism as a form of social interaction, during which the meaning of places and events is formed through shared symbols and interpretations [2; 3]. The tourist gaze theory (Urry, 1990) examines how tourists perceive and interpret places, focusing on the socially constructed nature of the tourist experience [4]. In modern tourism, not only infrastructure, finances, or marketing are essential, but also the human factor – the interaction between people and with tourists. From this perspective, tourism can be seen as a form of social interaction, where interpersonal relationships, trust, behavior norms, and community involvement play a crucial role. The theory of social capital (Bourdieu, 1986; Coleman, 1988; Putnam, 2000) helps to explore the relationships between social networks, trust, and tourism development [5; 6; 7]. Within this theory, tourism is analyzed not only as an economic phenomenon but also as a social process that strengthens local connections and forms a common social resource. The impact of globalization has led to the gradual transformation of the tourism product and changes in its offering format in the market. On the one hand, globalization fosters the development of tourism through the use of unified digital platforms, simplifying international travel. Globalization causes tourism companies to standardize services, while adapting them to local characteristics. The formation of a global tourism market enhances tourists' access to diverse cultures, services, and experiences. On the other hand, the issue of cultural authenticity is becoming more pronounced: popular destinations may lose their uniqueness due to mass tourism. The theory of globalization (Giddens, 1990; Beck, 1999) analyzes tourism in this context as part of global processes that promote the interaction of cultures and economies, while emphasizing the growing interdependence of the world [8; 9]. Within this theory, the focus is placed on the fact that borders in communication, economy, and culture are disappearing worldwide. This leads to an increase

in the mobility of goods, services, and people. One of the consequences of growing mobility is the formation of transnational communities, with universal social norms (human rights, tolerance, environmentalism) spreading globally. Globalization alters people's identities, and the role of personal choice in a multicultural world increases. A global culture arises, adapted to local characteristics. In a certain sense, the theory of globalization found its continuation in the formation of the Paradigm of New Mobility (Sheller, M., & Urry, J., 2006) [10]. This paradigm emphasizes the importance of the mobility of people, ideas, and things in modern society, analyzing tourism as a key element of these mobile processes. Mobility in the modern world implies changes in social structures: the transformation of labor forms (freelance, remote work), family relationships (migration, family mobility), and the development of new cultural and social practices. At the same time, it opens up new opportunities for development but also creates challenges such as cultural assimilation, social marginalization, and environmental issues. Digital technologies, in turn, significantly promote mobility, enabling virtual movement and creating new forms of interaction and information exchange. Thus, tourism, through this approach, becomes an important component of global mobility of people, information, and things, and mobility itself is seen as a structure of experience that includes a digital component.

Ukrainian scholars Lukashevich, M. P., Moshak, S. M., and Shandor, F. F. (2015) in their textbook "Sociology of Tourism" define the sociology of tourism as a sectoral theory of intermediate level, which uses specific sociological methods to study the social phenomenon of tourism through its various manifestations [11]. Zhu, J. J., et al. (2024) emphasize that the sociology of tourism has evolved from analyzing structured social orders to reconstructing phenomena of social transformations through interdisciplinary and post-disciplinary paradigms [12]. Zhu, J. J., and colleagues stress that further research on social structures should use methods such as meta-analysis and meta-ethnographic synthesis. Meta-analysis allows for assessing the impact of tourism on social integration across different countries by comparing numerous quantitative studies. Meta-synthesis allows for the integration of interviews, ethnographies, or case studies to gain a deeper understanding of how tourists experience the authenticity of cultural experiences, for example. Many contemporary

scholarly publications focus on analyzing tourism through social aspects. Pradhan, B. (2023), examining the phenomenon of tourism in the context of India, focuses on the impact of tourists on social relations within the tourism system [13]. Khudaverdiyeva, V. (2023) investigates the impact of the environment on the psycho-emotional state of tourists, emphasizing the importance of psychological analysis in tourism organization [14]. The scholar highlights that ensuring psychological compatibility between the tourist and the surrounding environment is a key condition for the development of the tourism industry. According to Çakmak, E. (2022), the sociology of tourism studies the relationships, roles, and motivations of tourists, as well as the current exchanges between tourists, institutions, and host communities [15]. Zhu, J. J., et al. (2024) also note in their research that the sociology of tourism has evolved to encompass the internal essence of tourism as an experience of physical and psychological emancipation in non-traditional environments [12].

As demonstrated by the works of Ukrainian and international scholars, sociology of tourism today is a dynamic and multifaceted discipline that integrates numerous theoretical paradigms to analyze tourism phenomena, such as authenticity, social relationships, the psychological impact of the environment, and the role of tourism in social transformations. Table 1 presents a summary of the main theoretical approaches within the sociological analysis of the tourism phenomenon:

The table demonstrates the interdisciplinary nature of this field, as the sociology of tourism integrates concepts from various scientific disciplines such as sociology, cultural anthropology, and postmodernism. Table 1 shows the evolution of sociological thought in tourism, from classical approaches that focus on basic social interactions (e.g., McCannell's concept of authenticity) to contemporary theories (digitalization, sustainable development).

Within the sociological analysis of the tourism phenomenon, it is worth mentioning several important approaches that help to better understand the social processes occurring in the context of tourism. These approaches cover various aspects: from postmodern theories focusing on simulations and hyperreality to gender studies, which examine the role of tourism in shaping and reproducing gender stereotypes, as well as structural-functional approaches that consider tourism as an important element of social stability.

However, some of these approaches were not included in the main review due to their specificity or limited application in the sociological context of tourism. For instance, postmodern approaches, specifically the ideas of Jean Baudrillard (1994) regarding simulacra and hyperreality, focus more on media and cultural images rather than on social structures [16]. Therefore, these theories are less relevant for a general sociological analysis of tourism. Similarly, the structural-functional approach, although important, does not account for the complex interactions in contemporary society, necessitating a focus on more dynamic and complex theories. Postcolonial critique, while significant, is also limited as it focuses on the cultural and political aspects of tourism rather than the sociological processes underlying these phenomena. The gender perspective, while crucial for understanding contemporary social processes in tourism, can be considered separately, as it is a more specific approach that requires further research in the context of theories related to social roles and stereotypes. Thus, postmodern approaches (simulation), particularly in the context of tourism, have gained significant attention thanks to Jean Baudrillard (1994), who argued that modern tourism exists in a world of simulacra, where people consume not reality, but its copies and images. In his theory, the concepts of simulacra, hyperreality, and virtuality become essential for understanding how tourists interact with cultural and social constructs that are merely reflections of the real world, created by media and other ideological tools. The structural-functional approach, represented by Talcott Parsons views tourism as part of the social order, fulfilling a stabilizing function within society. According to this approach, tourism promotes social integration by helping to maintain certain social statuses and roles that are shaped through interactions between tourists and local communities. Postcolonial criticism of tourism, represented by scholars such as Edward Said (1978) and David Harrison (2001), emphasizes that tourism reproduces colonial perceptions and hierarchies. In particular, concepts such as "exoticism," "the Other," and "wilderness" are used to create images that are integral to contemporary tourist practices. Postcolonial studies of tourism highlight how these cultural constructs contribute to the exploitation and reproduction of inequalities between developed and less-developed countries. The gender perspective in tourism, explored by scholars such as Annette Pritchard and Nigel Morgan (2000), draws attention to how tourism shapes and

reproduces gender roles [17]. This is especially evident in advertising and the workforce, where gender stereotypes often dominate. Their research focuses on the gender images that emerge through tourism practices and feminist critiques that analyze how tourism can either reproduce or break traditional gender stereotypes. Thus, all these approaches contribute to a better understanding of various aspects of tourism through the lens of a sociological perspective.

Table 1

Key Theoretical Approaches in the Sociology of Tourism

Approach / Concept	Author/s	Core Idea	Key Concepts
Authenticity	Dean MacCannell	The tourist seeks the "real," but often encounters staged representations.	Staged authenticity, alienation
Phenomenology of Tourist Experience	Erik Cohen	A typology of tourists based on the depth of experience: from recreational to existential.	Existential tourist, experience, meaning
The Tourist Gaze	John Urry	Tourism is a socially constructed way of "seeing," shaped by expectations and media.	Gaze, imagination, visuality
Host–Guest Relations	Valene Smith	Tourism affects the relationship between tourists and host communities, potentially reinforcing inequality.	Cultural contact, stereotypes
Digitalization / Social Media	Ulrike Gretzel, Mimi Sheller	Digital platforms transform the travel experience, leading to "Instagram tourism."	Smartphone tourism, #travel, self-presentation
Sustainable Tourism Development	Bramwell, Lane, Weaver et al.	Tourism as a development tool that avoids harming the environment, culture, and local communities.	Ecotourism, local participation, responsible consumption

Source: compiled by the author

The cumulative changes from 2016 to 2025 have created a significant effect that has greatly impacted the development of tourism as a socio-economic system. Between 2020 and 2022, tourism experienced a sharp

decline, and the industry adapted to the new conditions by introducing new safety and hygiene protocols. Many countries and companies began implementing initiatives for "green tourism," including reducing CO2 emissions, minimizing waste, and preserving natural resources. Over the last 10 years, there has been rapid development of information technologies such as artificial intelligence, big data, and mobile applications, which have greatly improved the organization of trips and the experience of tourists. Virtual reality (VR) and augmented reality (AR) have become essential tools for creating new experiences and virtual tours. Online booking platforms like Airbnb and Booking.com have radically changed the traditional model of tourism services. The issue of travel safety has also become a priority when choosing destinations. Geopolitical instability in certain regions, such as the Middle East, Southeast Asia, and Eastern Europe, has influenced the formation of global tourist flows. Due to the Russian-Ukrainian aggression, Europe faces the threat of losing its tourist markets. A comparison of tourism between 2016-2019 and 2020-2024 reveals significant changes, including the transformation of consumer economic behavior and the intensive introduction of innovative technologies in tourism organization. As such, the results of previous theoretical research within the sociology of tourism require refinement, considering these changes. From this perspective, studying the mechanisms for the practical implementation of theoretical conclusions is crucial within the sociology of tourism. Given the systemic nature of sociology as a discipline and the complex impact of tourism on society, it is appropriate to view the sociology of tourism as a scientific direction that studies the integration of social, economic, cultural, and innovative aspects within the context of tourism activities, as well as analyzes the social consequences of such integration. This approach allows for a comprehensive analysis of the role of tourism as a social phenomenon, which interacts with various spheres of social life and transforms social structures, values, and behavioral models.

Contemporary tourism operates within a unified digital space, where services and products acquire a standardized character. This creates new challenges for competitive rivalry, as digital platforms, built on a network-based principle, become the primary tools of interaction between businesses and consumers. Business models based on such platforms involve the use of both proprietary and user resources, necessitating effective coordination

among all participants in the process. Users have become active participants in service provision: they not only receive content but also create it, interact through reviews, ratings, and personalized recommendations. This leads to a transformation of traditional business models. Now, companies are evolving into platforms that coordinate both their own resources and those of users, enabling the creation of content collaboratively. Examples of the largest digital platforms in the tourism business are presented in Table 2:

Table 2

Major digital platforms in the tourism industry

Platform	Year founded	Users (2023–2025)	Functionality Description	Official Website
Expedia	1996	350.9 million hotel nights booked in 2023	Full-service travel platform: hotels, flights, cars, packages	expedia.com
TripAdvisor	2000	294 million monthly unique users	Travel guidance platform with reviews, price comparisons, and booking options	tripadvisor.com
Airbnb	2008	200+ million active users globally	Platform for booking vacation rentals and unique stays, including experiences	airbnb.com
Booking.com	1996	120+ million app users; 50% of bookings via mobile	Online hotel booking platform offering accommodation, flights, and car rentals	booking.com
Trafalgar	1947	Over 5 million customers served historically	Guided group travel and tour packages to global destinations	trafalgar.com
Couchsurfing	2004	14+ million users in 200,000+ cities	Community-based travel platform for free lodging with hosts around the world	couchsurfing.com
Viator	1995	24.1 million website visits (March 2025)	Online booking of tours, excursions, and travel experiences	viator.com
Agoda	2005	84+ million monthly visitors (2023)	Asia-focused booking site for hotels, vacation homes, and flights	agoda.com

Source: compiled by the author based on publicly available data from official websites

These changes have a direct impact on the personalization of the tourist experience. Consumers are seeking individualized offers that consider their preferences and needs, which in turn drives the development of data collection and analysis mechanisms to improve service delivery. Such changes also accelerate decision-making processes, as consumers now have the ability to instantly compare prices, available options, and receive all the necessary information for travel planning. An example of such changes is the introduction of dynamic package tours. Unlike traditional tours, this format allows tourists to independently select key travel parameters – departure date, duration of stay, accommodation type, flight route, etc. The creation of the tourism product is personalized according to the customer's preferences, and the tour cost is calculated in real-time at the time of booking. This approach to organizing tourism services shifts the responsibility for travel parameters from the tour operator to the consumer, which, in turn, transforms the roles of the participants in the tourism service market. Thus, a new ecosystem of interaction between businesses and consumers is being formed, where each participant plays an active role in shaping the final product. Digitalization optimizes processes, creating new forms of social connections between tourists and service providers. Platforms such as Airbnb, Couchsurfing, and TripAdvisor create trust networks where users share experiences, rate, and interact with each other. Airbnb allows property owners to offer rental options, while users choose the most suitable offers by evaluating hosts and properties, which influences the reputation and final offer. TripAdvisor provides users with the ability to leave reviews and ratings for tourism services, helping other travelers make decisions and compelling service providers to adjust their offerings according to feedback. Booking.com users can compare prices and reviews in real-time, forcing hotels and tourist establishments to quickly improve their services based on consumer preferences. On Couchsurfing, users can become hosts, offering accommodation to other travelers, which fosters interaction and collective experience, contributing to the final tourism product. Today, social networks and digital reviews have become the benchmark for social influence. People are increasingly relying on the opinions of other users rather than on advertising. This creates a culture of mutual responsibility and transparency in tourism. Xiang and Fesenmaier (2017) emphasize that social media has become not only a source of consumer activity but also

the foundation for building a new analytical paradigm in tourism [18]. This opens up new opportunities for analyzing the social behavior of tourists. User-generated content (UGC) – posts, photos, hashtags, geolocations, reviews – serves as a data source for understanding tourist motivations. This approach leads to a shift in the study of the tourist – from an abstract consumer to a socially active individual engaged in digital interaction with other participants of such communication. From this perspective, tourism can be viewed as a social construct, constantly evolving under the influence of digital communication and network behavior. Schwabe, G., & Schmutz, R. (2020) in their study also conclude that digital transformation facilitates travel by creating new models of interaction between tourists and businesses [19]. The authors note that mobile apps, AR/VR, AI, and big data enable companies to develop strategies to attract customers, improving their experience and service flexibility. Technologies shape new expectations of tourists, requiring continuous adaptation of services to changing demands. Continuing the thought on the role of social media in tourism development, Sigala, M. (2018) also emphasizes that social media has become not just a promotion tool but a key channel for building value-based interaction with customers [20].

However, alongside the new opportunities, the digitalization of tourism brings significant social consequences that require separate consideration. Changes in the interaction between tourists and service providers, as well as the transformation of social roles and cultural interactions, are only part of the social challenges that contemporary society faces in the context of the development of digital tourism.

2. Social Consequences of Tourism Digitalization

In the context of digital transformation, tourist destinations can not only sell services but also engage local residents in the process – for example, as guides, cultural intermediaries, or event organizers. An important aspect of the digitalization of event tourism is the accessibility of such products for various categories of consumers. As Shevelyuk, M. M. (2021) notes, digitalization has become a key factor in the transformation of the tourism industry, affecting all its aspects – from planning to the implementation of the tourism product [21]. Lysenko, T. (2019) also emphasizes that digitalization has become an essential element in the development of the tourism industry,

ensuring the integration of new technologies into all aspects of the tourism process, from travel planning to customer service [22]. In his research, Romanyuk, M. (2018) highlights that digital technologies are transforming tourism both economically and socially [23]. The use of technologies influences roles, communication methods, and consumer behavior patterns. The author believes that for the effective development of the industry, it is important to consider the sociological aspects of digitalization, including the challenges of digital inequality and the emergence of new forms of social interaction. This view is also shared by Shevchenko I. (2021), who, based on the analysis conducted, concludes that digitalization transforms the tourism industry comprehensively – not only at the technological level but also in the social dimension [24]. The author also believes that for the further development of the tourism sector, it is necessary to consider not only the technical but also the social aspects of digital changes. Shariffuddin, N. S. M. et al. (2023) emphasizes that establishing trust between tourists and online tourism platforms is a critical factor in the success of the tourism industry [25]. According to contemporary researchers, the tourism industry must focus on social flexibility, adapting its products and services to the needs of the digital generation. Romanyuk, M. (2018), Kovalenko O. (2020) [26], and Shevchenko I. (2021) in their studies highlight the social aspects of digital changes, particularly the intensification of digital inequality. In this study, digital inequality is understood as a social phenomenon reflecting the unequal access of different population groups to digital technologies, the internet, digital services, and the skills to use them. According to the UNESCO Institute for Statistics (UIS), only 40% of the world's population possesses basic digital skills [27]. At the same time, according to Eurostat research, in 2023, only 55% of residents of the European Union aged 16 to 74 had at least a basic level of digital literacy [28]. A particularly low level of digital skills is observed among older people, both men and women. The digital transformation of tourism brings numerous advantages, such as increased personalization of services, convenience in online booking and planning, improved communication between tourists and service providers, and the development of new forms of tourism. These achievements contribute to enhancing the competitiveness of businesses and increasing consumer participation. However, these advantages are accompanied by social

consequences, including digital inequality, reduced demand for traditional travel agencies, threats to the security of personal data, and the impact of excessive virtualization on the emotionality of real experiences. The main list of advantages and negative social effects of digitalization in tourism is presented in Table 3:

Table 3

Advantages and disadvantages of digital transformation in tourism

Advantages	Social Consequences
Personalization of services through big data analysis	Digital inequality between regions and social groups
Convenience of online booking and travel planning	Decreased demand for traditional travel agencies
Improved communication efficiency between tourists and service providers	Threats to personal data security and privacy
Development of new tourism formats (virtual tours, smart routes)	Reduced emotional depth of real-life experiences due to excessive "virtualization"
Increased competitiveness of businesses through digital innovations	Dependence on digital infrastructure and platforms (e.g., Booking.com)
Enhanced consumer engagement (reviews, ratings, UGC)	Manipulation of reviews and fake ratings

Source: compiled by the author

The list of social consequences of digitalization in tourism, presented in Table 3, reflects the results of a generalized analysis as of early 2025. The growth in the use of digital technologies contributes to a reduction in the number of direct social interactions, which can overall lead to a weakening of interpersonal communication and a shift in focus from emotional experiences to virtual presence. A change in forms of social interaction is observed among youth, where digital platforms have become the main channel of communication. Research findings from the Pew Research Center revealed that in 2021, young people in the U.S. actively used social media for communication, particularly Instagram, Snapchat, and TikTok [29]. Specifically, individuals aged 18 to 29 used Instagram (71%) or Snapchat (65%). Statistical observations in 2023, according to Eurostat data, showed that 97% of young people aged 16-29 in the EU

used the internet daily, significantly exceeding the average rate for the adult population (86%) [3].

The findings of the study by Pinto, I., & Huertas, A. (2025) showed that while VR and AR technologies improve access to cultural content, they do not provide the same level of emotional engagement as physical visits [31]. According to the "Digital Culture 2021" report in the UK, only 45% of young people actively create cultural content (such as posting their own videos or posts on culture), while 71% prefer passive consumption [32]. Thus, there is a global trend toward a decline in active youth participation in cultural life. Digital technologies are rapidly transforming the landscape of tourism as a whole. Virtual events and online experiences are becoming an integral part of the tourism offer, offering new formats of interaction. However, excessive virtualization may lead to the simplification of cultural elements, posing a threat to the uniqueness of traditions. At the same time, a positive trend is the active implementation of numerous international and national initiatives aimed at digitizing cultural heritage, contributing to the development of digital tourism. Table 4 presents examples of leading projects that combine cultural heritage with innovative digital formats:

According to the presented projects, the digitization of cultural heritage has become an important element in the development of digital tourism. Virtual tours, 3D scanning of monuments, and online exhibitions create new opportunities for interaction with cultural heritage. These initiatives contribute to the promotion of cultural sites among a global audience, particularly through interactive platforms and augmented reality. Digitization allows for the preservation of unique heritage sites by enabling virtual visits, which becomes an essential component of educational and cultural tourism. However, alongside the benefits associated with the development of digital technologies in tourism, serious environmental challenges arise. Specifically, the increased use of online platforms, virtual tours, and streaming services places additional pressure on energy resources, leading to an increased carbon footprint. While the digital transformation of the tourism sector brings significant socio-economic benefits, it also generates notable environmental impacts. In particular, the maintenance and operation of online platforms for virtual events demand substantial energy resources, contributing to the growth of global carbon emissions. Empirical data indicate that one hour of video streaming or videoconferencing may result

in carbon dioxide emissions ranging from 150 to 1000 grams, depending on the specific platform and service used. For instance, a virtual conference with 200 participants can generate up to 1324 kg of CO_2 emissions, of which approximately 64% are attributed to data transmission processes [32].

Table 4

Leading international and Ukrainian initiatives for cultural heritage digitization

Project Name	Country / Partners	Description	Digital Tourism Aspects
Google Arts & Culture https://artsandculture.google.com/project/ukraine	International (Google)	Virtual tours and digital exhibitions from 2000+ museums	Virtual access to museums; promotion of destinations via interactive tools
Google Arts & Culture – Ukraine https://artsandculture.google.com/project/ukraine	Ukraine / Google	Section focused on Ukrainian culture	Virtual tours of Ukrainian museums for global audiences
Europeana https://www.europeana.eu/en	EU	Digital archive of European cultural heritage	Cultural travel planning; educational tourism
CyArk https://www.cyark.org/	USA / International	3D documentation of endangered heritage sites	Virtual preservation; immersive heritage experiences
Treasures of Ukraine (Google Arts & Culture) https://artsandculture.google.com/project/ukraine	Ukraine / Google	Online showcase of Ukrainian cultural assets	Promotes cultural tourism through online exhibitions
eHeritage https://www.e-heritageproject.eu/en	Ukraine / NASU, Taras Shevchenko University, others	3D digitization of cultural sites	Virtual tours; augmented reality for tourists

Source: compiled by the author

According to a study conducted by Simon Fraser University (2021), video streaming activities – including services such as YouTube, embedded social media content, video calls, and online gaming – account for over 1% of global greenhouse gas (GHG) emissions [33]. This share is comparable to that of the aviation industry, which contributes approximately 1.9%. Moreover, the environmental burden of streaming is expected to rise further due to the expanding use of artificial intelligence, cryptocurrency technologies, and other digital infrastructures. The broader ICT sector, encompassing data centers, communication networks, and end-user devices, is currently responsible for an estimated 2.7% to 3.3% of global GHG emissions (Belkhir & Elmeligi, 2018; Lorincz, Capone, & Wu, 2019) [34]. Projections suggest that this figure could reach 7% by 2030 and potentially escalate to 15% by 2040, thereby positioning ICT as a rapidly growing and underrecognized contributor to climate change [35].

Digitalization of tourism leads to a series of significant social changes that have a substantial impact on cultural practices and social interaction. One of the key trends is the reduction in participation in physical cultural events. Online resources and virtual tours allow individuals to gain cultural experiences without physical presence, which is changing the habits of the younger generation. More and more, they opt for virtual tours and view exhibitions and museums online instead of attending real-life events. This results in a diminished emotional connection to cultural objects, as virtual tours cannot provide the same level of emotional engagement as in-person visits. Another important factor is the decline in face-to-face social interactions. Communication platforms, particularly social media and video calls, have replaced live interactions, which leads to a decrease in social activity and emotional connections between people. The lack of physical interaction with cultural objects leads to a more superficial perception of culture, which also reduces the depth of cultural experiences. Changes in content consumption habits, especially the increasing popularity of online resources among young people for viewing recorded cultural events or through social media, reduce the motivation to participate in live events or create personal cultural content. This shifts social norms, where digital access to culture begins to prevail over real cultural experiences, thereby diminishing the value of traditional cultural practices. Lastly, but no less importantly, there is a decrease in emotional engagement with cultural

events. Virtual technologies, such as VR and AR, while capable of creating visually captivating experiences, do not provide the same level of emotional interaction that physical attendance at cultural events offers. Therefore, while digital technologies make cultural content more accessible, they cannot replace the live experience, which is essential for deep emotional involvement.

3. Analysis of the level of digitalization in tourism in European countries

3.1. Research methodology

In the context of the technological revolution, digital tools have become an essential element in the development of tourism services. However, their application presents new social challenges and opportunities. European countries are actively adapting digital technologies to enhance the tourism experience, yet this process is accompanied by changes in people's behavior, an impact on social interactions, and new demands for digital literacy.

The analysis of the level of digitalization development was conducted based on the indices relevant as of 2024. This approach is justified by the fact that this year marked an important milestone in the development of technologies and the implementation of policies in European countries. In 2024, more stable trends emerged, allowing for the assessment of countries' achievements in digital infrastructure, innovation, and human capital in the post-pandemic period. Moreover, focusing on this year allows for taking into account the latest advancements in digitalization, particularly the intensive implementation of artificial intelligence across all sectors of economic activity. In this context, 2024 can be considered a cumulative year for the results of digitalization in countries, as it demonstrates the synergy of achievements from previous years and progress in key areas of digital transformation.

The assessment of the level of digitalization in countries was conducted using several indices: the Global Digitalization Index (GDI), Travel & Tourism Development Index (TTDI), World Competitive Digital Index, AI Preparedness Index (AIPI), Innovation and Economic Integration, ICT Development Index and Human Capital and Labor Market [36-41]. These indices comprehensively cover various aspects of digital development in countries, such as infrastructure, human capital, readiness for artificial intelligence implementation, and innovation. Using these indices allows for

the creation of a holistic view of the impact of digital technologies on tourism, taking into account various social and economic factors that are crucial for understanding the social consequences of digitalization in this field. The Global Digitalization Index evaluates countries based on 42 indicators that analyze the maturity of their digital infrastructure. The index covers four main areas: universal connectivity, digital foundation, green energy, and policies and ecosystems. The AI Preparedness Index and Human Capital and Labor Market allow for the evaluation of how prepared countries are to utilize intelligent technologies in tourism and whether they have the necessary qualified workforce for this work. The Digital Infrastructure Index helps assess the presence of digital infrastructure, which serves as the foundation for the development of digital tourism services. The TTDI assesses the level of tourism development in countries. The Innovation and Economic Integration indices help to understand how countries integrate into the global economy through innovation, which directly influences strategic planning in tourism. Meanwhile, the World Competitive Digital Index allows for an evaluation of how successfully countries compete on a global scale in terms of digital technologies. By utilizing these indices, an objective and comprehensive assessment can be made of how digitalization in tourism affects various social aspects. The selected indices for assessing the level of digitalization development in European countries are presented in Table 5:

Table 5

Indixes for assessing the level of digitalization development in European countries

K_1	Global Digitalization
K_2	Travel & Tourism Development
K_3	World Competitive Digital
K_4	AI Preparedness
K_5	Innovation and Economic Integration
K_6	ICT Development
K_7	Human Capital and Labor Market

Source: compiled by the author

Given the significant disparity in the level of digitalization across different regions of the world, the study focused exclusively on countries

within the European region. This choice was driven by the relative homogeneity of their development conditions, including widespread access to high-speed internet, well-developed digital infrastructure, and a high educational potential. Furthermore, for several countries outside the European Union, there is a lack of comprehensive data on key digitalization indices, making it impossible to conduct a representative analysis. Focusing on European countries allowed not only for data comparability but also for a more thorough examination of the social aspects of digital transformation within similar cultural-historical, socio-economic, and political contexts. In addition to the aforementioned reasons, the choice to analyze only European countries is also influenced by Ukraine's integration processes within the European community. Despite the current challenges caused by the war, Ukraine demonstrates significant potential in the context of digital transformation. During the second half of 2022, despite the ongoing conflict, Ukraine successfully managed to restore its tourism sector, which is evidence of the high level of development of its digital infrastructure. Thanks to the active implementation of digital technologies in tourism services and other economic sectors, the country was able to adapt to the new conditions, particularly through online services, booking platforms, and other tools that ensured the resilience of the industry.

The selection of 23 countries for analysis within the framework of the study on the level of digitalization is determined by the lack of data for a larger number of countries across all the presented indices. The list of countries selected for the analysis is provided in Table 6.

Table 6

European region countries

No.	Country name	No.	Country name	No.	Country name
C_1	Austria	C_9	Germany	C_17	Portugal
C_2	Belgium	C_10	Greece	C_18	Romania
C_3	Bulgaria	C_11	Hungary	C_19	Slovakia
C_4	Czech Republic	C_12	Ireland	C_21	Spain
C_5	Denmark	C_13	Italy	C_22	Sweden
C_6	Estonia	C_14	Lithuania	C_23	Turkey
C_7	Finland	C_15	Luxembourg	C_24	United Kingdom
C_8	France	C_16	Poland		

Source: compiled by the author

To obtain the final results of the analysis of the level of digitalization development in European countries, several methods were applied, including correlation analysis, VIF, regression modeling, principal component analysis (PCA) using the NIPALS algorithm, and cluster analysis. The relationships between the sub-indices of various digitalization indicators – such as GDI, TTDI, World Competitive Digital Index, AIPI, Innovation and Economic Integration, ICT Development Index, and Human Capital and Labor Market – were examined using Pearson and Spearman correlation matrices. The main goal of this stage was to assess the strength and direction of associations between variables before moving to further statistical modeling. The Pearson correlation matrix was used to identify linear relationships under the assumption of normal data distribution, while the Spearman matrix revealed monotonic relationships. Employing both correlation methods allowed for a comprehensive assessment of interdependencies among these indices. Since correlation analysis alone does not quantify the extent to which collinearity might distort model estimates, the results served as a necessary foundation for the subsequent variance inflation factor (VIF) analysis. This analysis helped evaluate potential multicollinearity among independent variables, as VIF enables assessment of the impact of collinearity for each variable individually rather than for the model as a whole. This made it possible to identify variables that could undermine model stability and provided valuable insight for further modeling. To further investigate the relationship between international digital standards and sustainable tourism development, PCA using the NIPALS algorithm was employed. This method makes it possible to extract the main latent factors that define interconnections between digitalization indices and international standards. Since the indices that evaluate digital infrastructure, innovation, and human capital are highly interrelated, PCA helped reduce data dimensionality while identifying key components that reflect the main trends in how digital technologies influence sustainable tourism. The NIPALS algorithm was chosen for its ability to efficiently handle incomplete data, which is a common challenge when analyzing digital indices across different countries. This ensured the derivation of generalized yet accurate conclusions regarding the role of digital standards in shaping sustainable development policies in the tourism sector. To classify countries by their level of digitalization, cluster

analysis was conducted. The k-means method identified groups of countries with similar digitalization profiles, enabling an evaluation of their digital technology implementation strategies. It also facilitated differentiation between countries by assessing key indicators such as internet access, ICT infrastructure development, innovation potential, and AI implementation. The optimal number of clusters was determined using the elbow method. The formation of four clusters was considered optimal for this analysis.

3.2. The results of the analysis of the digitalization level in European countries

A correlation analysis was conducted (Table 7) to assess the presence of linear relationships between the indicators.

Table 7

Correlations (Europe_digital_2024)
N=23

Variables	K_1	K_2	K_3	K_4	K_5	K_6	K_7
K_1	1,00						
K_2	0,05	1,00					
K_3	0,90	0,18	1,00				
K_4	0,84	0,13	0,88	1,00			
K_5	0,83	0,20	0,84	0,82	1,00		
K_6	0,58	0,17	0,72	0,88	0,63	1,00	
K_7	0,50	0,44	0,58	0,69	0,48	0,58	1,00

Note: The observed correlations are significant at the level $p<0.05$

Source: Author's calculations were performed using Statistica 12 software.

The results of the correlation analysis presented in Table 6 indicate that GDI (K_1) has a strong correlation with WCI (K_3) (r = 0.90), suggesting a direct impact of a country's level of digitalization on its overall competitiveness; AIPI (K_4) (r = 0.84) – the country's preparedness for the use of artificial intelligence is closely related to the overall level of digitalization; IEI (K_5) (r = 0.83) – the higher the level of digitalization, the greater the country's integration into innovation processes and the global economy. WCI (K_3) is strongly correlated with AIPI (K_4) (r = 0.88), confirming the importance of a country's readiness to adopt AI

technologies for its competitiveness; IEI (K_5) (r = 0.84) – innovation and economic integration are crucial components of high competitiveness. AIPI (K_4) has a strong correlation with DI (K_6) (r = 0.88), indicating that countries prepared for AI generally possess developed digital infrastructure. Moderate correlations (0.4–0.7) are observed between HCLM (K_7) and AIPI (K_4) (r = 0.69), indicating that AI preparedness is partially dependent on human capital qualifications; WCI (K_3) (r = 0.58) – the level of human capital development influences the country's competitiveness; DI (K_6) (r = 0.58) – developed digital infrastructure correlates with the level of skilled workforce.

Weak or nearly non-existent correlations (less than 0.4) are observed between TTDI (K_2) and HCLM (K_7) (r = 0.44), suggesting a moderate dependency of tourism development on the qualification level of the workforce; IEI (K_5) (r = 0.20) – tourism is less related to innovation and economic integration, reflecting its specific development dynamics. GDI (K_1) and TTDI (K_2) show virtually no correlation (r = 0.05), which may indicate that digital technologies are not yet a key factor in tourism development or their impact varies depending on the region.

Thus, two distinct groups of variables were identified:

– high interconnectivity group: K_1, K_3, K_4, K_5, K_6 (digitalization, competitiveness, AI readiness, innovation, and infrastructure). This confirms that digitalization contributes significantly to economic development, particularly by enhancing competitiveness, fostering the implementation of artificial intelligence, and improving digital infrastructure.

– low interconnectivity group: K_2 (TTDI) shows minimal correlation with the other indicators. This may indicate that the tourism sector follows its own developmental trajectory, relatively independent of digitalization and overall competitiveness.

Digitalization, competitiveness, innovation, and the development of digital infrastructure are closely interrelated, forming a unified cluster of economic growth factors. At the same time, the tourism sector (TTDI) demonstrates weak associations with the level of digitalization, pointing to its more autonomous development. These findings confirm that strategies aimed at enhancing competitiveness and driving digital transformation exert a comprehensive influence on economic growth; however, their impact on tourism appears to be more limited. The low correlation between the

TTDI and digital indexes may be explained by its multidimensional nature. The TTDI assesses tourism competitiveness across a wide range of factors. Since ICT is only one of the components of the TTDI, its influence may be diluted among other significant indicators. The low correlation between the TTDI and digital indexes also may be attributed to the fact that tourism competitiveness is a complex phenomenon, where digitalization plays an important, yet not exclusive, role.

To enhance the reliability of the results and to identify potential non-linear monotonic relationships between the variables, a Spearman rank correlation matrix was constructed. While Pearson's correlation coefficient is effective for assessing linear dependencies among variables, it is less sensitive to relationships that are non-linear or ordinal in nature. Considering that the TTDI (K_2) demonstrated weak or nearly no correlation with other digital and economic indicators in the Pearson matrix, the application of the Spearman coefficient is justified to detect potential hidden monotonic relationships that may not be revealed through linear analysis.

The results of the Spearman correlation analysis are presented in Table 8.

Table 8

Spearman's Correlation (Europe_digital_2024)
N=23

Variables	K_1	K_2	K_3	K_4	K_5	K_6	K_7
K_1	1,000000						
K_2	0,511122	1,000000					
K_3	0,877470	0,375680	1,000000				
K_4	0,831107	0,374877	0,866768	1,000000			
K_5	0,870361	0,636659	0,816785	0,803356	1,000000		
K_6	0,571038	0,205736	0,695023	0,886470	0,599384	1,000000	
K_7	0,488770	0,324836	0,575584	0,713341	0,507713	0,603538	1,000000

Note: The observed correlations are significant at the level $p<0.05$

Source: Author's calculations were performed using Statistica 12 software.

Table 7 demonstrates the presence of strong monotonic relationships between GDI (K_1) and WCI (K_3), as well as between IEI (K_5) and AIPI (K_4), confirming the importance of digitalization and innovation for competitiveness and readiness for artificial intelligence utilization.

On the other hand, TTDI (K_2) shows weak correlations with other indicators, suggesting the autonomous development of the tourism sector.

To further explore the interrelationships between variables and assess potential multicollinearity, Variance Inflation Factors (VIF) were calculated Table 9:

Table 9

Variance inflation factors (VIF) for independent variables

Variable	VIF	Interpretation
K_4	25.92	Very high multicollinearity. The value exceeds the critical threshold of 10, indicating a strong correlation other variables. Consider removing, transforming, or applying dimensionality reduction methods (PCA).
K_1	9.21	High multicollinearity. The value is close to the critical threshold (10), indicating a strong relationship with other variables.
K_3	8.23	Moderate to high multicollinearity. The index shows significant dependence on other variables, potentially complicating the interpretation of regression coefficients.
K_6	8.05	Moderate multicollinearity. This may result from high correlation with K_4 (AI Preparedness), which already has a very high VIF.
K_5	4.88	Acceptable level of multicollinearity. The value is below the critical threshold, and its influence on the model is minimal.
K_7	3.24	Low multicollinearity. The variable is stable in the context of regression analysis.
K_2	1.69	Very low multicollinearity. The influence on the distortion of regression results is virtually nonexistent. It is the most independent variable among the ones presented.

Source: Author's calculations were performed using Statistica 12 software.

Table 4 presents the results of the multicollinearity analysis, highlighting certain variables with elevated variance inflation factors (VIF), suggesting significant multicollinearity. Specifically, K_4 (VIF = 25.92), K_1 (VIF = 9.21), and K_3 (VIF = 8.23) demonstrate strong correlations with other predictors. These values exceed the critical threshold of 10, suggesting

the potential for further principal component analysis (PCA). The high VIF for K_4 is particularly notable, indicating strong correlation with other variables, particularly K_6 (VIF = 8.05), which also shows moderate to high multicollinearity. In contrast, variables K_5 (VIF = 4.88), K_7 (VIF = 3.24), and K_2 (VIF = 1.69) exhibit lower VIF values, indicating minimal multicollinearity.

For the data analysis, PCA was employed using the NIPALS Nonlinear Iterative Partial Least Squares algorithm. PCA facilitates data reduction by identifying dominant factors, which aligns with the research objective and enables handling complex indicators. The application of this algorithm preserved the majority of the data's variation, even when the initial variables were highly correlated, thus enhancing the interpretability and reliability of the results. The NIPALS algorithm was particularly beneficial in mitigating computational challenges, proving optimal when the number of observations exceeds the number of variables. The results of PCA are presented in Table 10:

Table 10

The results of PCA

83,0091% of sum of squares has been explained by all the extracted component						
Component	**R?X**	**R?X (Cumul.)**	**Eigenvalues**	**Q?**	**Limit**	**Q? (Cumul)**
1	1	0,668	0,668	4,676	0,555	0,182
2	2	0,162	0,830	1,135	-0,100	0,206

Source: Author's calculations were performed using Statistica 12 software

The Principal Component Analysis (PCA) identified two main components that explain 83.01% of the total variability in the data, indicating their high representativeness for the main structural patterns. The first component has an eigenvalue of 4.676, indicating its primary contribution to the variability and reflecting the main trend in the data. The second component, with an eigenvalue of 1.135, explains a smaller portion of the variability but still preserves important structure. Cumulatively, after the first component, 66.8% of the variability is explained, and after the second, 83.0%, demonstrating a high level of data generalization. The R?X correlation coefficient for the first component is 0.668,

indicating its significant role in explaining variability, while for the second component, it is 0.162, showing its smaller yet still important contribution. Regarding the Q? (Q? Cumul.) statistic, the first component explains 55.5% of the variability, and the second adds another 18.2%, highlighting their significance in retaining the main characteristics of the data. So, The PCA results indicate that for further analysis, focus can be placed on these two components, as they most effectively describe the data structure.

To evaluate the contribution of each variable to the components, their loadings were examined Table 11, offering a clear understanding of the relative importance of each variable within the overall model:

Table 11

Assessment of the importance of variables for the model

Variables	Variable number	Component 1	Component 2
K_1	1	0,886170	-0,263243
K_2	2	0,263653	0,909162
K_3	3	0,939782	-0,122600
K_4	4	0,969724	-0,103876
K_5	5	0,883144	-0,116296
K_6	6	0,831046	-0,014440
K_7	7	0,725716	0,446772

Source: Author's calculations were performed using Statistica 12 software

Table 10 show loadings for Component 1 indicate strong positive associations for K_1 (0.886), K_3 (0.940), K_4 (0.970), K_5 (0.883), and K_6 (0.831), highlighting their substantial contribution to the component structure. K_7 (0.726) shows a moderate association, while K_2 (0.264) demonstrates a weaker, yet still positive, relationship. Loadings for Component 2 reveal a strong positive contribution from K_2 (0.909) and a moderate one from K_7 (0.447). Negative but weak associations are observed for K_1 (–0.263), K_3 (–0.123), K_4 (–0.104), and K_5 (–0.116), while K_6 (–0.014) shows an almost negligible relationship with this component.

The first principal component demonstrates a strong association with indicators reflecting digital infrastructure, artificial intelligence readiness, innovation activity, and global indices of digitalization and competitiveness.

High loading values for variables such as the AI Preparedness Index, Global Digitalization Index, Competitiveness Index, and Innovation highlight the pivotal role of technological readiness and digital development in advancing tourism digitalization. From a sociological perspective, this reflects the growing demand for technologies within the industry, which transforms interactions between tourists and service providers. The second component is primarily driven by the Tourism Technology Development Index (TTDI), emphasizing its critical role in the digital transformation of the sector. Moderate associations with human capital and the labor market indicate the importance of workforce capacity in adapting to digital advancements. In a social context, this suggests a shift in consumption and communication patterns through the adoption of digital platforms and automated services. Overall, the digitalization of tourism is not merely a technological process but a catalyst for social change. It shapes new consumer behavior models, influences social mobility, and redefines interaction patterns within the globalized tourism landscape.

The relative importance of each variable was quantified to determine their contribution to the overall model structure Table 12:

Table 12

Importance of variables in the formation of Principal Components

Var	Var. number	Power	Importance
C_1	4	0,950512	1
C_2	3	0,897487	2
C_3	2	0,895569	3
C_4	1	0,853353	4
C_5	5	0,792866	5
C_6	7	0,729770	6
C_7	6	0,691082	7

Source: Author's calculations were performed using Statistica 12 software

Table 11 show K_1 (Global Digitalization Index), importance: 0.950512 (rank 1), emerged as the most influential variable, underscoring the critical role of global digitalization in shaping tourism digitalization processes. K_2 (TTDI), 0.897487 (rank 2), further confirmed the relevance of technological advancement in the sector. K_3 (World Competitive

Index), 0.895569 (rank 3), highlighted the importance of international competitiveness. K_4 (AI Preparedness Index), 0.853353 (rank 4), emphasized the necessity of readiness for AI integration. K_5 (Innovation and Economic Integration), 0.792866 (rank 5), reflected the role of innovation and economic cohesion. K_6 (Digital Infrastructure), 0.729770 (rank 6), demonstrated the foundational function of digital infrastructure in supporting technological progress. K_7 (Human Capital and Labor Market), 0.691082 (rank 7), although less dominant, still indicated the relevance of human capital in the digital transformation of tourism.

The Global Digitalization Index (K_1) emerges as the leading driver of the digital transformation within the tourism sector, highlighting the critical role of global digital processes in the modernization of the industry. Technological and innovation-related indicators (K_2, K_3, K_4) also exert a significant influence on the digitalization of tourism. In particular, the importance of the Artificial Intelligence Preparedness Index and the Tourism Technology Index underscores the strong interconnection between technological advancement and the functioning of the tourism sector. Although digital infrastructure (K_6) and human capital (K_7) demonstrate comparatively lower importance scores, they remain relevant components in the digitalization process, albeit with a more moderate impact relative to dominant macro-level technological factors.

In order to identify groups of countries with similar levels of digital development, a cluster analysis was conducted, allowing for the identification of homogeneous clusters based on digitalization characteristics Table 13:

Table 13

Clustering of Countries Based on the Level of Digitalization

Cluster	Countries
Cluster 1	Denmark, Finland, Germany, Sweden
Cluster 2	Czech Republic, Italy, Lithuania, Portugal, Spain
Cluster 3	Bulgaria, Greece, Hungary, Poland, Romania, Turkey
Cluster 4	Austria, Belgium, Estonia, France, Ireland, Luxembourg, United Kingdom

Source: Author's calculations were performed using Statistica 12 software

The clustering results reveal four distinct groups of European countries that differ in terms of digitalization and its sociological implications for the tourism sector. Cluster 1: Denmark, Finland, Germany, Sweden.

These countries exhibit a high level of tourism digitalization, resulting in significant social changes. In Sweden, for example, digitalization has transformed business models of travel agencies, influencing employment patterns and customer interaction strategies. In Germany, the integration of digital technologies into tourism supports sustainable tourism development and fosters community participation in tourism initiatives.

Cluster 2: Czech Republic, Italy, Lithuania, Portugal, Spain. Digital transformation in these countries also yields notable social impacts. In Italy, it has played a key role in revitalizing the tourism sector post-pandemic, enhancing user experience and promoting sustainability. In Portugal, cities like Matosinhos have embraced digital platforms to promote local gastronomy and sustainable tourism, preserving cultural heritage and encouraging community engagement.

Cluster 3: Bulgaria, Greece, Hungary, Poland, Romania, Turkey. These countries actively deploy digital tools to enhance tourism resilience and community involvement. In Greece, European Commission support is facilitating a more sustainable and digital tourism ecosystem, including the empowerment of local businesses and community-based tourism management. In Romania, workshops on tourism digitalization have improved the digital literacy of local enterprises and communities, helping them adapt to the demands of the modern tourism market.

Cluster 4: Austria, Belgium, Estonia, France, Ireland, Luxembourg, United Kingdom. Tourism digitalization in these countries is strongly linked to smart tourism development and active civic participation. In Linz, Austria, innovative digital solutions have enhanced the tourist experience and engaged local residents in tourism initiatives. Estonia's advanced e-governance infrastructure supports efficient tourism management and facilitates citizen involvement in decision-making.

Thus, it can be concluded that in countries with a higher level of digitalization, the social impacts of digital transformation are more pronounced. This is manifested in the growing digital interaction between tourists and service providers, the active use of smart technologies, changes in consumer behavior patterns, and the emergence of new forms of social mobility. Therefore, digitalization not only accelerates the innovative development of the tourism sector but also significantly influences the social structure of relationships within the industry.

4. Conclusions

The results of the conducted study confirm the key role of digitalization in the transformation of the tourism industry, influencing its economic and social processes. Digitalization in tourism has become a key factor that has transformed not only the economic but also the social processes within the industry. It has influenced consumer behavior, service organization, and social mobility. The application of innovative technologies significantly transforms the tourism experience, while the pandemic and geopolitical changes have shifted the choice of travel destinations.

Digitalization reduces participation in physical cultural events and changes social norms, creating new forms of interaction through virtual tours and online exhibitions. At the same time, it has a significant environmental impact due to increased energy consumption by online platforms, which contributes to the carbon footprint. It also leads to changes in emotional engagement with cultural objects. It is essential to maintain a balance between digital and traditional cultural practices to preserve the authenticity of the experience.

The results of the conducted study confirm that digitalization plays a key role in the transformation of the tourism sector, influencing both its economic indicators and social dynamics. The application of the Principal Component Analysis (PCA) method enabled the identification of the most influential drivers of digital development, among which the Global Digitalization Index, AI preparedness, innovation capacity, and global competitiveness showed the highest significance. Cluster analysis allowed the classification of European countries into four groups based on their level of digital maturity. It was revealed that countries with high levels of digitalization (e.g., Denmark, Finland, Sweden) demonstrate more pronounced social effects of digital transformation, including increased digital interaction between tourists and service providers, shifts in consumer behavior patterns, and the emergence of new forms of social mobility. In contrast, countries with moderate or low levels of digital integration exhibit fragmented implementation of digital tools, indicating the need for stronger digital policy frameworks and further development of digital infrastructure.

Therefore, digitalization not only acts as a catalyst for innovation in the tourism sector but also significantly transforms the social relationships

within it, reshaping the roles and behaviors of both consumers and service providers. Future research should focus on exploring the impact of digital practices on inclusiveness, employment, and the quality of the tourism experience within the framework of sustainable development.

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