

THE ROLE OF INNOVATIVE TECHNOLOGIES IN TOURISM - A BENCHMARKING ANALYSIS OF CROATIA, GREECE, ITALY AND SPAIN

Abstract

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Purpose – The purpose of this research is to understand the role and importance of innovative technologies in stimulating tourism and economy, particularly in tourism-orientated Mediterranean economies of the European Union such as Croatia, Spain, Italy and Greece.

Methodology – The research uses a benchmarking analysis to analyse the role of information and communication technologies (ICT) in tourism economies. It combines quantitative and comparative methods to analyse economic and digital indicators from 2015 to 2023, using a benchmarking analysis to examine changes in economies and the degree of digital integration and its role on tourism.

Findings – Innovative technologies are significantly influencing consumer behaviour in tourism. These technologies improve the user experience, simplify processes and open up new sources of revenue. Countries that place a higher value on ICT activities in the domestic market use ICT technologies more intensively in tourism. The results show that countries with higher ICT activities also achieve a positive trend in increasing overall tourism competitiveness.

Contribution – This study contributes to the understanding of the role of technological advances on tourism and contribute to a deeper understanding of the differences in digitalization levels among the observed Mediterranean destinations. It provides a foundation for further analysis of the dynamics of digital transformation and its impact on the competitiveness of tourism destinations, offering insights for the practical application of these findings in future development strategies.

Keywords Innovative technologies, tourism, Mediterranean economies, benchmarking analysis

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INTRODUCTION

With globalisation, digital technologies have become an important aspect of today's world, as they facilitate the rapid performance of tasks and reduce costs. At the same time, they are key factors for long-term economic growth (Efikasi & Ahmed, 2024). Digital technology enables greater efficiency in the use of resources, reduces costs and opens up new opportunities for growth through better communication, process optimisation and the promotion of innovation. The technological changes associated with the digital economy are having a significant impact on inflation, wages, labour markets and production, while global technological development is becoming one of the fastest growing aspects of industry today (Ahmed, 2024; Asongu et al., 2023; Chiarini & Kumar, 2023; Freund et al., 2021; Nial, 2021).

The tourism sector was one of the first to experience a revolution with the development of information and communication technology and was among the first to begin digital transition and the transformation of business processes (Buhalis & Law, 2008). Tourism is currently facing new challenges driven by Industry 4.0. Innovative technologies are transforming the tourism industry and defining some new tourism offerings through personalised experiences, increasing business efficiency (Buhalis et al., 2023; Zhang & Szabó, 2024). Although there is no general consensus on the most important technologies related to Industry 4.0, some of the most common technologies can be found in the scientific literature: artificial intelligence (AI) and autonomous robots, blockchain, simulation, Internet of Things (IoT), cybersecurity, cloud, additive manufacturing, augmented reality (AR) and big data analytics (Rodrigues et al., 2024). Digital technologies, especially the development of the internet and mobile communication devices, have greatly changed production and consumption patterns in the tourism sector. Internet platforms, social networks and smartphones have redefined the interaction between service providers and users, enabling two-way communication, rapid information exchange and the personalisation of services in real time (Buhalis & Law, 2008; Bilan, Tovmasyan & Dallakyan, 2023). This digital convergence has created the foundations for a new market dynamic where continuous investment in technology enables companies not only to maintain their competitiveness but also to adapt quickly to changes in consumer behaviour (Bethapudi, 2013).

The purpose of this research is to understand the role and importance of innovative technologies in stimulating tourism and the economy. For the benchmarking analysis, Croatia and its competitive Mediterranean economies within the European Union (Greece, Italy and Spain) were selected. These four countries were chosen because they represent Croatia's main competitors in the field of receptive tourism, i.e., the leading Mediterranean receptive tourism economies within the EU.

The research focuses on the integration of innovative technologies in the tourism sector and their role in both tourism and the economy. Based on the above, the main objectives of the research are as follows: (1) to investigate the role of innovative technologies in shaping tourism; (2) to describe digital technologies and determine how they can improve business efficiency and reduce operational costs in the tourism sector; (3) to examine how digital technologies can provide personalized experiences

to tourists; (4) to conduct a benchmarking analysis of the implementation of digital technologies in different tourism economies, specifically analyzing countries such as Croatia, Greece, Italy, and Spain in the period from 2015 to 2023, depending on the availability of specific data. In future research, the analysis could be expanded to include a broader group of EU countries, which may offer additional insights into the comparative development of innovative tourism economies.

The paper is structured into three interconnected parts, aside from the introduction and conclusion. The first part explores various innovative technologies and their role in tourism and reviews previous research on technology, tourism, and economy, while the second part outlines the research methodology. The third part presents a benchmarking analysis of the role of ICT technologies in the tourism economies of Croatia, Greece, Italy, and Spain. The conclusion discusses the research results and provides a summary of the entire research.

1. AN OVERVIEW OF INNOVATIVE TECHNOLOGIES IN TOURISM

In the travel and tourism industry, innovative technologies are critical to their business because they improve the customer experience, promote customer loyalty and help companies understand market trends and customer behaviour, leading to better marketing strategies (Buhalis & Law, 2008; Sigala, 2003). Companies that do not follow the latest trends in tourism technology risk losing a competitive advantage and having disappointed customers who expect a certain level of service and remain disappointed when their expectations are not met (Loureiro, Guerreiro, & Ali, 2020). Although innovative technologies are now a strategic resource for any business, Buhalis et al. (2019) emphasise that innovative technologies in tourism are not the core of the service, but rather a means to deliver services to the customer.

Artificial intelligence (AI), described as a machine-based system that exhibits aspects of human intelligence, is increasingly used today and is an important source of innovation (Bulchand-Gidumal et al., 2024, Huang et al., 2019). It is defined as a knowledge-based system that uses algorithms to derive how to generate outcomes such as predictions, content, recommendations or decisions that can influence physical or virtual environments (OECD, 2024). The integration of AI in the tourism sector enables the personalisation of user experiences based on the analysis of their preferences, making tourism efficient and environmentally sustainable (Siddik et al., 2024). Kim et al. (2024) point out that AI reduces the operating costs of companies, while Tapaya et al. (2024) emphasise the long-term impact of AI on both economic performance and customer satisfaction in tourism. AI is evolving alongside other technologies in tourism, such as virtual and augmented reality, robotics and blockchain technology (OECD, 2024).

Virtual and augmented reality (VR/AR) and other interactive and immersive technologies such as extended reality (XR) and mixed reality (MR) are becoming increasingly popular to enhance the tourist experience (Loureiro, et al., 2020). AR places digitally created content in the user's real environment, while VR integrates the user into the virtual world for a fully immersive experience (Rauscher et al., (2020). MR can be a combination of AR and VR technology, while XR summarises all of the aforementioned technologies. Users of VR headsets can get to know the destination they want to visit before they arrive, walk through interesting places, see the hotel they will stay in and virtually participate in the tourist offer of the destination (Rauschnabel et al., 2022; Yung & Khoo-Lattimore, 2017). In this way, these technologies reduce the need for physical presence and contribute to the competitiveness and sustainability of the tourist destination and make the offer more attractive (Tussyadiah et al., 2017).

One of the most important innovations in modern tourism is the introduction of *blockchain technology (BT)*, which is significantly changing the way data is exchanged between market participants. Instead of traditional models with numerous intermediaries, BT enables direct and secure communication between users, reducing costs and increasing transparency. It is based on a decentralised data storage system where all transactions are predetermined and confirmed by multiple parties. Such an approach effectively eliminates the possibility of errors and ensures the permanence of records, as all data is stored in immutable databases (Satpute, 2024).

BT has the ability to reshape the way the travel industry evolves by providing integrated and seamless experiences for travellers (Khan et al., 2017). In the field of tourism, BT is used as an important tool for more efficient supply chain management, reservations and ticket sales, especially in air travel, and cryptocurrency payments for residents and tourists (Treiblmaier, 2020; Kurgun et al., 2023; Filimonau & Naumova, 2019). By implementing smart contracts, hotels can use BT to manage hotel keys (Satpute, 2024). BT can also be used in attracting and retaining customers as part of loyalty programmes and personalised marketing by ensuring transparency, giving customers control and gaining their trust to participate in blockchain-powered loyalty programmes (Bhattacharya et al., 2024).

When it comes to the tourism sector, *big data analytics* is the easiest way to better understand the wishes and needs of tourists, analyse the current market situation and automate some work processes (Belias et al., 2021). Typically, this data is about predicting customer demand, personalising services, marketing and optimising pricing strategies. Combined with AI technology, they can identify behavioural patterns based on travel history and predict future consumer behaviour (Mariani, 2020; Agrawal et al., 2022) it is also possible to manage revenue, calculate and predict occupancy more accurately based on current market trends and thus be less exposed to the risk of unexpected costs (Xiang & Fesenmaier, 2017). Big data also has a major impact on

the viability of tourism, as we can use it to manage resources more intelligently, optimise visitor flows and reduce the negative impact of tourism on the environment (Agrawal et al., 2022).

The abbreviation IoT is often used for the *Internet of Things* and includes all things that are connected to the Internet or equipped with an Internet connection to receive and send data, which is why they are often referred to as “smart” (Mercan et al., 2020; Novera et al., 2022). The IoT represent devices with the purpose of efficient data transmission using 5G technology and intelligent data processing based on AI technology (Wang et al., 2020). Although the IoT is also used in other industries, the tourism industry is already a pioneer when it comes to investing in the IoT (Car, et al., 2019). This technology enables further automation of business processes, greater personalisation of services and easier execution of everyday tasks in hotel operations or travel agencies (Mercan et al., 2020). The authors of Novera et al. (2022) emphasise that the use of IoT can achieve numerous savings in the form of more rational energy use in business facilities and give guests more control and access to information via mobile devices.

A *chatbot* is an intelligent device from the field of AI that has been specially developed to answer user enquiries (Dash & Bakshi, 2019). The main advantage of chatbots is that they are available to their users 24 hours a day so that users can receive the services they require (Brandtzaeg & Følstad, 2017;). As the development of innovative technologies represented by *service robots* continues to accelerate, their popularity is growing, especially in the tourism and hotel industries (Zhang et al., 2023; Carter et al., 2019; Ivanov et al., 2017). Due to increasing consumer demands, tourism and the hotel industry are currently facing the challenge of improving the quality of services, which is why the use of robots has become almost commonplace. Thus, everything from intelligent chatbots to assistance robots can be found in this sector, which have a major impact on the improved guest experience (Ivanov & Webster, 2020). The benefits of using this technology are lower costs, higher speed and automation. Self-service options and a simplified check-in and check-out process for guests increase convenience for guests and employees alike.

Applications that offer various services related to location information are also referred to as location-based services. Their goal is to accurately identify all elements related to a destination - including visitors, services, facilities and attractions (Kumar et al., 2023). The *geolocation service* is experiencing exceptional growth thanks to increasingly advanced hardware and software development and increased consumer demand. The market for GPS tracking devices continues to grow and consequently influence the transformation of the tourism industry (Ivanochko et al., 2021). For travellers, new opportunities such as real-time location, mobile applications with up-to-date information on transportation, attractions, events and places to stay and eat are changing the way they access information, make plans and create new experiences (Sarasa-Cabezuelo, 2023). This technology can also help tourism businesses make informed decisions about marketing, services and infrastructure.

The use of *drones* (Unmanned Aerial Vehicles – UAV) in tourism is a challenging trend where tourists use drones to record aerial photographs of certain destination attractions to increase the online visibility of places by publishing them on various social networks. The contemporary trend in mass tourist behaviour is to replace cameras with digital devices (Berbeka, 2022). Drones can be seen more and more frequently at various tourist destinations, which has certainly changed the way tourism works (Ritter, 2023). In addition, drones can be used for surveillance to protect property and tourists in certain tourist locations, which contributes to the safety of the tourist destination and the tourists themselves (Ko & Song, 2021). In addition to advertising tourism offers, drones can also be used for virtual travel. As a virtual traveller, you can visit the world's most famous sights from the comfort of your own home. As this technology develops faster and faster and offers new applications for tourism, its impact on tourism is expected to be even greater.

Academic literature dealing with the relationship between informatisation, tourism and economic development is still relatively scarce. To measure the strength and direction of the reciprocal relationship between tourism, regional economy and information industry, Zhou and Chen (2021) have developed an indicator known as the TRI system (Tourism-Regional economy-Information industry index). Tourism and the Internet have a direct and indirect impact on growth because they complement other sectors of the economy. However, their impact may vary depending on the level of development of the economy (Haini, 2020). Innovative technologies, especially ICT technologies, play a key role in the development of tourism and economic growth, as confirmed by the example of the research conducted by Audina, Yuliana and Kartiasih (2024) using the example of Indonesia from 2015 to 2021 using panel data regression analysis. Internet access, digital connectivity, foreign investment and improved hotel services have a positive impact on regional gross domestic product and overall economic stability. Therefore, it is important to ensure an even development of digital infrastructure and technological innovations that can improve the competitiveness of the tourism sector and strengthen economic development.

The tourism sector can act as a driving force for the development of the information industry, particularly through the application of modern technologies and the creation of a stimulating development environment. At the same time, the expansion of tourism has a positive impact on economic indicators, as it contributes to the creation of new jobs, the development of infrastructure and the stimulation of growth in related industries. Tourism thus contributes directly and indirectly to the sustainable development of the local economy and society. On the other hand, the information industry strongly influences tourism through the development of the concept of smart tourism, innovations in marketing, the display of relevant data and the rapid dissemination of information. Wang et al. (2016) used methods such as the comprehensive evaluation function, efficiency function and coordination level analysis to investigate the relationship between tourism development and informatisation in Chinese provinces. The results showed that

regions with more developed IT infrastructure also have greater economic concentration. In more developed areas, a stronger link between tourism and informatisation was observed, with the key factors influencing this relationship being the level of economic development, technological endowment, availability of resources and demographic characteristics of each province.

All these studies show how innovative technologies are shaping tourism and playing an essential role in economy, and emphasise the need for further research and adaptation within the industry.

Some of the most important innovative technologies for promoting tourism and economy are listed in the following table.

Table 1: **Classification of emerging innovative technologies in tourism: functional applications**

Technology	Application in Tourism	Source
Artificial Intelligence (AI)	personalization of services, predictive analytics, automation	Bulchand-Gidumal et al. (2024), Huang et al. (2018), Siddik et al. (2024), Kim et al. (2024), Tapaya et al. (2024)
Virtual and Augmented Reality (VR/AR)	Virtual tours, user engagement, pre-trip decision support	Loureiro, et al. (2020), Rauscher et al. (2020), Rauschnabel et al. (2022), Yung & Khoo-Lattimore (2017), Tussyadiah et al. (2017)
Blockchain	Secure transactions, digital identity management	Satpute (2024), Khan et al. (2017), Treiblmaier (2020), Kurgun et al. (2023), Filimonau & Naumova (2019), Bhattacharya et al. (2024)
Big Data Analytics	Customer behavior analysis, service optimization	Belias et al. (2021), Mariani (2020), Agrawal et al. (2022), Xiang & Fesenmaier (2017), Agrawal et al. (2022)
Internet of Things (IoT)	Automation, device connectivity, smart hotel rooms	Mercan et al. (2020), Novera et al. (2022), Wang et al. (2020), Car et al. (2019), Mercan et al. (2020)
Chatbots, Service Robots	Real-time communication, 24/7 customer support and assistance Hotel and restaurant service, staff substitution	Dash & Bakshi (2019), Brandtzaeg & Følstad (2017), Zhang et al. (2023), Carter et al. (2019), Ivanov et al. (2017), Ivanov & Webster (2020)
Geolocation Services	Navigation, location-based promotions and content	Kumar et al. (2023), Ivanochko et al. (2021), Sarasa-Cabezuelo (2023)
Unmanned aerial vehicle (UAV)	Aerial imagery, delivery, safety monitoring	Berbeka (2022), Ritter (2023), Ko & Song (2021)

Note: The applications of each technology in tourism listed in this table were selected based on two main criteria: (1) their frequency of appearance in recent and relevant literature, and (2) their practical significance for receptive tourism destinations. This approach ensures that the selected applications represent both widely recognized and operationally important uses of innovative technologies within the tourism sector.

Source: created by authors

2. METHODOLOGY

This research adopts a benchmarking analysis to evaluate the role of ICT technologies in shaping the tourism economies of Croatia, Greece, Italy, and Spain from 2015 to 2023. This period was selected due to: (i) data availability, (ii) the scope of this particular research, and (iii) the noticeable intensification of investments in the field of IT technologies over the past decade. The methodology integrates quantitative and comparative approaches to assess the economic structure, digitalisation level, and tourism competitiveness of these countries. The primary sources of data include gross value added (GVA) for economic structure benchmarking, the Digital Economy and Society Index (DESI) for assessing the digital transformation of economies, and the Travel and Tourism Development Index (TTDI), which measures tourism competitiveness and ICT readiness. The data were collected from available official sources, including Eurostat, the European Commission, and the World Economic Forum databases. All data processing and analysis were performed using Microsoft Excel.

The analysis is carried out in three phases:

Phase One: Economic structure benchmarking – This phase compares the gross value added (GVA) by sector in the observed countries, focusing on the dynamic growth of the ICT sector relative to other industries. This allows for an understanding of the economic changes and digital sector development over time.

Phase Two: Digitalisation assessment – In this phase, the integration of ICT technologies into the tourism sector is evaluated using the DESI index. The aim is to determine how well these countries have adopted digital tools within their tourism industries, taking into account factors such as digital connectivity, infrastructure, and innovation.

Phase Three: Competitiveness analysis – Using the TTDI, this phase assesses the tourism sector's competitiveness and its connection to ICT integration. The analysis seeks to understand if the implementation of digital technologies influences the competitiveness of tourism destinations.

The research is guided by the following research questions:

RQ1: Which innovative technologies are most frequently used in tourism, and what benefits do they offer to the tourism market?

RQ1: Do economies with growing production in ICT-related activities exhibit greater competitiveness and overall economic results?

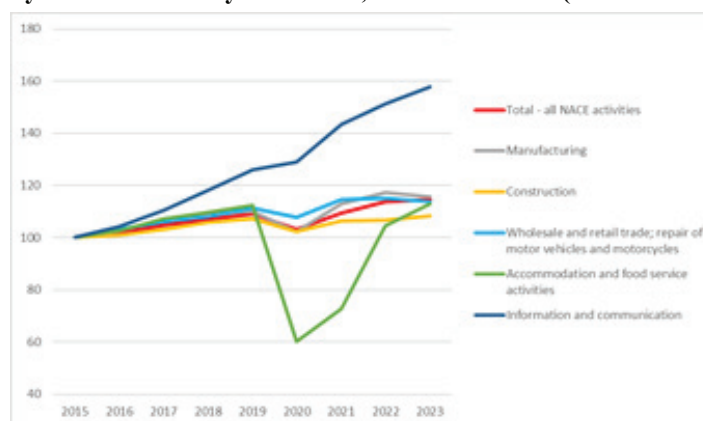
The methodological approach is designed to offer both a comprehensive understanding of the impact of digitalisation on tourism economies and comparative insights into how different countries have adopted ICT in the tourism sector. While the research aims to provide significant theoretical contributions, it also recognizes the limitations of using secondary data sources and the absence of empirical testing, which will be addressed in future studies through more in-depth empirical validation and case studies.

3. BENCHMARKING OF SELECTED MEDITERANEAN ECONOMIES ACCORDING TO THE IMPORTANCE OF ICT TECHNOLOGIES – RESULTS AND DISCUSSION

The EU economy recorded growing indicators in the period 2015-2023. By observing the development of total gross value added and individual activities, significant deviations in individual activities become apparent. Total gross value added increased by 15% during this period. All selected activities showed positive values, except during the pandemic, when the highest negative decline rates were recorded for the activity of accommodation and food service.

Over the period as a whole, the information and communication activity recorded the highest growth with an increase in gross value added of 58%, followed by manufacturing with 16%, wholesale and retail with 14%, accommodation and food service with 13% and construction with 8%. The above comments confirm the fact that the dynamics of ICT activities are significantly faster than those of all other activities at EU level.

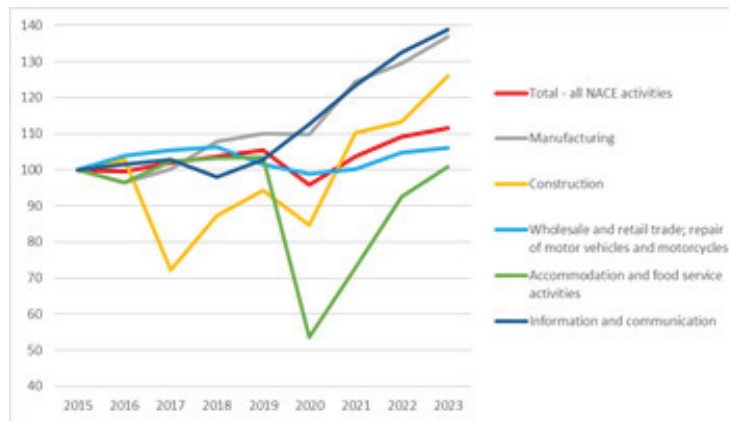
Figure 1: Gross value added by detailed industry 2015-2023, Index 2015=100 (NACE Rev.2)



Source: created by authors (Eurostat, Database: nama_10_a64)

Are there significant differences in the economic structure of the competitive tourist countries Croatia, Greece, Italy and Spain? Selected economic activities according to NACE Rev. 2 were analysed to identify similarities and differences in economic production by economic activity in the period 2015-2023. To what extent is the importance of ICT activities emphasised in each tourist country and are there differences in relation to accommodation and food service activities and other activities during the observed period. To what extent have tourist countries recognised the importance of ICT technologies and integrated them into their national markets?

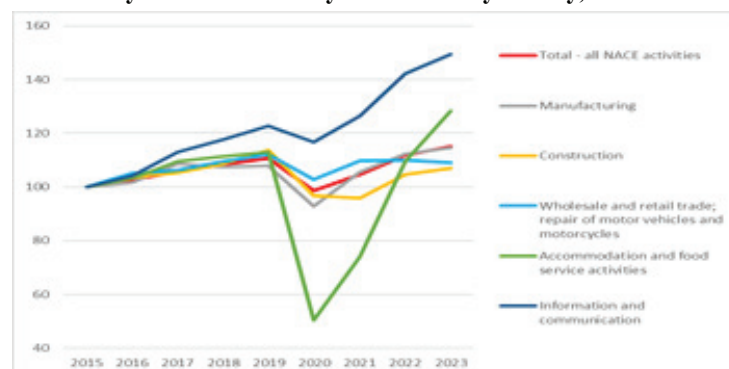
Figure 2: Greece – Gross value added by detailed industry 2015-2023 by county, Index 2015=100



Source: created by authors (Eurostat, Database: nama_10_a64)

The dynamics of gross value added in industry in Greece differ in comparison to the EU-27. The overall economy grew by 12% in the period 2015-2023, which is lower than the EU average. In Greece, the ICT activity recorded the highest growth at 39%, which is lower than in the EU-27. The increase in the manufacturing activity was exceptionally high at 37%, compared to the EU-27, where it was 16%. The development of the accommodation and food activities, which is important for tourism, shows a similar susceptibility to the pandemic in the period 2019-2021. The recovery was slower than in the EU-27. 1% more gross value added was generated in 2023 than in 2015, while the same indicator was 13% in the EU-27. Large deviations can be observed in the construction activity, where an increase of 8% was achieved with large fluctuations over the entire period. In the area of information technologies, Greece ranks third among the countries observed and is therefore above the EU-27 average.

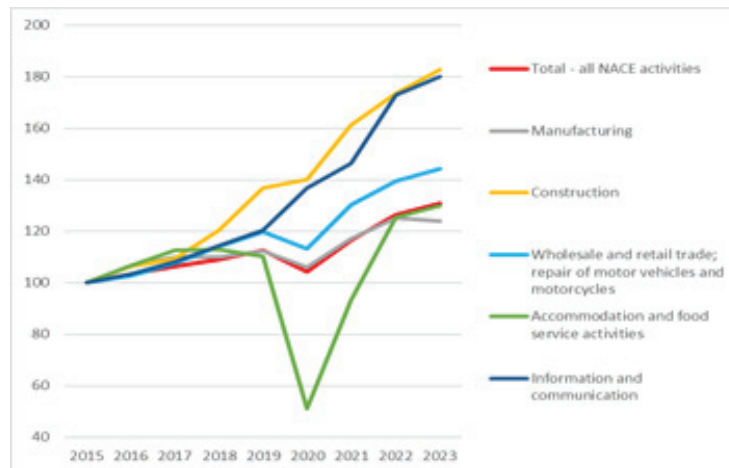
Figure 3: Spain - Gross value added by detailed industry 2015-2023 by county, Index 2015=100



Source: created by authors (Eurostat, Database: nama_10_a64)

As the leading tourist country among the Mediterranean destinations observed, Spain shows a similar dynamic to the EU-27. Total gross value added increased by 15% in the period 2015-2023 as in the EU-27. The manufacturing and construction sectors achieved the same growth rates of 15 and 7% respectively, while wholesale and retail recorded slightly lower growth of 9%. The accommodation and food service activity recorded a significantly faster and stronger recovery than the EU-27 and Greece, achieving an increase of 28%. The largest increase was achieved in the information and communication activity and totalled 49%. Spain shows similar dynamics to the EU-27 and all activities of the economy recorded a decline in activity in 2019-2020, followed by a recovery to a higher level than in 2015. In information technologies, Spain ranks second place among the countries observed and above the EU-27 average.

Figure 4: Croatia – Gross value added by detailed industry 2015-2023 by county, Index 2015=100



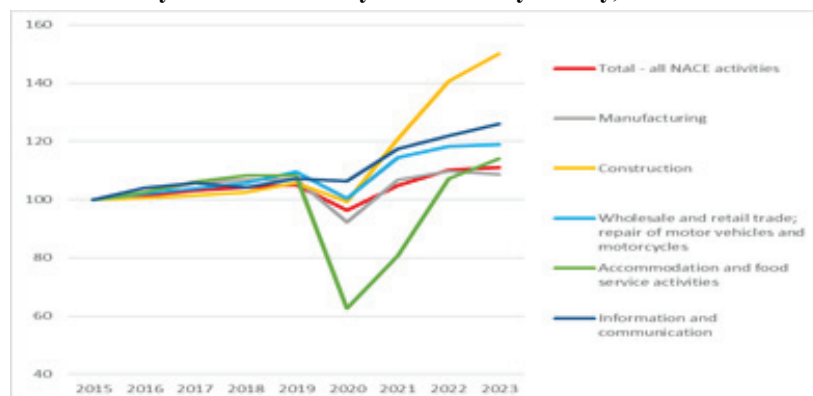
Source: created by authors (Eurostat, Database: nama_10_a64)

The Croatian economy has achieved the best results compared to the EU-27 and competing tourist destinations according to the analysed indicators. The graph shows strong dynamic and a rapid recovery after the slowdown in 2019-2020. As in other countries, the highest growth rate of 80% was achieved in the information and communication activity. An even higher rate was achieved in construction at a high 83%, mainly due to the EU reconstruction programme and public projects following the earthquake. The accommodation and food service activity recorded an increase of 30%, which is a better result than in Spain. An extremely high increase of 44% was achieved in wholesale and retail. In information technologies, Croatia ranks first among the countries surveyed and above the EU-27 average.

The following is a benchmarking analysis of the implementation of information technologies using the Digital Economy and Society Index (DESI), which monitors the level of digitalisation at EU level and in line with the policy of the EU Europe Digital Decade programme, with the aim of promoting selected information technology development that supports sustainable economic development for all EU economies. The DESI index provides an assessment of the overall digital maturity of economies; however, it lacks indicators that capture the specific level of digital implementation within the tourism sector.

This research, the periodic evolution of the DESI for the period 2017-2022 is presented for the EU-27 and selected inbound tourism economies – Croatia, Greece, Italy and Spain. The development of the overall indicator and the integration of digital technology based on the Digital Intensity indicator was analysed. According to the DESI index, all countries had a positive growing trend with similar dynamics. According to the results, the most digitally developed country is Spain, which achieved an increase from 40.5 in 2017 to 60.8 in 2022. In second place is the EU-27, which had an increase from 33.7 to 52.3. The index level is approximately the same for Italy and Croatia, which achieved an increase from 29 to approximately 48 in 2022. The weakest results, i.e. the level of digitalization, are in Greece, which had a significant increase from 22.4 to 38.9 in 2022.

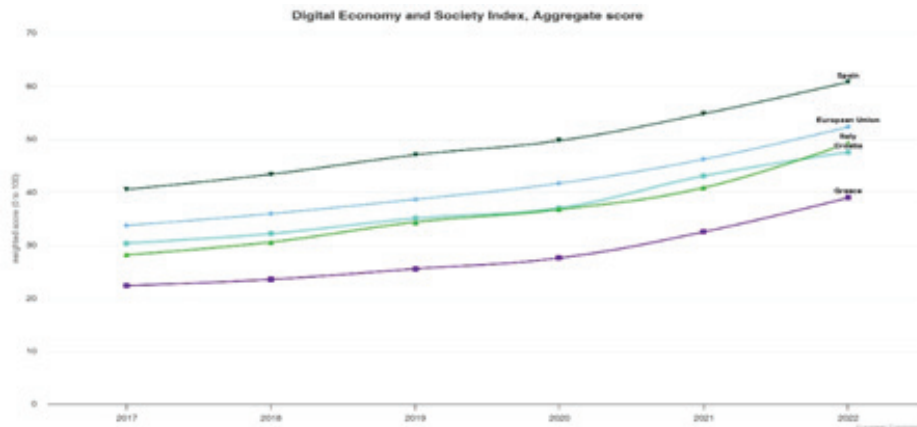
Figure 5: Italy – Gross value added by detailed industry 2015-2023 by county, Index 2015=100



Source: created by authors (Eurostat, Database: nama_10_a64)

Italy shows a similar dynamic to other EU-27 countries with certain deviations. This primarily refers to the importance of information and communication activities, which are lagging behind the most compared to other countries. This area has only increased by 26% in Italy, which is the weakest result of all countries. Similarly to Croatia, construction activity is very active due to a series of incentives and facilities granted by the government for the renovation of facades and houses in Italy. Wholesale and retail is in third place with an increase of 19%. The accommodation and food service activity grew by 14%, which is on a par with the EU-27. In terms of information technologies, Italy ranks fourth among the countries surveyed and is therefore below the EU-27 average.

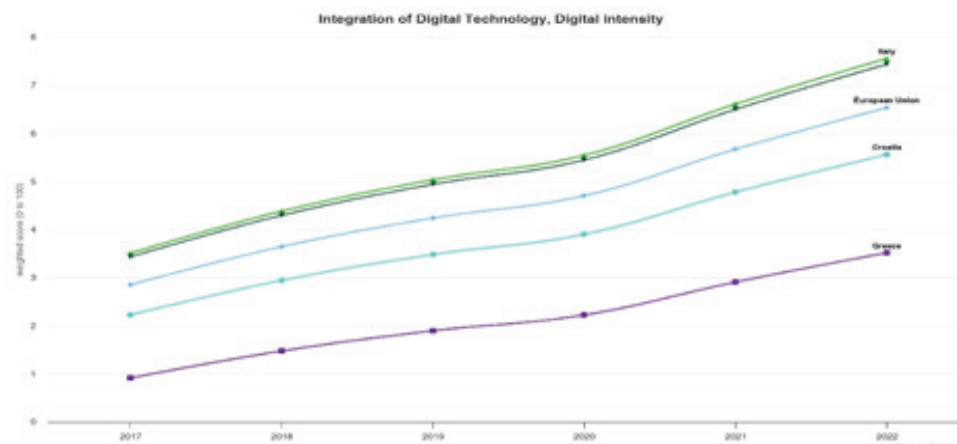
Figure 6: Digital Economy and Society Index 2017-2022



Source: created by authors (European Commission. Digital Decade DESI visualisation tools)

The index of digital technology integration was analysed, which shows that Spain and Italy have achieved extremely high levels of integration throughout the five years; there was an increase from around 3.5 to 7.5 in 2022. This is followed by the EU-27, where growth from 2.9 to 6.5 was achieved. Croatia is in fourth place with an increase in digitalisation from 2.2 to 5.6, as is Greece, which achieved an increase from 0.92 to 3.52. It can therefore be concluded that, according to the DESI index, all the economies analysed are showing positive growth trends in the implementation of digital technologies, which will have a positive impact on tourism and tourist consumption. It is an element of the tourist offer that must be satisfied and that is increasingly becoming a premise for increasing competitiveness and sustainable tourism and economic development.

Figure 7: Digital Economy and Society Index, Integration of Digital Technology 2017-2022



Source: created by authors (European Commission. Digital Decade DESI visualisation tools)

The following is a benchmarking of selected tourism countries based on the development of the Travel and Tourism Development Index (TTDI), which has been monitored since 2007 and replaces the Travel and Tourism Competitiveness Index (TTCI). The TTDI index assesses the level of travel and tourism economies according to various criteria and areas, with the index ranging from 1-7, with 7 being the highest score. In addition to the overall TTDI index, the development of the ICT Readiness Index, which is monitored as part of the Pillar Enabling Environment, is also analysed for the purposes of this study.

The TTDI index trend for all countries from 2019 to 2024 shows consistent results with no major fluctuations. Spain stands out as the most competitive and developed tourism destination among the observed countries, with its TTDI value ranging from 5.2 in 2019 to 5.18 in 2024. Despite a slight decrease in the TTDI value, Spain's overall ranking has improved. Italy also made progress, advancing from 12th place in 2019 to 9th place in 2024, with a TTDI index value of 4.9. Greece holds the third position among the countries analyzed, with a TTDI value of 4.52, ranking 21st out of 119 countries. In contrast, Croatia showed a negative development during the same period, slipping from 42nd place in 2019 to 46th place in 2024.

According to the implementation of digital technologies in tourism, all countries are relatively uniform and belong to the group of medium-positioned countries. Overall, this means that these Mediterranean countries, although some of them are among the leading tourism countries in Europe, do not have an adequate implementation of digital technologies in tourism and that it is necessary to work on their accelerated development. Such an approach can have a direct positive impact on all tourism indicators in a short time, including an increase in tourism revenues. Among the countries, Spain has the highest technological integration, which, despite the improvement in the ICT Index score from 5.8 to 6.05, has deteriorated from 18th to 23rd place

among 119 countries, indicating that all countries are intensifying their activities in the field of digitalisation because this meets the needs of the market and consumers. It is followed by Greece, which ranks 33rd with an index of 5.85 in 2024. Immediately behind Greece is Italy, which has significantly and rapidly improved its position over a 5-year period, increasing its index score from 5.4 to 5.85 in 2024. Croatia has results that are very close to Italy. Throughout the period, Croatia ranks 43-45 with a positive trend of increasing the ICT Readiness Index, which stands at 5.67 in 2024.

Table 2: **The Travel and Tourism Development Index 2019-2024**

	CROATIA			GREECE			ITALY			SPAIN		
	2019	2021	2024	2019	2021	2024	2019	2021	2024	2019	2021	2024
TTDI	4.3 (42/119)	4.2 (46/119)	4.13 (46/119)	4.5 (28/119)	4.5 (28/119)	4.52 (21/119)	4.9 (12/119)	4.9 (10/119)	4.9 (9/119)	5.2 (5/119)	5.2 (3/119)	5.18 (2/119)
ICT Readiness	5.3 (45/119)	5.5 (43/119)	5.67 (44/119)	5.6 (32/119)	5.6 (37/119)	5.85 (33/119)	5.4 (42/119)	5.5 (42/119)	5.85 (34/119)	5.8 (18/119)	5.9 (17/119)	6.05 (23/119)

Source: created by authors (World Economic Forum, 2024)

DISCUSSION AND CONCLUSION

Digitalisation and technological progress are changing from day to day, so the field and the possibilities for action are almost unlimited. The results of the research show that the ICT sector and digitisation represent an important role in shaping the economic structures in the tourism countries of the European Union. Traditional tourism activities such as accommodation and catering are sensitive to times of crisis. All countries observed recorded economic growth in the period under review and ICT was the most dynamic sector. The Digital Economy and Society Index (DESI) confirms the trend of accelerated digitalisation, with Spain in the lead, while Croatia, Italy and Greece show steady but slower progress. As far as the Travel and Tourism Development Index (TTDI) is concerned, the countries analysed show a medium level of competitiveness in the implementation of ICT technologies in tourism.

The results point to the significant role of digital technologies and the ICT sector in strengthening competitiveness and fostering the long-term development of tourism economies, especially in the observed Mediterranean countries that traditionally rely heavily on tourism. However, it is interesting to note that the overall level of digitalization of the economy does not always progress at the same pace as the digital transformation of the tourism sector. The example of Croatia confirms this thesis — although a positive trend in digitalization at the societal level is observed, tourism as a key economic branch lags behind in integrating innovative solutions. Such a mismatch can have multiple negative consequences. For instance, tourists from highly digitalized markets expect advanced, personalized, and technology-supported services, and destinations that fail to meet these demands risk losing competitiveness and market share. The underutilized potential of digitalization in tourism slows down the broader economic effects that digital transformation can generate, including GDP growth, increased employment, and the development of related sectors.

Furthermore, this raises the issue of digital literacy and capacity to manage digital transformation within the tourism sector. Without the active involvement of key stakeholders — the private sector, public institutions, and educational organizations — digital transformation risks remaining fragmented. This is also confirmed by the DESI index for Croatia, which shows slower progress in certain segments of digital integration.

These results can also be viewed in the context of the smart tourism destinations concept, which emphasizes the necessity of synergy between digital infrastructure, the entrepreneurial sector, sustainable resource management, and local community participation. Buhalis et al. (2023) highlight that without such a holistic approach, there can be no long-term competitiveness or resilience of tourist destinations against global challenges such as climate change, demographic shifts, and disruptive technological innovations. What becomes evident is that countries with a stronger presence of the ICT sector in their domestic market tend to integrate these technologies more effectively into tourism services, thereby attracting tourists who seek advanced, personalized, and seamless digital experiences. This connection further underscores the strategic importance of fostering synergy between national digital development and the tourism economy. Economies with growing production in the field of information and communication activities show greater demand for technologically advanced tourism products. Tourism countries that adapt their products and services accordingly can expect increased tourism demand from economically developed markets, as well as higher spending at tourist destinations.

Theoretical contribution and practical implications

The theoretical contribution of this research is to understand the role of ICT technologies in tourism and their connection to economy. The combination of quantitative and comparative methods using index such as GVA, DESI and TTDI provides a new perspective in analysing the relationship between digital transformation and the competitiveness of tourism economies. Benchmarking analysis among countries such as Croatia, Greece, Italy and Spain contribute to a better understanding of the differences in digitalisation between different tourist destinations. The research focuses on which innovative technologies tourist destination can utilise to improve their competitiveness and attract new tourist segments. A particularly innovative aspect of the approach is its use of comparative analysis to link digital capacities with specific indicators of tourism competitiveness, providing practical guidance for decision-makers. The results of this research can contribute to the development of long-term strategies and policies that promote greater integration of digital technologies for the sustainable economic development of tourism in the European Union. Thus, the research, alongside the theoretical framework, also provides concrete practical recommendations, which enhances its relevance for tourism development in the era of the digital economy. This research created the basis for further analysing the dynamics of digital transformation and its impact on the competitiveness of tourist destinations, as well as opportunities for practical applications in future development strategies.

Limitations and future research

Although this research provides significant insights, several limitations should be acknowledged. Geographically, the study focuses exclusively on tourism economies within the Mediterranean region (Croatia, Greece, Italy, Spain), which limits the generalisability of the findings. The results cannot be applied to non-tourism-oriented economies or to regions outside the Mediterranean context, where socio-economic structures, tourism demand patterns, and the level of digital maturity may differ significantly. Future research should therefore consider expanding the geographical scope to include other European regions or global tourism markets to provide a more comprehensive and globally relevant perspective. One of the limitations of the research relates to the availability of secondary data, as the DESI index measures the overall digital maturity of economies but does not track the specific level of digital implementation within the tourism sector.

Another important limitation is the predominance of quantitative and comparative methods based on secondary data, which may not fully capture the qualitative aspects and practical challenges of digital transformation in tourism.

To address this, future research is encouraged to include qualitative approaches, such as in-depth interviews with hotel managers, tourism service providers, and destination management organisations. This would enable a better understanding of the barriers to digital transformation and the readiness of tourism stakeholders to adopt innovative technologies. Furthermore, the study does not consider the potential negative impacts of technology in tourism, such as the digital divide affecting older tourists, privacy concerns, or the potential loss of authenticity in tourism experiences. These aspects should be included in future research to ensure a balanced perspective on the consequences of digitalisation in tourism. Future research could focus on the impact of digitalisation on sustainable tourism practises and tourist behaviour, as well as on the development of specific indices to monitor the progress of digital transformation in tourist destinations.

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