**ADSEE Project**

**Applied Data Science Educational Ecosystem**

**Cultural Heritage and Tourism**

**Applied Data Science Educational Ecosystem**

**Approach Analysis Whitepaper**

1. **Cultural Heritage**

Cultural heritage is the legacy of **cultural resources** and intangible attributes of a group or **society** that is inherited from past generations. Not all legacies of past generations are "heritage"; rather heritage is a product of selection by society. Cultural heritage includes **tangible culture** (such as buildings, **monuments**, landscapes, books, works of art, and artifacts), **intangible culture** (such as folklore, traditions, language, and knowledge), and **natural heritage** (including culturally significant landscapes, and **biodiversity**).

Q1. Why is Cultural heritage important?

The deliberate act of keeping cultural and heritage from the present for the future is known as **conservation**, which cultural and historical ethnic **museums** and **cultural centers** promote, though these terms may have more specific or technical meaning in the same contexts in the other dialect. Preserved heritage has become an anchor of the global **tourism industry**, a major contributor of **economic value** to local communities.[[1]](#footnote-1)

Q2. How can digitalization influence cultural heritage?

Cultural heritage assets are priceless artefacts with a very important historical and moral value. It is the only tool that can trace the lifecycle of a civilization and thus transfer knowledge and education through the time. Conserving these assets is a top priority for all nations. With the increasing performance of digital technologies, heritage organizations around the world are considering adapting these technologies to cultural heritage promotion. Museums are digitizing their collections not only for cultural heritage preservation, but also to value and promote their collections and make their inventory accessible for a larger audience in an attractive way, by using Virtual Reality (VR), Augmented Reality (AR), 3D TV, etc. These technologies are now integrated into web-based platforms adapted to cultural content consumption (Belhi and Boursa 2017).

Digital collections paved the way to a new era in cultural heritage exhibition. Current studies are mentioning that only 10% of world heritage is physically exhibited (in museums, art galleries, archeological sites, etc.). The remaining assets are archived in museums warehouses, which are inaccessible due to geopolitical reasons, or are simply severely degraded and their restoration is costly.

Cultural heritage institutions in many countries are taking steps for creating national digital memories (Boamah, 2014) and are framing policies for addressing different issues concerning digital preservation and access patterns. Many organizations are suggesting cloud facilities, as is evident from the case of the DuraCloud digital preservation system discussed by Mannheimer and Cote (2017) which provides cloud backup, regular monitoring and integrity checks of digital archival content and the geographical distribution of digital preservation copies. These cloud-based solutions enable smaller cultural heritage institutions with limited resources to participate in the building of a digital collection and to manage their digital assets in standards-compliant digital preservation systems (Matusiak, Tyler, Newton, & Polepeddi, 2017).

Digital fabrication technology enables curators, scholars and researchers to create accurate physical reproductions out of 3D digital models and is now evolving as an enabling technology that opens new possibilities for the study and coming to fruition of Cultural Heritage assets (Scopigno, Cignoni, Pietroni, Callieri & Dellepiane, 2014). Furthermore, ‘Digital Humanities’ incorporates an array of convergent practices that explore a universe in which print is no longer the exclusive or the normative medium, where knowledge is produced and disseminated, and which is absorbed into new multimedia configurations and digital tools, techniques, and media (The Digital Humanities Manifesto 2.0, n.d.). Therefore, fields such as Digital Humanities and Digital Cultural Heritage provide ample opportunities for researchers to carry out research activities in different areas of human understanding by ascertaining long-term accessibility and the preservation of social, economic and cultural assets depicting human values (Khan, Shafi and Ahangar 2018).

# **Tourism**

Tourist experiences are set in a traditionally highly technology-dependent industry context and for a long time have been greatly affected by information technology design, both in relation to the use of specialized interactive systems (e.g. destination management systems, in-room entertainment, self-check-in kiosks) (Lehaney et al. 1999) or based on general purpose systems for the delivery or enhancement of services (e.g. provider websites, mobile phone applications) (Slivar et al. 2019; Wani et al. 2017). It is therefore not surprising that tourism has been quick to jump onto the emerging Industry 4.0 trend, embracing increased technological development within this framework of Tourism 4.0. Tourism 4.0 may be referred to as a new tourism value eco-system built upon a highly technology- based service production paradigm and supported by the common principles of Industry 4.0; namely interoperability, virtualization, decentralization, real-time data gathering and analysis capability, service orientation, and modularity (Pencarelli, 2019).

Q1: Why is the Tourism sector important? Why is ICT important for the Tourism sector?

Buhalis and Law (2008) argue to understand the role ICT has in tourism. Scholars should focus on either consumers and their demand, technological innovation or the state of the industry.

Digitalization leverages digital technologies and data to transform businesses and business ecosystems. It transforms markets and production processes, and has significant implications for economic and social organization, innovation, and competitiveness. In tourism, digitalization presents opportunities for SMEs to expand their market reach, increase growth, improve operational efficiencies, and sharpen their competitive edge (Stankov and Gretzel 2020). At a collective level, it can also help to develop and customize product offerings, improve destination connectivity, generate data to track performance, and help to improve destination management. In 2014, there were approximately 2.3 million tourism enterprises in the E.U., with the majority being small and medium sized enterprises (SMEs). These SMEs employed some 12 million people, which is approximately 9% of total employment in the non-financial business economy. Due to the very traditional nature of tourism and hospitality, digitalization brings with it a range of challenges and opportunities for SMEs. The tourism sector is highly fragmented, and subsectors such as transport, accommodation, restaurants and catering, and personal services are all subject to very different challenges and opportunities when it comes to digitalization. There are significant differences in human resource capabilities, varying levels of access to financial and non-financial resources, different levels of awareness, and variations in digital skills. Moreover, in the tourism sector, the challenges and opportunities that individual businesses encounter become magnified, distorted, and amplified both in business ecosystems, and at the collective destination level (European Commission).

The evolution and application of digital technologies are profoundly changing the way people live, work, travel and do business, and in the process, they are transforming and reshaping tourism. The scope and uptake of digital technologies varies across countries, sectors, organizations and places. The resulting opportunities and barriers create an uneven playing field, which is exacerbated by a growing gap between tech-driven and globally connected tourism businesses, and traditional micro and small businesses often characterized by low-tech business practices. Much attention to date has focused on digital marketing and e-commerce as a way of reaching new markets, engaging customers and building brand. However, while these technologies might build market access and awareness, increasing connectivity and facilitating financial transactions, they are less effective in enhancing productivity or innovation in an increasingly competitive global marketplace.

Productivity-enhancing technologies (e.g. cloud computing, data analytics, revenue management software) have generally received low uptake in tourism, while innovative technologies (e.g. augmented reality, geotagging) are generating, customizing and delivering, in ever more novel ways, new visitor products, services and experiences. Digital transformation is thus pushing tourism in new and often unpredictable directions. Digital technologies have important implications for tourism based businesses of all sizes, for the structure and operation of tourism value chains and for the sector as a whole. Facilitating and enabling digitalization in tourism is therefore a key policy challenge (OECD 2020).

1. **Tourism 4.0 – Flows – analysis of tourist flows**

Q2: How does it link to the ICT sector?

FLOWS is one of the four pillars of Tourism 4.0. It will enable GDPR compliant advanced analyses and forecasts of tourist movements based on anonymized data from a multitude of different sources (traffic counters, data from mobile operators, freely accessible Wi-Fi networks, tourist tax, vignettes sold, water and energy consumption, waste, social media posts, etc.). A simple user interface will display traffic flows: excessive traffic loads, seasonal deviations, entrances / exits to a destination, movement within the destination, etc. It will be possible to display the analyses in the selected time interval (year, month, week, day), display forecasts based on historical data and weighted by special parameters (weekend, weather, national or holiday in other countries, etc.) [[2]](#footnote-2).

Q3: Offer some examples where the Tourism sector and ICT merge?

Q4: What are the major traffic flows in a region?

Q5: How much traffic is just transit?

Q6: Can we predict tourist flows for a future date?

1. **User Case Block**

**Approach Analysis**

**Descriptive** - is designed to get you basic expository information: who, what, when, where, how many?

**Diagnostic** - helps you answer the question of *why* something happened.

**Predictive** - helps you identify trends in relationships between variables, determine the strength of their correlation, and hypothesise causality.

**Prescriptive** - predicts outcomes based on numerous variables

Q7: What type of result can we get by using these methods?

**Data Selection**

Data provided by DARS (Slovenian road network operator)

through Tourism 4.0 project

Traffic counters for year 2020

100m records, 2-3 GB of data

Need to reduce the dataset and use aggregates since it is too big

Pay attention and analyze the data based on the flows in the region.

Analyze and see the patterns of the traffic flow.

Consider all the factors that contribute to tourist flow.

**Data Science Technique Selection**

1. Data loading
2. Data cleaning
3. Visualisation
4. Feature engineering
5. Decision trees
6. Predictive models

Q8: What type of result we can we get by using these techniques of selection?

**Model Development**

1. Focus on simple visualisations and plotting

* Busiest regions, busiest roads, busiest days in year
* COVID lockdown effects on traffic

1. Developing a decision tree model with sklearn

* Identifying most important features, error rates, visualising prediction

**Sample Data Set Development**

1. Group the data and aggregate based on different features:

* Daily aggregates, region-based...

1. Feature engineering/augmenting the dataset with other features based on datetime:

* Day of week, weekend, month start/month end...

1. Reduction of the dataset size because of hardware and software limitations

**Result Decomposition**

Describe the figures that you have in front of you.

**Operationalization of results**

Traffic flows according to:

* Period of the year
* Nr. of transit (inflow and outflow)
* Preferred destinations

Q9: Please describe the results that you have obtained.

**References**

Abdelhak B. and Abdelaziz B. 2017. Digitization and Preservation of Cultural Heritage: The CEPROQHA Approach, 11th International Conference on Software, Knowledge, Information Management and Applications (SKIMA)

Boamah, E. 2014. Towards effective management and preservation of digital cultural heritage resources: an exploration of contextual factors in Ghana. Available at <http://hdl.handle.net/10063/3270>

Buhalis D, Law R. 2008. Twenty years on and 10 years after the Internet: the state of Tourism research. Tour Manag 29(4):609–623. https ://doi.org/10.1016/j.tourm an.2008.01.005

Cultural Heritage – available at <https://en.wikipedia.org/wiki/Cultural_heritage>

Francesco Piccialli1 · Paolo Benedusi2 · Luca Carratore3 · Giovanni Colecchia An IoT data analytics approach for cultural heritage. Springer-Verlag London Ltd., part of Springer Nature 2020, <https://doi.org/10.1007/s00779-019-01323-z>

Khan, N. A., Shafi S. M. and Ahangar, H. 2018. Digitization of Cultural Heritage: Global Initiatives, Opportunities and Challenges. Journal of Cases on Information Technology 20(4)

Lehaney B, Clarke S, Kimberlee V, Spencer-Matthews S, Lehaney B, Clarke S, Spencer-Matthews S. 1999. The human side of information systems development: a case of an intervention at a British visitor attraction. J Organ End User Comput (JOEUC) 11(4):33–39

Mannheimer, S. and Cote, C., 2017. Cultivate, assess, advocate, implement, and sustain. Digital Library Perspectives

Matusiak, K. K., Tyler A., Newton, and Polepeddi. C. P. 2017. Finding access and digital preservation solutions for a digitized oral history project: A case study. Digital Library Perspectives 33 (2), 88-99

*OECD. 2020. Tourism Trends and Policies*, OECD Publishing, Paris, <https://doi.org/10.1787/6b47b985-en>

R. Scopigno, M. Callieri, P. Cignoni, M. Corsini, M. Dellepiane, F. Ponchio, and G. Ranzuglia, 2011. 3D Models for Cultural Heritage: Beyond Plain Visualization, Computer, 44(7):48–55, 2011.

Slivar I, Stankov U, Pavluković V. 2019. Case study: delegated distribution: hotels should be warned! An example from Croatia. Transnatl Mark J 7(2):245–256. https ://doi.org/10.33182 /tmj.v7i2.838

Stankov U. and · Gretzel U. 2020. Tourism 4.0 technologies and tourist experiences: a human‑centered design perspective. Information Technology & Tourism (2020) 22:477–488, <https://doi.org/10.1007/s40558-020-00186-y>

Tonino Pencarelli. 2019. The digital revolution in the travel and tourism industry. Information Technology & Tourism https://doi.org/10.1007/s40558-019-00160-3

Tourism 4.0 – Flows – analysis of tourist flows, available at <https://tourism4-0.org/flows/>

Vergo P. 1990. The New Museology. Reaktion Books

1. https://en.wikipedia.org/wiki/Cultural\_heritage [↑](#footnote-ref-1)
2. For more information visit Tourism 4.0 – Flows – analysis of tourist flows, available at <https://tourism4-0.org/flows/> [↑](#footnote-ref-2)