Vilnius University Press

Content lists are available at VilniusUniversity Press

Transformations In Business & Economics
2025, Vol. 24 No 2 (65), pp.421-438.

E-ISSN 2538-872X
https://doi.org/10.15388/Tibe.2025.24.2.19

Chapter: Strategic Digital Transformation: Enhancing Business through Innovation

INNOVATION POTENTIAL AND TOURISM DEVELOPMENT IN THE EU: THE IMPACT OF DIGITALISATION AND RESEARCH INVESTMENT ON TOURISM PERFORMANCE

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Annotation. This paper examines the relationship between the innovation potential of the economy and tourism development in European Union countries, using data from indices such as the European Innovation Scoreboard (EIS), the Tourism and Travel Development Index (TTDI), the Digital Economy and Society Index (DESI), and statistics from UNWTO and Eurostat. Spearman's correlation coefficient measures the strength and direction of the relationships, revealing moderate to strong correlations between innovation potential and tourism performance. The results show that investment in research and development (GERD) and digitalisation (DESI) significantly enhance the development of the innovation potential of tourism. Countries with higher digitalisation and innovation investments outperform in tourism, while the use of European funds (ERDF/CF) shows weaker or negative correlations. The findings underline the importance of supporting innovation strategies that focus on digital technologies, research and sustainable tourism development, while collaboration between the public and private sectors can be key to maximising innovation opportunities.

Keywords: innovation potential, digitalisation, research and development, tourism performance, European Union.

JEL classification: O31, O52, Z32.

Introduction

Innovation in tourism is a key factor in increasing the competitiveness and sustainable development of the sector. It includes not only the creation of new tourism services and the development of tourist routes, but also the use of modern technologies to enhance the visitor experience (Sardak and Sarkisian, 2018). As Ribarić (2015) points out, innovation is one of the main drivers of competitiveness of tourist destinations and requires stakeholders to rethink and strengthen innovation activities.

Submitted on October 2024. Accepted on April 2025.

Sustainable tourism development can benefit from innovations that go beyond traditional ways of thinking and bring new approaches to destination (Moscardo, 2008) or product development (Szczepańska-Woszczyna, 2024). One of these approaches is open innovation, which involves the active participation of tourists in the creation of new solutions and services, thus enhancing their creative potential (Hołderna-Mielcarek, 2018; Kajzar and Mura, 2023).

Innovation potential in tourism includes not only new products and technologies, but also challenges to established practices and assumptions, which can lead to significant changes in tourism development (Hjalager *et al*., 2018; Mura *et al*., 2021). These innovative initiatives can help the sector to better respond to global challenges such as environmental issues or changing tourist needs, while strengthening its ability to contribute to social and environmental goals, making tourism an important actor in promoting sustainable development.

The COVID 19 pandemic has further strengthened the role of innovation in sustainable tourism development, with an emphasis on building resilience to potential crises, inclusion, environmentally beneficial activities, and resource efficiency (UNWTO, 2023). These priorities are inextricably linked to the debate on innovation and entrepreneurship in tourism, as the sector needs to respond to global challenges and ensure sustainable development through effective and innovative solutions (Loureiro, 2019; Hjalager, 2002; Iwu, 2023; Bilan *et al*., 2023; Keller *et al*., 2023). Innovation potential in tourism, as defined by Topilovich (2020), Krupskyi (2015) or Mykhailichenko (2020), plays a key role in this transformation, enabling tourism operators and clusters to effectively change experiences, innovate products and create new opportunities for resilient and sustainable destinations.

Service theory is concerned with the impact of innovativeness on business and economic performance (Bulkley, Alstyne, 2004; Brynjolfsson, Hitt, 1996; Gretton *et al*., 2004; Khalifa, 2023). Studies that have focused on the impact of the innovation environment on tourism performance present different, often contradictory results (Gunday *et al*., 2008; Rubera, Kirca, 2012; Nepierala, Szutowski, 2019; Guisado-González *et al*., 2013; Prima Lita *et al*., 2020; Hurtado-Palomino *et al*., 2022; Razzaq *et al*., 2023 or Hanáčková and Takáč, 2024).

Tourism services are defined as low knowledge intensity services. Because of their development based on new knowledge and technology, they are therefore very closely linked to other disciplines in the economy and in research. The purpose of the study is to examine the conditionality of achieving tourism performance through innovation and the existing innovation environment of the economy. It can be assumed the validity of the premise about the impact of innovations on performance and competitiveness also in the environment of tourism production. Tourism is an interdisciplinary industry; its knowledge requirements are addressed to a wide range of disciplines. It can be assumed that the tourism industry is able to take advantage offered by the knowledge-intensive and innovative environment of the economy. Tourism businesses are able to use ties to a knowledge-advanced economy to build and utilise their own innovation potential for sustainable growth. Therefore, the aim of this study is to assess the relationship between the innovation potential of an economy and tourism performance. The main objective of the study is to answer the research question: ‘Does the maturity of an economy’s innovation environment affect tourism performance?’

1. Chronological Literature Overview

Due to the complementary nature of the product, tourism is part of a rather complex value chain. Both demand sophistication, and sustainability ambitions are challenges for tourism that stakeholders have to accept. These realities are important when considering innovation in tourism. The knowledge-intensive production of tourism services places them in the position of users of innovation, rather than creators. It is therefore logical to assume that the knowledge- and innovation-intensive environment in which tourism services are produced will have an impact on the emergence and development of their innovation potential and, consequently, on business performance. The aforementioned relationship has been confirmed by the work of several authors (Lin, 2013; Hult *et al*., 2004; Gunday *et al*., 2008; Mavimbela, 2024; Rubera, Kirca, 2012; Nepierala, Szutowski, 2019; Bano *et al*., 2022; Gan *et al*., 2023). The innovation potential of an economy, as expressed by total government expenditure and business R&D expenditure, positively affects labour productivity in tourism services (Kubičková, Benešová, 2022; Nguyen *et al*., 2021).

The literature defines innovation potential in tourism in different ways, with each approach emphasising a different aspect of innovation in the sector. Mirzaev Abdullajon Topilovich (2020) defines innovation potential in recreation and tourism as the ability of tourism actors and clusters to change and streamline experiences, as well as to transform established stereotypes of interaction between participants in the entrepreneurial process. This ability is crucial for the development of the national economy, as it supports innovation processes within tourist destinations. Similarly, Oleksandr P. Krupskyi (2015) defines the innovation potential of tourism enterprises as the ability to transform experiences and rethink stereotyped interactions between business actors. This concept is closely related to the innovation culture of the enterprise and the professional culture of the manager, which emphasises the importance of management and corporate culture in the development of innovation.

Azizul Hassan and Roya Rahimi (2016) focus on innovation from the perspective of consumption of tourism products and services, highlighting the importance of technological innovations such as augmented reality (AR) as a digital marketing tool in tourism. Similar findings on the impact of AR on tourism are obtained by Florek and Lewicki (2022) during the pandemic period. Technologies such as AR can enhance the customer experience and provide a new dimension to destination marketing, thereby increasing the attractiveness of tourism products. Mykhailichenko (2020) defines tourism innovation potential as the ability to create innovative tourism products within a destination. This approach emphasises the positive impact of innovation on the realisation of the tourism potential of a country or region, thus contributing to the overall growth and development of tourist areas.

Authors who have addressed this issue have used different approaches to measure and assess innovation potential, incorporating factors such as human resource potential, industrial structures, socio-economic factors, and the business environment. *Table 1* summarises the approaches and methodologies used to measure innovation potential.

Pritula, Davydova and Kostyukova (2019) focused on the innovation potential of the territory and analysed the components necessary for the effective management of innovation processes. Their study provided a comprehensive overview using the example of Novgorod region. The innovation potential of human resources was investigated by Gryshchenko and Gryshchenko (2020), who focused on the theoretical and methodological foundations of this concept as a key component of innovation potential. Zdolnikova, Babkin and Smolskaya (2017) extended this topic to integrated industrial structures, where

they proposed a method for assessing the innovation potential of industrial structures, providing a comprehensive view of the industrial sector.

Table 1. Approaches and Methodologies Used to Measure Innovation Potential

Authors	Focus	Methodology
O. Pritula, S. Davydova, A. Kostyukova (2019), D. Hanáčková, I. Takáč (2024)	Innovation potential of the territory	Analysis of the components of the innovation process
I. Gryshchenko, V. Gryshchenko (2020)	Innovation potential of human resources	Theoretical and methodological foundations
S. Zdolnikova, A. Babkin, N. B. Smolskaya (2017)	Assessing the innovation potential of integrated industrial structures	Approach to definition and assessment
I. Tsvetkova, T. Ivanova (2017)	Social and economic aspects of urban reform	Quantitative assessment of resources
P. Král, K. Janošková (2021)	Key dimensions of a successful innovation strategy	Comprehensive consideration of conditions
O. Vladimirova, A. Petrova (2015)	Indicators for assessing the innovation propensity of regions	Methodological approach to evaluation
E. Marusinina, V. Moseyko, V. Epinina, S. Korobov (2019)	Nature and structure of innovation potential	Comprehensive assessment from the perspective of the three components
O. Mysova, G. P. Dovlatyan, I. Belikova, T. Kostyuchenko, M. Troyanskaya (2016)	Dependence of economic growth on innovation-oriented entrepreneurship	Regression analysis
D. V. Parshukov, D. Khodos, N. Pyzhikova, Kovalenko Elizaveta Ivanovna, Vlasova Elena Yuryevna (2015)	Evaluation of the innovation potential of the economic environment	Analysis of fuzzy sets and hierarchical analysis
Chatkalbai K. Raymbaev, Chynara Kulueva, Aidarbek Giyazov, B. Bezrukov, T. Bezrukova (2017)	Innovative development of entrepreneurial potential of small enterprises	Developing a concept that combines the assessment of the potential of small enterprises with a competency-based approach, emphasising the role of the entrepreneur in innovative development

Source: created by the authors.

Socio-economic aspects were analysed by Tsvetkova and Ivanova (2017), who focused on the reform of the city of Togliatti, where they examined the diversification of production and the business environment as important factors for innovative development. King and Janoskova (2021) defined the key dimensions of innovation strategies for global competitiveness, emphasising the importance of external and internal conditions for the successful implementation of innovation strategies. Vladimirova and Petrova (2015) focused on the regional level and proposed a methodological approach to assess the innovation susceptibility of regions, which contributed to a better understanding of regional innovation potential.

Marusinina, Moseyko, Epinina, and Korobov (2019) proposed a three-component approach to assessing innovation potential that includes resources, the internal sphere, and production, providing a broader view of the structure of innovation potential. Mysova *et al*. (2016) used regression analysis to analyse the relationship between economic growth and innovation-oriented business development, which demonstrated how these factors interact in modern economic systems.

Parshukov *et al*. (2015) contributed to the field with research that focused on assessing the innovation potential of the economic environment using fuzzy set analysis and hierarchical analysis, which allowed

for a more detailed view of economic regions. Raymbaev *et al*. (2017) focused on the innovative development of small enterprises, providing a comprehensive concept of the development of innovative entrepreneurial potential in this sector.

These different approaches and analyses offer a systematic view of innovation potential in different contexts, ranging from regional to industrial and entrepreneurial settings, highlighting the wide range of factors that influence innovation potential in different segments of the economy.

2. Methodology

The analysis presented in this study is based on the use of the Spearman's correlation coefficient. Spearman's correlation coefficient is a method for measuring the strength and direction of the relationship between two variables that are measured at the ordinal level. This coefficient is the non-parametric equivalent of the Pearson correlation coefficient and is suitable for situations where the data does not meet the assumptions of the Pearson correlation, especially normal distribution (Schober *et al*., 2018).

The data sources consisted of a selection of indicators from the European Innovation Scoreboard (EIS), Travel and Tourism Development Index (TTDI), World Tourism Organisation (UNWTO), European Court of Auditors, Eurostat, and the Digital Economy and Society Index (DESI) databases. The 27 countries of the European Union were included in the analysis. The reference year was 2023, except for the indicator 'ERDF/Cohesion Fund investment in tourism', where the year 2021 was used. Research questions and hypotheses were formulated in order to establish the relationship between the innovation potential of an economy and the performance of tourism:

RQ_1: What is the relationship between the innovation potential of the economy and tourism performance?

To express the innovation potential of the economy, the following indicators were chosen: the value of the EIS index, the intensity of digitalisation in SMEs, the expenditure on R&D from public sources (GERD), and the volume of funds for tourism in ERDF/CF. To express the performance in tourism, the following indicators were used: specialisation in tourism (service standard), TTDI index value, tourism expenditure per capita and internal consumption of tourism per capita.

$H_0$1: There is no positive relationship between the innovation potential of the economy (expressed by the indicators: EIS index, SME digitalisation, R&D expenditure, and ERDF/CF funds) and tourism performance (tourism specialisation, TTDI index, tourism expenditure per capita, tourism internal consumption per capita).

$H_1$1: There is a positive relationship between the innovation potential of the economy (expressed through the EIS index, SME digitisation, R&D expenditure, and ERDF/CF funds) and tourism performance (tourism specialisation, TTDI index, tourism expenditure per capita, tourism internal consumption per capita).

RQ_2: Is there a relationship between the innovation environment of the economy and the innovation potential of tourism?

$H_0$2: There is no relationship between the innovation environment of the economy, as expressed by the EIS index, and the innovation potential of tourism, as expressed by the TTDI index.

$H_1$2: There is a relationship between the innovation environment of the economy, as expressed by the EIS index, and the innovation potential of tourism, as expressed by the TTDI index.

$H_0$3: There is no relationship between the innovation environment of the economy, as expressed by the DESI index, and the innovation potential of tourism, as expressed by the TTDI index).

$H_1$3: There is a relationship between the innovation environment of the economy, as expressed by the DESI, and the innovation potential of tourism, as expressed by the TTDI.

$H_0$4: There is no relationship between the innovation environment of the economy, as expressed by the GERD, and the innovation potential of tourism, as expressed by the TTDI.

$H_1$4: There is a relationship between the innovation environment of the economy, as expressed by the volume of GERD, and the innovation potential of tourism, as expressed by the TTDI index.

In the case of the RQ solution, two indicators were chosen. The innovation environment of the economy was expressed by the indicators: EIS index value, the intensity of digitalisation in SMEs, R&D expenditure from public sources (GERD). Due to its construction, the indicator 'TTDI index value' was recognised as an indicator expressing the level of innovation potential of tourism.

The calculation of Spearman's correlation coefficient is a systematic process that involves several steps to ascertain the strength and direction of the relationship between two variables. This procedure starts by assigning a rank to each value of the two variables. If two or more values have the same numerical value, an average ranking is assigned to each of them. Then, for each pair of values, the difference between their ranks, denoted as *d,* is computed. Once the differences have been computed, the squared value of *d* is calculated for each *d*. The square of the difference eliminates negative values and focuses on the magnitude of the difference, regardless of its direction. Once the squares of the differences are calculated, they are added together to obtain the total sum of these squares. This sum is then used in the final formula to calculate the Spearman's coefficient. The formula for calculating the Spearman's correlation coefficient is as follows:

$$\rho = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)} \tag{1}$$

where:

$_i$d is the difference between the order of each observed value of the two variables,

n is the number of observations.

The resulting coefficient *ρ* can take values from -1 to +1. A value of +1 indicates a perfect positive correlation, i.e. as the value of one variable increases, the value of the other also increases. A value of -1 represents a perfect negative correlation, meaning that as the value of one variable increases, the value of the other decreases. A value close to 0 indicates no or a very weak correlation, meaning that there is no or only a very weak relationship between the variables (Cuyler, 2014).

The methodology for generating the maps and box plots involved several key steps to ensure the accuracy and relevance of the visual data presented. Data for the maps and box plots were obtained from EU statistical databases and reports, such as Eurostat and the European Commission's

publications. The indicators include travel and tourism employment per capita, expenditure per capita, GERD on R&D in the government sector, and internal consumption of tourism. To enable fair comparisons between countries of different sizes and economic conditions, the data were normalised per capita where applicable.

The maps were created using a Geographic Information System (GIS) tool that accurately represents the distribution of data across the EU Member States. The colour scales were chosen to provide a clear visual distinction between lower and higher values for each indicator.

The box plots were generated using statistical analysis software that computed the median, interquartile range (IQR), and outliers for each indicator. The presence of outliers in the plots highlights countries with exceptional values that deviate from the typical range.

3 Results and Discussion

To assess the tourism innovation potential of EU countries, we used a multivariate analysis based on selected indicators that provide a comprehensive overview of countries' innovation performance and tourism development capacity.

- *European Innovation Scoreboard (EIS) (2023)*: This index assesses a country's innovation performance using several input indicators. It captures the innovation potential of an economy. It is assumed that a higher score of an economy in the EIS predicts the ability of individual sectors, including tourism, to exploit the innovation potential for their own development.

- *Travel and Tourism Development Index (TTDI) (2023):* The TTDI includes factors such as infrastructure, security, cultural resources and business environment, and assesses a country's ability to provide competitive tourism services.

- *Travel and tourism employment per capita (2023) – Service Standard:* This indicator defines the specialisation of the economy in the production of tourism services. It reflects the importance of the tourism sector to the country's economy and its ability to create jobs.

- *ERDF/Cohesion Fund investment in tourism up to 2020:* It reflects EU investment in innovative tourism projects and infrastructure that support the competitiveness and modernisation of the sector.

- *Tourism expenditure per capita (2023):* It reflects tourism consumption by tourists. Tourism expenditure is limited to the amount paid for such acquisition. It is an important indicator of the economic performance of the sector (United Nations, 2017).

- *Internal consumption of tourism per capita (2023):* It expresses the consumption of tourists in inbound and domestic tourism. Internal consumption includes imputed transactions and non-monetary expenditure by visitors. Non-monetary expenses are expressed by additional calculations. Tourism consumption is a broader concept than the tourism expenditure indicator. Consumption includes data for inbound and domestic tourism expenditure, which together make up total internal tourism expenditure (United Nations, 2017; Statistical Office of the SR, 2020).

- *DESI Index (% of SMEs with digitalisation) (2023).*

- *GERD on R&D in the business sector (2021):* It indicates the total R&D expenditure from government sources flowing to the business sector. In the private sector and represents the commitment to innovation and potential growth in tourism.

Table 2. Ranking of Countries According to the Values Achieved in the Selected Indicators of Innovation Potential and Tourism Performance in the Countries of the European Union

EIS 2023 (European Innovation Scoreboard)	TTDI 2023 (Travel and Tourism Development Index)	Travel and Tourism employment per capita 2023	ERDF/CF tourism budget per Member State by 2020	Tourism expenditure per capita 2023	DESI Index 2023 -> % of SMEs with at least basic digitization intensity	GERD on R&D in the business sector 2021 in million EUR per capita	Internal consumption of tourism per capita 2023
Denmark	Spain	Malta	Italy	Luxembourg	Finland	Ireland	Finland
Sweden	France	Netherlands	Hungary	Austria	Denmark	Denmark	France
Finland	Germany	Cyprus	Poland	Finland	Sweden	Sweden	Austria
Netherlands	Italy	Estonia	Greece	Cyprus	Ireland	Belgium	Spain
Belgium	Portugal	Germany	France	Ireland	Netherlands	Austria	Germany
Austria	Austria	Ireland	Czech Republic	Germany	Malta	Germany	Ireland
Germany	Netherlands	Denmark	Germany	Estonia	Germany	Finland	Estonia
Luxembourg	Denmark	Sweden	Spain	Netherlands	Belgium	Luxembourg	Cyprus
Ireland	Sweden	Lithuania	Romania	France	Portugal	Netherlands	Slovenia
Cyprus	Finland	Hungary	Portugal	Malta	Cyprus	France	Netherlands
France	Greece	Austria	Slovakia	Slovenia	Italy	Slovenia	Croatia
Estonia	Belgium	Luxembourg	Croatia	Belgium	Czech Republic	Czech Republic	Portugal
Slovenia	Ireland	Slovakia	Lithuania	Spain	Spain	Estonia	Slovakia
Czech Republic	Poland	Portugal	Estonia	Slovakia	Austria	Italy	Poland
Italy	Luxembourg	Finland	Slovenia	Latvia	Slovenia	Spain	Italy
Spain	Cyprus	Latvia	Finland	Czech Republic	Estonia	Portugal	Czech Republic
Malta	Czech Republic	Poland	Belgium	Croatia	Luxembourg	Greece	Greece
Portugal	Malta	Czech Republic	Netherlands	Lithuania	Lithuania	Poland	Romania
Lithuania	Estonia	Slovenia	Malta	Poland	France	Lithuania	Hungary
Greece	Hungary	Bulgaria	Sweden	Hungary	Poland	Croatia	Lithuania
Hungary	Bulgaria	Spain	Latvia	Portugal	Slovakia	Hungary	Bulgaria
Croatia	Slovenia	Belgium	Bulgaria	Italy	Croatia	Cyprus	Malta
Slovakia	Romania	Croatia	Austria	Greece	Romania	Malta	Luxembourg
Poland	Lithuania	France	Denmark	Bulgaria	Latvia	Slovakia	Latvia
Latvia	Croatia	Romania	Cyprus	Romania	Hungary	Latvia	Belgium
Bulgaria	Slovakia	Greece	Ireland		Bulgaria	Bulgaria	Denmark
Romania	Latvia	Italy	Luxembourg		Greece	Romania	Sweden

Notes: *colors in the table show individual countries. *country rankings in the table indicate the ranking from best to worst on the indicator.

Source: authors' own results based on EIS, 2023, TTDI, 2023, UNWTO, 2023, European Court of Auditors, 2020, Eurostat, 2024, DESI, 2023.

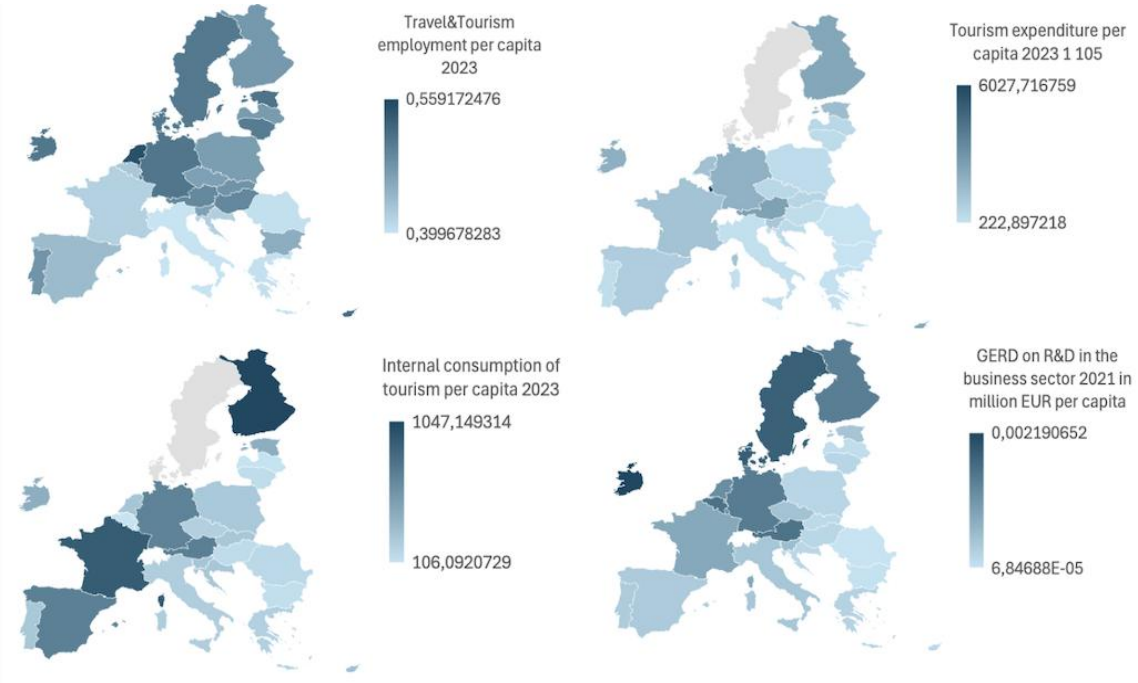
Table 2 illustrates the ranking of countries for each of the selected indicators, with the highest ranked countries achieving the best value in a particular indicator, and then descending to the countries with the lowest value achieved in the indicator under consideration.

The assessment of the innovation potential and performance of the European Union countries in the field of tourism yielded several key findings, reflecting the different levels of the monitored parameters. Denmark and Sweden dominate the European Innovation Scoreboard (EIS) 2023, indicating their high innovation capacity with a potential positive impact on tourism. Spain and France stand out in the Travel and Tourism Development Index (TTDI) 2023, linked to their tradition and specialisation in tourism, as well as their rich cultural resources and advanced infrastructure.

Countries such as Malta and the Netherlands show a high degree of tourism specialisation in terms of employment (high share of travel and tourism employees per capita), reflecting the importance of this sector for their economies. Italy and Hungary dominate the uptake of ERDF/CF funding, indicating their focus on tourism infrastructure development. Luxembourg and Austria are the leaders in tourism expenditure per capita, which is linked to the high quality of services provided, the number of visitors to the destination, and the price level of the products.

Finland and Denmark lead in the digitalisation of SMEs according to the DESI index (2023), which is key for the digital transformation of the tourism sector. Ireland and Denmark invest the most in research and development (GERD) in the business sector, which supports innovation processes in tourism.

The V4 countries, namely Hungary, Poland and the Czech Republic, benefit from ERDF/CF funding, which strengthens their position in the tourism sector. There are clear differences between high and low performers in various indicators, which points to the need for improvement even in strong economies. For example, high investment in R&D may not always be accompanied by high degree of digitalisation.



Source: created by the authors by authors' own results.

Figure 1. **Key Tourism Indicators across European Countries, 2023**

The following maps provide an insightful overview on the performance of different EU countries across key tourism-related indicators (Figure 1). By visualising data on employment, expenditure, research investment, and internal consumption, these maps help to contextualise the differences in tourism significance and innovation between European countries.

The accompanying maps provide a visual representation of several critical indicators that highlight these differences across European countries:

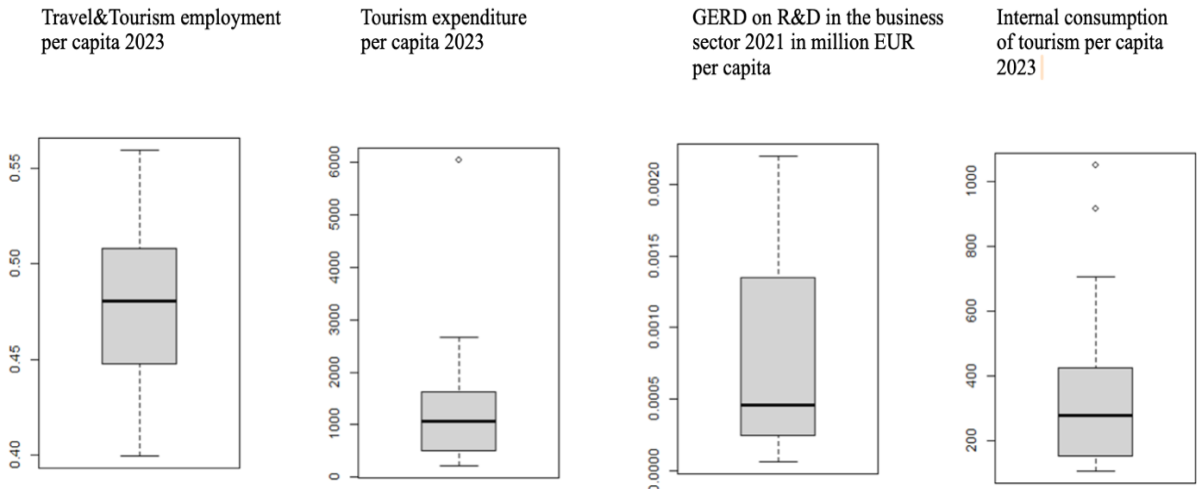
1. *Travel and tourism employment per capita 2023:* The first map in the top left illustrates the density of tourism employees relative to the population. Notable countries such as Malta and the Netherlands show a high concentration of travel and tourism employment, underlining the sector's significant role in their economies.

2. *Tourism expenditure per capita 2023:* The map in the top right emphasises the levels of tourism expenditure per capita. Luxembourg and Austria lead in this area, demonstrating the high quality and premium pricing of their tourism offerings, which attract both domestic and international visitors.

3. *GERD on R&D in the business sector 2021 in million EUR per capita:* The map on the bottom left depicts the gross domestic expenditure on research and development within the business sector. Countries such as Ireland and Denmark emerge as top investors, signaling their commitment to fostering innovation that can have a positive influence on tourism-related industries.

4. *Internal consumption of tourism per capita 2023:* The map on the bottom right shows internal consumption of tourism per capita. Finland and Denmark stand out as leaders in this category, reflecting robust domestic tourism and significant spending within the sector.

These visualisations show clear disparities in the performance of EU countries. The maps reinforce the findings that countries with higher investment in R&D and digital innovation, such as Denmark and Ireland, position themselves strongly in terms of tourism development potential. Similarly, countries with substantial tourism expenditure and employment, such as Luxembourg and Malta, demonstrate the importance of the tourism sector for their overall economic health.



Source: authors' own results.

Figure 2. **Distribution Analysis of Key Tourism Indicators Across EU Countries, 2023**

To complement the insights provided by the maps, the box plots offer a focused analysis of the distribution and variation within these key indicators (Figure 2). By illustrating the spread, median, and presence of outliers, the box plots help to better understand the range of performance across the EU countries.

In addition to the maps, the box plots provide additional insights into the distribution of these key indicators across the EU countries:

1. Travel and tourism employment per capita 2023: The box plot for this indicator shows a relatively narrow interquartile range, indicating that most countries have a similar density of tourism employement per capita. However, there are some outliers above the median, highlighting countries with notably higher employment in the tourism sector.

2. Tourism expenditure per capita 2023: This box plot displays a wider range and a notable outlier, suggesting that while most countries have moderate tourism expenditure per capita, there are a few with significantly higher expenditure. This reflects the position of leading countries such as Luxembourg and Austria.

3. GERD on R&D in the business sector 2021 in million EUR per capita: The distribution shown in this box plot indicates that the majority of EU countries have relatively low R&D expenditure per capita, with a few standing out as high investors. This supports the earlier findings that countries such as Ireland and Denmark prioritise R&D for innovation.

4. Internal consumption of tourism per capita 2023: The box plot for this indicator shows a diverse range with a few high outliers, suggesting that while many countries have modest internal tourism consumption, some, such as Finland and Denmark, exhibit significantly higher values.

The analysis of the relationships between the indicators using Spearman's correlation coefficient provided important insights into the link between the innovation potential of an economy and tourism. The correlation coefficients show different levels of interaction between economic and innovation factors, which helps to better understand the dynamics of the sector within the European Union.

Based on the results of the correlation analysis, we can identify several key findings regarding the relationship between the innovation potential of an economy and tourism performance. The results of the correlation analysis allowed us to answer the research question RQ_1: 'What is the relationship between the innovation potential of the economy and tourism performance?' The relationship between the innovation potential of the economy, expressed by EIS index, the level of SME digitalisation (DESI index), public expenditure on research and development (GERD) and the volume of ERDF/CF funding for tourism, with tourism performance, expressed by specialisation in tourism (service standard), TTDI index, tourism expenditure per capita and internal consumption of tourism per capita, shows different correlations depending on the individual indicators. Overall, however, it is confirmed that the innovation potential of the economy can positively influence the performance of the sector.

The moderate to strong positive correlation between EIS of 2023 and tourism performance suggests that countries with higher innovation potential, as measured by the EIS index, perform better in the tourism sector. This correlation is logical because economies with higher innovation potential can adopt and integrate technological innovations and innovative solutions more quickly, which increases the attractiveness of their destinations to tourists and makes the delivery of tourism services more efficient. This suggests a direct link between the innovation environment and tourism performance.

The relationship between the volume of ERDF/CF funding and tourism performance shows a moderate negative correlation. This result suggests that increased absorption of European funds for tourism is not necessarily associated with improved performance in the sector. This negative correlation may be explained by inefficient use of these funds or by their focus on areas that do not directly support tourism competitiveness.

The significant moderately strong positive correlation between the DESI index and tourism performance shows that a higher level of digitalisation of the economy may have a positive impact on the sector. The integration of digital technologies can improve the efficiency of services and tourists' access to information, thus contributing to higher customer satisfaction. However, this relationship is not very strong, which may indicate that digitalisation in tourism has not yet been fully exploited or is influenced by other factors.

The correlation between public R&D expenditure (GERD) and tourism performance is strongly positive. This suggests that public investment in R&D has significant benefits for tourism as it promotes the creation of innovations, new technologies and services that can improve the competitiveness of the sector. R&D plays an important role in modernisation and innovation, which are key to maintaining the dynamism of tourism.

Based on the above results, we can support hypothesis $H_1 1$, which posits that there is a positive relationship between the innovation potential of an economy and the performance of the tourism industry. Indicators such as the EIS index and public R&D expenditure (GERD) have a significant positive effect on the performance in this sector, while digitalisation has a weaker but still positive effect.

Table 3. Expression of the Spearman's Correlation Coefficient Values between the Selected Indicators

EIS 2023 and tourism performance	Correlation result	ERDF/CF tourism budget per Member State until 2020 and tourism performance	Correlation result	DESI Index 2023 and tourism performance	Correlation result	GERD 2022 and tourism performance	Correlation result
TTDI 2023	0.59	TTDI 2023	-0.35	TTDI 2023	0.48	TTDI 2023	0.64
Travel and tourism employment per capita 2023	0.43	Travel and tourism employment per capita 2023	-0.35	Travel and tourism employment per capita 2023	0.38	Travel and tourism employment per capita 2023	0.52
Tourism expenditure per capita 2023	0.81	Tourism expenditure per capita 2023	-0.49	Tourism expenditure per capita 2023	0.53	Tourism expenditure per capita 2023	0.80
Internal consumption of tourism per capita 2023	0.48	Internal consumption of tourism per capita 2023	-0.09	Internal consumption of tourism per capita 2023	0.38	Internal consumption of tourism per capita 2023	0.50

Notes: *the colours in the table show the strength of the relationship between the two variables: green - strong positive correlation ($r \geq 0.5$), orange - moderate positive correlation ($0.3 \leq r < 0.5$), yellow - weak positive correlation ($0.1 \leq r < 0.3$), red - strong negative correlation ($r \leq -0.5$), pink - moderate negative correlation ($-0.5 < r \leq -0.3$), blue - weak negative correlation ($-0.3 < r \leq -0.1$).

Source: own calculations.

The relationship between the EIS (2023) and the TTDI (2023) is expressed by a correlation coefficient of 0.59, which implies a moderately strong positive correlation (*Table 3*). This result suggests that countries with a higher innovation potential, as represented by the EIS index, tend to have a better innovation potential in tourism, as measured by the TTDI index. These countries are better able to adapt innovative practices and technologies to the tourism sector, thereby increasing its competitiveness and efficiency.

The relationship between the DESI (2023) and the TTDI (2023) shows a correlation coefficient of 0.48, which represents a moderately strong positive correlation. This result suggests that a higher level of digitalisation in the economy (the DESI index) contributes to improving the innovation potential of the tourism sector. Although this correlation is slightly weaker than for the EIS, it still shows the importance of integrating digital technologies into the tourism sector for its further development.

The correlation between GERD (2023) and TTDI (2023) shows a correlation coefficient of 0.64, indicating a strong positive correlation. Public expenditure on R&D (GERD) is strongly related to the innovation potential of tourism, confirming that R&D investment contributes significantly to the development of innovation in the sector. This strong positive relationship indicates that countries that invest in R&D have a greater capacity to introduce innovative practices also in the tourism sector.

The results confirm that there is a relationship between the innovation environment of an economy and the innovation potential of tourism. This relationship is most pronounced for public expenditure on R&D (GERD) and for the innovation potential of the economy, expressed through the EIS index. Digitalisation, as expressed by the DESI index, also has a positive impact on the tourism innovation potential, albeit somewhat weaker.

- *$H_0$2 is rejected and $H_1$2 is confirmed:* There is a moderately strong positive relationship between the innovation environment of the economy, as expressed by the EIS index, and the innovation potential of tourism, as expressed by TTDI.

- *$H_0$3 is rejected and $H_1$3 is confirmed:* There is a moderately strong positive relationship between the innovation environment of the economy (DESI index) and the innovation potential of tourism (TTDI).

- *$H_0$4 is rejected and $H_1$4 is confirmed:* There is a strong positive relationship between public expenditure on R&D (GERD) and tourism innovation potential (TTDI).

These results suggest that countries with better innovation environments and higher investments in R&D and digitalisation are significantly better placed to develop the innovation potential in tourism.

Conclusions

The input data used for to assess the innovation potential and performance of EU countries in the field of tourism showed considerable variability across countries. Denmark and Sweden lead in innovation potential (EIS 2023), while Spain and France stand out in the Tourism Development Index (TTDI 2023) due to their rich cultural resources and infrastructure. Malta and the Netherlands are notable for their high share of employees in tourism, while Italy and Hungary excel in the uptake of ERDF/CF funding. Finland and Denmark lead in the digitisation of SMEs, which is key to the digital transformation of the sector, and Ireland and Denmark stand out for high investment in research and development (GERD).

Based on the results presented in the study, it can be concluded that the innovation potential in the tourism sector of EU countries is influenced by investment in research, digitisation and infrastructure.

The innovation potential of an economy is an important factor in the economic performance of tourism. Tourism services are thus able to benefit from a knowledge- and innovation-rich environment. The positive correlation between R&D expenditure and tourism performance demonstrates the importance of innovation in this sector.

Given the relatively complex value chain of tourism service production, as well as the low knowledge intensity of their production, it is important to focus the attention of innovation policies on strengthening the cooperation of tourism operators with the relevant environment. Cooperation between the private and public sectors and with university and research environment is important. Attention should be directed to the introduction of digital technologies, artificial intelligence tools and green solutions into tourism services. Tourism clusters and the management of innovation processes through a system of open innovation in tourism can be identified as an effective means of transferring knowledge and innovative solutions. These platforms enable the generation and use of new practices and solutions for the needs of tourism from different disciplines.

The limitations of the above research include the absence of statistics on innovation in tourism and problems with the availability of data in a time consistent manner, which made it difficult to analyse and interpret the results in detail. These shortcomings hinder anaccurate assessment of the impact of research and innovation on the tourism sector and its innovative activities.

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Acknowledgements

This study is part of the VEGA internal grant no 1/0271/23 of the University of Economics in Bratislava with the title 'Sustainable renewal of spa tourism in the Slovak Republic in the context of the impacts of civilization crises'.

INOVACIJŲ POTENCIALAS IR TURIZMO PLĖTRA ES: SKAITMENINIMO IR INVESTICIJŲ Į TYRIMUS ĮTAKA TURIZMUI

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Santrauka. Remiantis Europos inovacijų rezultatų suvestinės (angl. EIS), Kelionių ir turizmo plėtros indekso (angl. TTDI), Skaitmeninio ekonomikos ir visuomenės indekso (angl. DESI) ir UNWTO bei „Eurostat“ statistiniais duomenimis, straipsnyje nagrinėjamas ryšys tarp ekonomikos inovacijų potencialo ir turizmo plėtros Europos Sąjungoje. Spearmano koreliacijos koeficientu įvertinamas sąryšių stiprumas ir kryptis, atskleidžiantys vidutines ir stiprias inovacijų potencialo ir turizmo veiklos rezultatų koreliacijas. Rezultatai atskleidžia, kad investicijos į mokslinius tyrimus ir eksperimentinę plėtrą (angl. GERD) ir skaitmeninimą (DESI) reikšmingai didina turizmo inovacinio potencialo plėtrą. Šalių, kuriose investicijos į skaitmeninimą ir inovacijas yra didesnės, turizmo rezultatai yra geresni, o Europos fondų (angl. ERDF / SF) lėšų naudojimas rodo silpnesnes arba neigiamas koreliacijas. Išvadose pabrėžiama, kad svarbu remti inovacijų strategijas, orientuotas į skaitmenines technologijas, mokslinius tyrimus ir tvarią turizmo plėtrą, o viešojo ir privataus sektorių bendradarbiavimas gali būti labai svarbus siekiant maksimaliai išnaudoti inovacijų galimybes.

Reikšminiai žodžiai: : inovacijų potencialas; skaitmeninimas; tyrimai ir plėtra; turizmo veiklos rezultatai; Europos Sąjunga.