D 2.2.1 Publication in selected journals and conferences

Activity A.2.2 Media relation and publications

September 2022 – Final

Partner: Pp5, Pp4
Authors: Ogrizovic, Castelli
Email: dario@uniri.hr

Project Acronym	E-CHAIN
Project ID Number	10048282
Project Title	Enhanced Connectivity and Harmonization of data for the Adriatic Intermodal Network
Priority Axis	4 - Maritime Transport
Specific objective	4.1 - Improve the quality, safety and environmental sustainability of marine and coastal transport services and nodes by promoting multimodality in the programme area
Work Package Number	2
Work Package Title	Communication activities
Activity Number	2.2
Activity Title	Media relation and publications
Partner in Charge	PP5 - University of Rijeka, Faculty of Maritime Studies Rijeka
Partners involved	LP - Municipality of Ancona PP1 - Amatori Interestate SRL PP2 - Brusutti S.R.L. PP3 - G.M.T. S.P.A. PP4 - University of Trieste PP6 – Prosoft d.o.o. PP7 - Jadrolinija PP8 - City of Split PP9 - Rathmann d.o.o.
Status	Final
Distribution	Public

VERSION CONTROL

Date	Version	Prepared by	Responsible	Approved by	Revision	Comment
Jun'21	draft	Ogrizovic, Castelli				draft
Sep'22	final	Ogrizovic, Castelli		All Pps		final

ACRONYMS / ABBREVIATIONS

ACRONYM	DEFINITION
PP	Project partners
PT	Project Team
TC	Technical task coordinator
WP	Work package
IT	Information Technologies

1. Introduction

Scientific papers published and presented:

1. Conference mipro 27.05.2022. in Opatija, Croatia (1 scientific paper published and presented):
   Enhanced Connectivity and Data Harmonization for the Adriatic Intermodal Network using modular integrated software
2. My First Conference, 6th Annual PhD Conference on Engineering and Technology, 22 September 2022, Rijeka (1 scientific paper published and presented):
   Realization of a modular integrated software for the management of multimodal passenger transport services in port areas
3. International Conference on Sustainable Transport (SuTra 2022) - 29 Sep–1 Oct 2022, Opatija, Croatia (1 scientific paper published and presented):
   Green Travel Planner and Infomobility Modular Software Platform
4. International Conference on Sustainable Transport (SuTra 2022) - 29 Sep–1 Oct 2022, Opatija, Croatia (1 scientific paper published and presented):
   E-CHAIN Web Platform for Sustainable Passenger Transport
5. Zbornik Veleučilišta u Rijeci (1 scientific paper accepted, under revision):
   Modularna softverska platforma za učinkoviti i održivi putnički promet
6. XIII Postgraduate Conference 2022 ESGHT – University of the Algarve of the Polytechnic Institute of Lisbon, 8. July 2022., Portugal (1 scientific paper published and presented):
   From fragmentation to collaboration for cross-border sustainable tourism: The E-CHAIN experience
7. XXIV – XXV Seminario Scientifico SIDT, June 15.-17. 2022., Genova (1 scientific paper published and presented):
   May info-mobility solutions contribute to increase sustainable transport connectivity? Lessons learned from E-Chain project

8. Scientific journal: Archivio di studi urbani e regionali (1 scientific paper accepted):
   E-Chain come modello di mobilità sostenibile per promuovere un flusso sostenibile di passeggeri nell'area Adriatica
9. Sixth International Conference on Universal Design, 7th – 9th September 2022., Brescia Italy (1 scientific paper published and presented):
   Gather travel needs and preferences to customize truly inclusive experiences: The case study of the Interreg E-chain project
10. MDPI Sustainability (1 scientific paper accepted, under revision):
    An info-mobility platform for sustainable tourism: the E-Chain case study

PP are going to publish more scientific papers.

Enhanced connectivity and harmonization of data for the Adriatic Intermodal Network using modular integrated software

Dario Ogrizović*, Ana Perić Hadžić*, Ozren Rafajac **
* Sveučilište u Rijeci / Pomorski fakultet, Rijeka, Hrvatska
dario@pfri.hr, ana@pfri.hr,
** Veleučilište u Rijeci, Rijeka, Croatia
ozren.rafajac@veleri.hr

***Abstract* - The realization of a modular integrated software for the management of intermodal transport services in port areas for passenger transport will enhance connectivity and harmonization of data for the Adriatic Intermodal Network in order to improve the efficiency, quality, safety and environmental sustainability of maritime and coastal transport services. Design and development of the services, interfaces and main functions integrated in modular software platform will be presented.** **The presented research has been supported by the European Regional Development Fund, under the Interreg V IT-HR CBC programme, project ID: 10048282 (E-CHAIN).**

Keywords - modular integrated software, connectivity and harmonization of data, transport services

I. INTRODUCTION

A modular integrated information software for the management of intermodal transport services in port areas for passenger to improve efficiency, quality, safety and environmental sustainability of marine and coastal transport services is the backbone of the E-CHAIN (Enhanced Connectivity and Harmonization of Data for the Adriatic Intermodal Network) project funded by the European Regional Development Fund under the Interreg V IT-HR CBC programme. The main E-CHAIN project objective is to enhance connectivity and harmonization of data for the Adriatic Intermodal Network [1]. E-CHAIN will allow integration between different services/systems for a multimodal transport providing timetables and trip solutions optimizing resources, real-time events in a seamless solution. It will also include booking and ticketing to allow integrated payment of transport modes operated by different operators in a "single windows". This will be possible thanks to the integration between IT systems and stakeholder involvement. Those joint efforts for enhancing the quality and environmental sustainability of services and node emissions. The rest of the paper is organized as follows: Section 2 reviews the E-CHAIN software architecture. Section 3 explains the three principal functions of E-CHAIN software (travel preparation, assistance during the journey and data analysis). Section 4 shows E-CHAIN main outputs and results. Section 5 concludes the paper.

II. SOFTWARE ARCHITECTURE

The back-end (server) is implemented with the PHP MVC framework Laravel [20], where the manipulation of data is separated from data presentation. Laravel is the most popular PHP framework for the development of the complete software stack [21]. It is flexible, scalable and it has easy learning curve. It was created in 2011 and it is based on Symfony 2 [22]. The back-end database is based on typical MySQL database software which delivers a very fast, multithreaded, multi-user, and robust SQL (Structured Query Language) database server for mission-critical, heavy-load production systems as well as for embedding into mass-deployed software [23]. The front-end (client) is built with the JavaScript framework Angular [24]. This framework is designed as a development platform, built on TypeScript [25], and consists of components for building scalable web applications, software libraries and developer tools that has a wide variety of forms, client-server communication, routing, etc. and tools to develop, build, test, and update programming code. The E-CHAIN software architecture can be seen in figure 1.

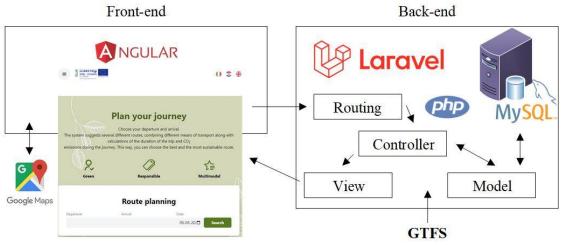

Figure 1. E-CHAIN software architecture

The map feature of E-CHAIN software is realized with the Google Maps API from the front-end application. The GTFS (General Transit Feed Specification) is used to share static public transit data and an extension to GTFS GTFS-realtime is used to share real time public transit data. Both GTFS static and GTFS realtime show public transit information (stops, routes, schedule, live departure times, service alerts, etc.). GTFS script is realized as a custom code in Laravel. From supplier side Trenitalia is already on Google Transit routing (therefore with real-

time movements), Jadrolinija is on Google Transit but without routing (therefore either they integrate it or we take it from the port authorities of Ancona and Split as data) and Conerobus is on Google Transit for the Ancona and Jesi areas.

III. SEGMENTATION OF E-CHAIN SOFTWARE

E-CHAIN software is designed as web platform and it is divided in three principal functions:

- Function A: travel preparation (before the trip). The interface will be a responsive web portal.
- Function B: assistance during the journey (aimed at facilitating the relationship between customer and supplier). The interface will be: login page for customers, instant messaging to the customer, login page for suppliers.
- Function C: data analysis (aimed at port authority for the analysis of flows and improvement of transport performance in the port area). The interface will be: dashboard with aggregated analysis data for the port authority, dashboard with specific analysis data for each supplier.

A. Function A: travel preparation

Customer side

The customer will use the platform to plan the trip, they will insert departure and arrival destination, date of the trip and click on search button, figure 2. The platform uses Google Maps to show the different option to reach the defined access point of the port (in Venice Tronchetto, in Ancona the maritime station, in Split the maritime station), once arrived at the access point the user moves (by clicking on a specific button that allows sharing of its position for the time in which it is stationed in port) on a static SVG map drawn according to the routes from the maritime station to the embarkation dock.

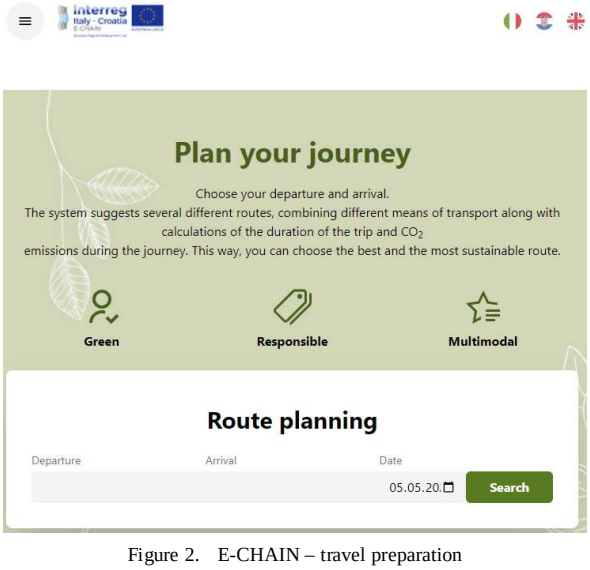

Figure 2. E-CHAIN – travel preparation

The path designed for the user is as follows:

- Search on the E-Chain portal with Google Maps
- User is notified of the CO2 of the various routes he sees
- Based on the suppliers reported, web platform place next to the link to proceed with the booking of the single service on the site of the supplier to which web platform associate a series of contacts. In the first case it would be advisable for the page to already open with the fields pre-filled by the search carried out by Google Maps. The purchased tickets should create a customer wallet created thanks to the tracked booking (link to the supplier site with trace of the starting site), to the data of this wallet we will associate the activities of function B. In the second case it will be the operator who will load in the single wallet the tickets purchased by activating the activities of function B. In particular, the tracking will take place between the E-CHAIN web portal and the sites of the various suppliers and between the sites of the various suppliers and E-CHAIN to activate function B.
- This second step is done consciously by the customer who clicks to request to be kept informed during the trip, the data are provided by the supplier with a dedicated link or uploaded by the customer if the supplier does not want to provide the dedicated link.
- At the end of the selection process or after completing the purchase, web browser returns to the E-CHAIN web page and web platform suggest in cross-selling or up-selling the non-transport services that web platform have managed with the DMS.

Supplier side

Web platform use Google Maps thanks to the "Google Transit" system that provides real-time data of timetables and means and is conceived as a channel manager, therefore in the future it will allow integration on an immense list of suppliers, for each of them integrating with Google Transit is free and works with API GTFS.

There are several web platforms and solutions that already exist on the market. Some platforms are created with the purpose of organizing trips around the world, regardless of the location such as Google Maps [2], Waze [3] and Herewego [4]. Other platforms allow the users to plan their trip through the booking of transportation (flights, ferries, buses, trains, etc.) and accommodation (hotels, campings, apartments, etc.), providing tips and contents to better organize their stay in the chosen destination such as Booking.com [5], Skyscanner [6], etc.

To understand the real usage of CO2 emissions there are web platforms which are dedicated to the CO2 calculators and the carbon footprint estimation such as Carbon Footprint calculator [7], Native - Carbon Offset Providers [8], PTV Map&Guide [9], Green Tripper calculator [10] and My climate [11].

E-CHAIN web platform have some competitive advantages because it's focused on the Adriatic area, so it's not a worldwide general platform as most of them are, nor a website focused on a single city or island. Web platform integrates several services that are important for travellers: the route calculator, information about what to do in the destinations and the CO2 calculator. It integrates the only CO2 calculator that is able to suggest the best way of transport that reduces the emissions. The other calculators available online are not suggesting the best route but ask the user to select from the start the vehicle they intend to use.

B. Function B: assistance during the journey

With the dedicated links and "keep me informed" service web platform will start the pre-filled editorial plans for instant messaging. These are predefined messages from individual suppliers, sent via SMS / email, which are sent on specific dates and times starting from basic information such as date and time of departure (of the ferry for example), route, means of transport up to the access point.

The path for the user of transport services is as follows:

- The user clicks on the dedicated link and accesses the landing page already preloaded with his travel data, is informed of the GDPR and clicks to start the editorial plan within which there are also the assistance numbers with short links for quick communication and effective (also dedicated chat for example)

The path for the transport service provider is as follows:

- Supplier establishes the contents of the editorial plans based on ports, seasonality, type of customers, dates of departure, etc.
- Supplier integrates a dedicated link on each confirmation email to the customer for online sales that preloads the above data in E-Chain and, upon the customer's consent, starts the editorial communication plan
- Supplier integrates the above customer data on a dedicated page, by importing from .CSV for example

The path for the non-transport service provider is the following:

- The supplier uses the DMS to load the bookable services and manage the availability on demanding request always with instant messaging, the DMS already starts the editorial plans as preloaded by the suppliers themselves.

The path devised for the user of non-transport services is as follows:

- The customer uses the DMS then receives confirmation via instant messaging and receives the communications of the editorial plan prepared by the supplier.
- The data needed to start the editorial plans (both transport and non-transport) are (non-exhaustive list to be reviewed together):
  - Date and time of departure - LIVE (from Google Transit or port authorities)
  - Place of check-in and how long before passenger must be there before boarding
  - Supplier contacts and assistance contacts
  - Languages spoken and passenger's special needs – loaded by supplier and / or customer after booking

The path for the PA (e.g. port services manager) is as follows:

- Tourist Board loads the events with date, time and place - if they match the client's arrival data, they are automatically sent to him in the editorial plan
- Weather station automatically send forecasted weather - simple integration with place and date and time
- Port authority or other territorial body provides special communications valid for defined periods of time (e.g. internal viability of the port temporarily modified with respect to what is present in the official communications) or particular indications (e.g. specific anti Covid regulations) or documents required for expatriation (e.g. post-Covid health passport/Green Pass)

There are few companies that offer a customer care service to their clients and outsource customer care services to other companies' like Amadeus [12] or WOW 24-7 [13].

E-CHAIN web platform have some competitive advantages because is the first "green" travel alert service, aimed not just to give customer support, but to reduce the emissions and therefore reduce the impact on the destinations. Also it's the first co-marketing project in the Adriatic area, aimed to improve the economic impact of the travellers who are just passing by the port areas.

C. Function C: data analysis

Web platform will provide two types of dashboards, one with aggregated data for the port authority and one with precise data for each supplier, always in a non-exhaustive form, they are divided by the phases before and during the trip.

Before the trip:

- Analysis of requests and routes requested on the site
- Analysis of how many links to suppliers' booking sites have been detected and how many have been successful
- Percentages of reduced CO2 (and how many have chosen to reduce it compared to the fastest/cheap trip)
- Successful cross-selling rates

During the trip:

- Geolocation of users who have joined the service in real time
- List of special needs shown (to create standard patterns of behaviour with which to respond)

Web platform will also give both port authority and suppliers the possibility to send a message after the use of the service, for example to fill out a customer satisfaction questionnaire or to up-sell.

This phase involves the creation of reports which will then be made available to the partner/supplier companies and to public authorities, so as to allow better insight of the needs of passengers, improve the clients flow and provide targeted services.

Few web platforms have been identified that can offer detailed reporting and data analysis services related exclusively to tourism like Travel Appeal [14], Str [15], Mabrian [16], MMGY Intel [17], Nsight For Travel [18], Hbenchmark [19], etc.

E-CHAIN web platform have some competitive advantages because is the only service focused on specific Adriatic locations that has data on these destinations, provided directly by the travel companies. Collected data is more complete than other providers, since it is collected starting from the travel intent to the real ticket purchase (through the travel companies who require the CRM service) and to the travel feedback. E-CHAIN web platform also provides a full service that includes the customer care alerts and a strong intelligence service to the travel companies that join the project.

D. TOTEM

In the pilot sites of Ancona and Split will be placed two different types of totems, to let the people in the port area to be able to use the E-Chain's services, figure 3.

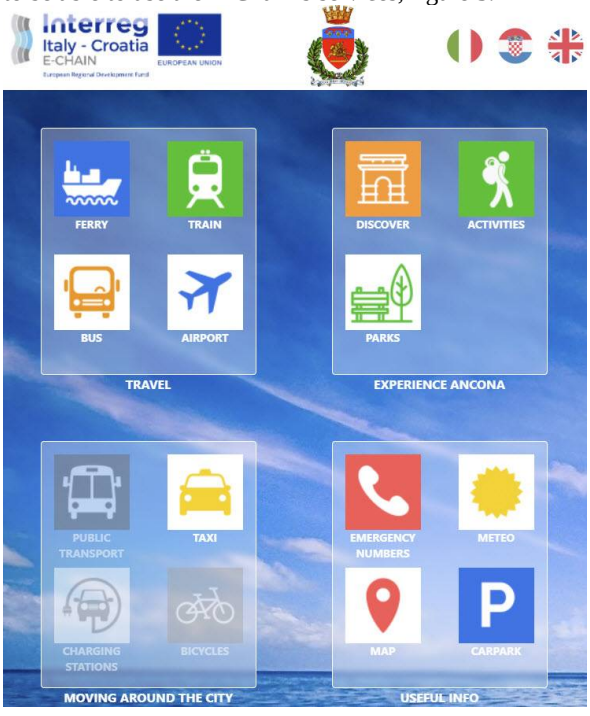

Figure 3. E-CHAIN pilot sites totem

The totems that will be placed in Split will be touch responsive while the Ancona's one not. In the Ancona's one different pages will be showed in a carousel to display as much information as the E-CHAIN web platform. QR code's will be used to let the travellers easily send the interested information in their smartphone. The totem in Split will be just a personalization of the Split web page of the platform. Both Split and Ancona will have the possibility to manage the information showed in the totems.

IV. E-CHAIN MAIN OUTPUTS AND RESULTS

Main outputs and results of E-CHAIN project are:

- After the identification of state of the art, identified stakeholder roles and goals, defined use-cases (2 pilot sites), analyzed potential E-CHAIN service use-cases, studied service and content providers' requirements.
- Definition of users' functional and performance requirements for the proposed E-CHAIN platform and application features.
- E-CHAIN collaborative and platform for a seamless trip solution and service implementation. E-CHAIN will provide timetables and travel solutions optimizing resources (vehicles, staff), real-time events: plan trip from origin to destination, integrating train, bus and ferry logistic information. E-CHAIN will include booking and ticketing allowing the unique payment for trips performed by different operators thanks to integration: transport operators, passengers, maritime agency, public authorities.
- E-CHAIN pilot implementation which consists of Business Model creation based on specific pilot site's needs (Ancona and Split): staff training, installation plan for the Pilot Sites, operational test, evaluation of the project benefits and final review of the Business Plan defining corrective actions for each Pilot Site and giving recommendations for transferability.

V. CONLUSION

E-CHAIN modular integrated information software is designed as web platform and it is divided in three principal functions: before, during and after the trip. Before the trip function is created to help travelers define their route, buy tickets, hotels and organize their trip in a more general way and it is dedicated to the CO2 calculator and the carbon footprint estimation. During the trip function provide the travelers useful information about their trip (time tables, addresses information, delays, warnings, etc.). The after trip phase involve the creation of reports based on aggregated information, collected both through the analysis of the passenger's data and the messages sent to them, and through surveys to passengers who have used the service. In each of three phases E-CHAIN web platform will have some competitive advantages because it's focused on the Adriatic area to improve the economic impact of the travellers who are just passing by the port areas. It integrates the only CO2 calculator that is able to suggest the best way of transport that reduces the emissions and therefore reduce the impact on the destinations. E-CHAIN web platform also provides

a full service that includes the customer care alerts and a strong intelligence service to the travel companies that join the project. Future works will include development of additional modules, adding more suppliers with Google Transit routing and uploading the events with date, time and place on the web platform.

ACKNOWLEDGMENT

The presented research has been supported by the European Regional Development Fund, under the Interreg V IT-HR CBC programme, project ID: 10048282 (E-CHAIN).

REFERENCES

[1] E-CHAIN official website, https://www.italy-croatia.eu/web/e-chain (20.02.2022.)

[2] Google Maps, https://maps.google.com/ (15.02.2022.)

[3] Waze, https://www.waze.com/ (15.02.2022.)

[4] Herewego, https://wego.here.com/ (15.02.2022.)

[5] Booking.com, https://www. booking.com/ (16.02.2022.)

[6] Skyscanner, https://www.skyscanner.com/ (16.02.2022.)

[7] Carbon Footprint calculator, https:// calculator.carbonfootprint.com/ (17.02.2022.)

[8] Native - Carbon Offset Providers, https://www.native.eco (17.02.2022.)

[9] PTV Map&Guide, https://www.ptvgroup.com/en/solutions/products/ptv-mapandguide/ (17.02.2022.)

[10] Green Tripper calculator, https://www.greentripper.org/ (17.02.2022.)

[11] My climate, https://CO2.myclimate.org/ (17.02.2022.)

[12] Amadeus, https://amadeus.com/ (19.02.2022.)

[13] WOW 24-7, https://wow24-7.io/ (19.02.2022.)

[14] Travel Appeal, https://www.travelappeal.com/ (19.02.2022.)

[15] Str, https://str.com/it/data-solutions/ (19.02.2022.)

[16] Mabrian, https://mabrian.com/ (19.02.2022.)

[17] MMGY Intel, https://www.mmgyintel.com/ (19.02.2022.)

[18] Nsight For Travel, https://www.nsightfortravel.com/ (19.02.2022.)

[19] Hbenchmark, https://www.hbenchmark.com/ (19.02.2022.)

[20] Laravel, https://laravel.com/docs/9.x (23.02.2022.)

[21] H. Abutaleb, A. Tamimi and T. Alrawashdeh, "Empirical Study of Most Popular PHP Framework," 2021 International Conference on Information Technology (ICIT), 2021, pp. 608-611, doi: 10.1109/ICIT52682.2021.9491679.

[22] Symphony2, https://symfony.com/ (23.02.2022.)

[23] MySQL database server, https://dev.mysql.com/doc/refman/8.0/en/introduction.html (23.02.2022.)

[24] Angular, https://angular.io/guide/what-is-angular (25.02.2022.)

[25] TypeScript, https://www.typescriptlang.org/ (25.02.2022.)

Realization of a modular integrated software for the management of multimodal passenger transport services in port areas

Dario Ogrizović[1], Ana Perić Hadžić[2], Valentina Šutalo Šamanić[3*]

[1]*Faculty of Maritime Studies, University of Rijeka*
E-mail: dario@pfri.uniri.hr

[2]*Faculty of Maritime Studies, University of Rijeka*
E-mail: ana.peric@pfri.uniri.hr

[3]*Faculty of Maritime Studies, University of Rijeka*
E-mail: valentina.sutalo@pfri.uniri.hr

Abstract

The development of a modular integrated software for the management of intermodal transport services in port areas for passenger transport will improve data connectivity and harmonization for the Adriatic intermodal network, increasing the efficiency, quality, safety and environmental sustainability of maritime and coastal transport services. It will be shown how services, interfaces and core functionalities can be designed and developed in a modular software platform. The modular integrated information software E- CHAIN was developed as a web platform and is divided into three main functions: before, during and after the trip, which are described in detail in this article. In the future, new modules will be developed, more providers will be integrated with Google Transit Routing and events with date, time and location will be uploaded to the web platform. This study was funded by the European Regional Development Fund under the Interreg V Italy-Croatia CBC program, project ID: 10048282. (E- CHAIN - Enhanced Connectivity and Data Harmonization for the Adriatic Intermodal Network).

Keywords

modular integrated software, multimodality, transport services, data connectivity and harmonization

References

[1] E-CHAIN official website, https://www.italy-croatia.eu/web/e-chain (20.02.2022.)
[2] Google Maps, https://maps.google.com/ (15.02.2022.)
[3] Waze, https://www.waze.com/ (15.02.2022.)
[4] Herewego, https://wego.here.com/ (15.02.2022.)
[5] Booking.com, https://www. booking.com/ (16.02.2022.)
[6] Skyscanner, https://www.skyscanner.com/ (16.02.2022.)

[7] Carbon Footprint calculator, https:// calculator.carbonfootprint.com/ (17.02.2022.)
[8] Native - Carbon Offset Providers, https://www.native.eco (17.02.2022.)
[9] PTV Map&Guide, https://www.ptvgroup.com/en/solutions/products/ptv-mapandguide/ (17.02.2022.)
[10] Green Tripper calculator, https://www.greentripper.org/ (17.02.2022.)
[11] My climate, https://CO2.myclimate.org/ (17.02.2022.)
[12] Amadeus, https://amadeus.com/ (19.02.2022.)
[13] WOW 24-7, https://wow24-7.io/ (19.02.2022.)
[14] Travel Appeal, https://www.travelappeal.com/ (19.02.2022.)
[15] Str, https://str.com/it/data-solutions/ (19.02.2022.)
[16] Mabrian, https://mabrian.com/ (19.02.2022.)
[17] MMGY Intel, https://www.mmgyintel.com/ (19.02.2022.)
[18] Nsight For Travel, https://www.nsightfortravel.com/ (19.02.2022.)
[19] Hbenchmark, https://www.hbenchmark.com/ (19.02.2022.)
[20] Laravel, https://laravel.com/docs/9.x (23.02.2022.)
[21] H. Abutaleb, A. Tamimi and T. Alrawashdeh, "Empirical Study of Most Popular PHP Framework," 2021 International Conference on Information Technology (ICIT), 2021, pp. 608-611, doi: 10.1109/ICIT52682.2021.9491679.
[22] Symphony2, https://symfony.com/ (23.02.2022.)
[23] MySQL database server, https://dev.mysql.com/doc/refman/8.0/en/introduction.html (23.02.2022.)
[24] Angular, https://angular.io/guide/what-is-angular (25.02.2022.)
[25] TypeScript, https://www.typescriptlang.org/ (25.02.2022.)

Logistics and Supply Chain

Green Travel Planner and Infomobility Modular Software Platform

Dario Ogrizović, Ana Perić Hadžić, Mladen Jardas & Valentina Šutalo Šamanić,

Faculty of Maritime Studies, University of Rijeka

The Green Travel Planner allows users traveling between Italy and Croatia to calculate, compare, and select different routes based on their estimated CO_2 consumption depending on the distance and duration of the journey. Users will use the platform to plan their trip. They will enter their departure and arrival locations and travel dates, and click the "Search" button. The platform uses Google Maps to display the different travel options to the defined destination with the CO_2 values of the different routes. The platform promotes the greenest travel option throughout the user's journey starting from the purchase process to the destination. Green travel infomobility provides the option to sign up for the platform's support system, which will send users a series of messages about boarding/landing procedures and port mobility services. The use of instant messaging enables real-time management of critical situations for both users and providers, and ensures a fast and secure contact channel to avoid crowding. The first message comes immediately after the purchase and shows the amount (kilograms) of CO_2 consumed compared to the use of private vehicles. Then the user has to subscribe to the plan according to the GDPR legislation and receives the rest of the messages suggesting eco-friendly behaviour.

Sustainable Mobility

E-CHAIN Web Platform for Sustainable Passenger Transport

Valentina Šutalo Šamanić, Mladen Jardas, Ana Perić Hadžić & Dario Ogrizović,

Faculty of Maritime Studies, University of Rijeka

The E-CHAIN web platform will improve the efficiency, quality, safety and environmental sustainability of maritime and coastal passenger transport in the Adriatic region. The E-CHAIN web platform is developed using the PHP MVC framework Laravel, and MySQL database (back-end), while the client part (front-end) is built using the JavaScript framework Angular and Google Maps API. The GTFS (General Transit Feed Specification) and GTFS-real-time are used to exchange static and real-time public transit data (stops, routes, schedules, live departure times, service alerts, etc.). The E-CHAIN web platform is divided into three main functions: travel preparation (before the trip), support during the journey (to facilitate the relationship between customer and provider) and data analysis (for the port authority to analyse flows and improve transport performance in the port area). The potential for B2B, B2C and B2PA and the functionality of the E-Chain web platform are presented. The presented research was supported by the European Regional Development Fund, under the Interreg V IT-HR CBC programme, project ID: 10048282 (E-CHAIN).

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MODULARNA SOFTVERSKA PLATFORMA ZA UČINKOVITI I ODRŽIVI PUTNIČKI PROMET

Marko Bakarčić

Univ. bacc. ing. logist., student, Sveučilište u Rijeci, Pomorski fakultet, Studentska 2, 51000 Rijeka, Hrvatska;

e-mail: bakarcic.marko2@gmail.com

Ozren Rafajac

Dr. sc., viši predavač, Veleučilište u Rijeci, Vukovarska 58, 51000 Rijeka, Hrvatska; e-mail: ozren.rafajac@gmail.com

Dario Ogrizović

Dr. sc., docent, Sveučilište u Rijeci, Pomorski fakultet, Studentska 2, 51000 Rijeka, Hrvatska; e-mail: dario@pfri.uniri.hr

SAŽETAK

E-CHAIN modularna softverska platforma predstavlja jedinstveno rješenje za upravljanje intermodalnim prometnim uslugama u lučkim područjima za putnički promet kako bi se poboljšala učinkovitost, kvaliteta, sigurnost i ekološka održivost pomorskih i obalnih prijevoznih usluga. Omogućava redove vožnje i putnička rješenja koja optimiziraju resurse te događaje u stvarnom vremenu kao što je planiranje putovanja od polazišta do odredišta pritom integrirajući logističke informacije o vlakovima, autobusima i trajektima uz ekološku održivost usluga koje doprinose smanjenju emisije CO2. E-CHAIN platforma nudi mogućnost rezervacije i prodaje karata omogućujući jedinstveno plaćanje putovanja koju obavljaju različiti operatori zahvaljujući integraciji: prijevoznici, putnici, pomorske agencije, javne vlasti. E-CHAIN platforma nastala je kroz provedbu Interreg V IT-HR CBC E-CHAIN (Enhanced Connectivity and Harmonization of data for the Adriatic Intermodal Network) projekta financiranog od Europskog fonda za regionalni razvoj.

Ključne riječi: *E-CHAIN, prijevoz putnika, ekološka održivost*

FROM FRAGMENTATION TO COLLABORATION FOR CROSS-BORDER SUSTAINABLE TOURISM: THE E-CHAIN EXPERIENCE (#42)

ELISA MARIAVITTORIA BERTOLINI

Dipartimento di Ingegneria e Architettura (DIA) - Università degli Studi di Trieste | Italia

elisamariavittoria.bertolini@phd.units.it

LORENZO CASTELLI | GIOVANNI LONGO

Aims: The purpose of this paper is to identify the main challenges that need to be faced in creating a cross-border tourism network. The work relies on the analysis of a case study: the E-chain project. This is an INTERREG ITA-CRO project that aims to develop an info-mobility platform to combine a range of modalities and services (transport-related, cultural and commercial) to provide information on travels between Croatia and Italy.

Theoretical framework: In recent years, the concept of network collaboration has stimulated wide interest in tourism management studies as it can remedy the lack of coordination and cohesion within highly fragmented environments, as cross-border coastal tourism. There is a general belief that participation in a collaborative tourism network produces benefits: tourists will increase, and the network makes it possible to reap the benefits of tourist growth by mitigating its negative consequences. The analysis of the literature, however, highlights the scarcity of empirical evidence linked to this theory.

Methods: The E-Chain platform is the virtual place upon which the cross-border tourism network is built because tourists are going to generate useful data about their trips, such as their routes, interests, special needs, etc. that would be very useful to the other stakeholders. In fact, the tourist data collected by the platform will be analysed, aggregated and shared to transport companies, local businesses and even Authorities and Municipalities, which need to have a better understanding of the tourists flows in their areas improving the traffic management and the quality of life of their cities. Before developing and implementing the platform, it is necessary to simulate its utilization and its features, involving different stakeholders to understand (a) how they would interact with the platform, (b) the relevance of platform features, and (c) improvement suggestions. In this simulation phase, two main data collection methods have been used in order to obtain results able to validate the supported assumptions: two simulation surveys, for tourists and stakeholders respectively, and four focus groups supported by all E-Chain partners.

Results and discussion: The multifaceted E-Chain partnership consents to better understand management problems in transnational tourism and shows what are the main challenges in creating a cross-border tourism network that allows vertical and horizontal integration of services. The relations between the objectives of the tourism network and the expected results provides evidence that changes in travel patterns may occur not only focusing on individual choices but on paying more attention to shaping the overall travel chain with people at the center.

Conclusions and research implications: This paper allows for a critical reflection on the relations between the objectives of a cross-border tourism network and the expected results. In view of realizing the benefits deriving from the network the role of public and private actors in the management of tourism must be rethought, reducing the gap between the various actors. Achieving changes in travel patterns needs a pluralistic approach: relationship and collaboration between stakeholders are fundamental for the creation of tourism networks based on cross-sector partnerships.

Originality/value: This paper explores the main obstacles to the realization of a cross-border tourism network through the analysis of a case study.

Keywords: Coastal tourism; Transport; Cross-border; Collaboration; Tourism network.

References

Bramwell, B., & Lane, B. (Eds.). (2003). *Tourism collaboration and partnerships: Politics, practice and sustainability* (Vol. 2). Channel View Publications.

Cairns, S., Harmer, C., Hopkin, J., & Skippon, S. (2014). Sociological perspectives on travel and mobilities: A review. *Transportation Research Part A: Policy and Practice*, 63, 107-117.

Gunn, C. A. (1977). Industry pragmatism vs tourism planning. *Leisure Sciences*, 1(1), 85-94.

Hrelja, R., Rye, T., & Mullen, C. (2018). Partnerships between operators and public transport authorities. Working practices in relational contracting and collaborative partnerships. *Transportation Research Part A: Policy and Practice*, 116, 327-338.

van der Zee, E., & Vanneste, D. (2015). Tourism networks unravelled; a review of the literature on networks in tourism management studies. *Tourism Management Perspectives*, 15, 46-56.

11:50 ▶ 12:10 Room 4H	Marco Bocciolone, Pierluigi Coppola, Francesco De Fabiis **Economic and environmental Life-Cycle Assessment (LCA) of bus fleet transition towards clean-fuel**
12:10 ▶ 12:30 Room 4H	Valeria J. Aranda Salgado, Roberto Notari, Lorenzo Mussone **Evaluation of Robustness in underground networks**
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12:10 ▶ 12:30 Room 5H	Facundo Storani, Luca Di Costanzo, Luigi Pariota **Quantifying transportation system contributions to urban air quality by means of Land Use Regression models**	
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14:30 – 16:10	SCIENTIFIC SESSION	Room 4H
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ci lasci scusare per il ritardo della risposta, ma purtroppo sono settimana intense di attività di diversa natura e non di rado risulta alquanto difficile stare al passo con le comunicazioni.

Detto questo, La ringraziamo per l'attenzione prestata alla nostra rivista per la pubblicazione del vostro saggio "E-Chain come modello di mobilità sostenibile per promuovere un flusso sostenibile di passeggeri nell'area Adriatica".

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Gather travel needs and preferences to customize truly inclusive experiences

The case study of the Interreg E-chain project

Elisa Maria Vittoria Bertolini, ***University of Trieste***
Lorenzo Castelli, ***University of Trieste***
Barbara Chiarelli, ***University of Trieste***

Abstract

Accessibility is a central element of any responsible and sustainable tourism policy: it is both a human rights imperative, and an exceptional business opportunity, as mentioned by UNWTO Secretary-General Taleb Rifai. Accessible tourism for all is not only about providing access to people with disabilities, but also it addresses the creation of universally designed environments that can support people that may have temporary disabilities, families with young children, the ever increasing ageing population as well as creating a safer environment for employees to work. It must also be considered that accessible tourism benefits everyone: as more individuals enjoy the opportunity to travel, the tourism industry gets more visitors, longer seasons and new incomes. Society as a whole benefits from new job opportunities, more tax revenue and an accessible environment for both inhabitants and visitors.

As cited by the report Recommendations on Accessible Tourism by UNWTO, accessibility must be present throughout the tourism chain: links between all sites, services and activities must be well planned and tested. Elements of the tourism chain include: tourism destination management; tourism information and advertising (Preparation, information and booking); urban and architectural environments; modes of transport and stations; accommodation, food service and conventions; cultural activities (museums, theatres, cinemas, and other); other tourism activities and events.

The following discussion presents the approach taken within the Italy-Croatia Interreg Project "E-Chain – Enhanced Connectivity and Harmonization of data for the Adriatic Intermodal Network", focused on the provision of useful and personalized information for the traveling user. The project effort has moved in the direction of creating a multimodal info mobility platform useful for offering to transit passengers a range of integrated intermodal transportation services and travel solutions between the two sides of the Adriatic, allowing them to optimize the search for information during all phases of travel (before, during, after). Through a preliminary registration, the user is profiled according to specific categories, e.g., user travelling with family, user travelling specifically with small children (0-3 years old), user with disability, user travelling as a helper of a person with disability. The needs of those categories are very different than those traveling alone or with other adults, starting from the planning of the trip which becomes a strategic phase:

knowing in advance what you will encounter before, during and after the trip are essential information to avoid problems or inconveniences that could make the experience negative.
To function at full capacity, and thus provide useful and personalized information to travelers, the platform needs to receive data of various types, both from the public and private sectors: transportation schedules, types of services offered, characteristics of venues and spaces open to the public, ...
Where do we stand with the availability and accuracy of all this amount of data?
Although there are more and more tourism providers on the market that seek to meet the criteria of accessibility, however, there remain some critical issues that need to be strategically addressed: a general lack of awareness and knowledge of the needs of the most vulnerable users; a general unsystematic involvement of the most vulnerable users in defining what "accessible" means; an uneven and/or hypertrophic provision of information, often inaccurate.

In one sentence:
what impedes the implementation of Universal Design principles in your experience?
In the case study investigated, the unavailability of some data does not allow the provision of truly personalized information to users. For example: some hotels make available information regarding the accessibility of their rooms (private data), but there is no data with respect to the urban accessibility of the neighbourhood and nearby services (public data).

In one sentence:
what is necessary to change the situation for the better?
The information most relevant to vulnerable users should emerge and be integrated, to obtain a broad overview of the possibilities that a place can offer in terms of accessibility and hospitality.

References
https://www.italy-croatia.eu/web/e-chain

Isabelle Cloquet, Marco Palomino, Gareth Shaw, Gemma Stephen & Tim Taylor (2017): Disability, social inclusion and the marketing of tourist attractions, Journal of Sustainable Tourism, DOI: 10.1080/09669582.2017.1339710

Peter Conradie, Sunil Choenni (2014): On the barriers for local government releasing open data, Government Information Quarterly, DOI: https://doi.org/10.1016/j.giq.2014.01.003

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An info-mobility platform for sustainable tourism: the E-Chain case study

Sara Carciotti [1], Dario Ogrizovic [2] and Lorenzo Castelli [1,*]

[1] University of Trieste, Italy; scarciotti@units.it, castelli@units.it
[2] University of Rijeka, Croatia; dario@pfri.uniri.hr
* Correspondence: castelli@units.it

Abstract: Nowadays, an integration of tourism demand and supply is necessary to pursue the goal of territory's sustainable development. The integration of demand and offer is possible by the introduction of the personalised experience concept in the tourism system. This paper proposes the ICT technology as a key tool for the creation of a personalised touristic experience. In this context, the E-Chain project is proposed as a case study. The E-Chain aim is to enhance connectivity and harmonization of data for the Adriatic Intermodal Network. Moreover, through the realization of a modular software platform for the management of intermodal transport services in port areas for passengers, the project is able to improve efficiency, quality, safety and environmental sustainability of marine and coastal transport services. This case study is a first step of good tourism practices to meaningfully integrate ICTs into tourism experiences aimed at a sustainable future.

Keywords: Sustainable tourism; ICTs in tourism experiences; big data platform

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1. Introduction

According to the UNWTO World Tourism Barometer, the 2019 was the tenth consecutive year of tourism growth after which the global trends had changed as never happened before. From a continuous growth with 1.5 billion international tourist arrivals recorded globally to a nearly complete stop due to the Covid- 19 pandemic period. In 2020, the worldwide tourist's destinations have received 1 billion fewer international arrivals than in the previous year [1]. Moreover, a lot of industries were seriously affected by the Covid - 19 crisis, and the T&T (travel and tourism) industry is unarguably one of those industries [2]. During the 2020, a lot of tourist destinations were forced to stop due to lockdown measures causing both job losses and economy crisis: before the pandemic, the tourism industry (at a global level) accounted for 10.6% of total employment (334 million jobs) corresponding to 10.4% of global GDP (USD 9.2 trillion) [3].

However, there are a good chance that in the next years, the number of tourists return as in the past and that environmental situation arise in the future worse than before. Let us not forget that some cities as Dubrovnik, Barcelona, and Venice were under pressure already before the pandemic due to the massive tourist flows [4]. Moreover, the investigation of tourist flows impacts on the territory (socio economic, cultural and environmental impacts), be they positive or negative, is well studied in the literature and it has become a primary research interest in the last two decades. Furthermore, a tourist destination is susceptible to both material and immaterial impact caused by the tourism flows and improper management of these flows can cause irreparable damage to the destination [5].

In this context, this paper focuses the attention on a specific touristic territory, and more in detail, on the passengers flows that arrive, move and depart in the port-city destination. Generally, this kind of tourism is seen as mass tourism and consequently considered as unsustainable [6]. In the last decades, the Sustainability concept in the tourism industry has become a key variable in the competitiveness of tourist destinations [7].

However, making tourism sustainable is not easy due to its multidisciplinary structure. It has to be an intersection of heterogenous activities that are at the same time socially acceptable, economically viable, and environmentally appropriate.

In the continuation of this sustainability aim, this paper raises the issue whether passengers' flows are an intrusive activity or an opportunity for the port-city development. From a historical point of view, the port-city relations are always been complex system and this became even more evident with the introduction of information and communication technologies (ICTs). Moreover, a lot of destinations follow a governance model which are not in tune with the times and forward-looking. Several times, the tourism sector had evolved following the globalization and technological development, whereas the tourism destination had difficulty to change so fast [8].

This missing link between port and cities has led to an uncontrolled growth of tourist flows and consequently to an unsustainable development of the territory as well as to a tourists and residents' dissatisfaction. Therefore, this paper responds to the European call for further research on the sustainability of tourism development [9] with a proposal of a new way of integrated services for passengers' flow management in order to promote a sustainable territorial governance in the city-port destination.

The main contributions of this paper are related to the case study proposed. The INTERREG Italy-Croatia Project called E-Chain (Enhanced Connectivity and harmonization of data for the Adriatic Intermodal Network) focuses on providing new services such as an improved port multimodal info-mobility system for the passengers and an advanced touristic co-marketing tool for the operators. The aim is the development of an info-mobility platform to improve passenger connectivity between the two sides of the Adriatic Sea, allowing to optimize in real time the available resources.

The remainder of this work is organized as follows: Section 2 presents literature review on tourism experiences focusing on the globalization and technological development changes. Section 3 delves some of the most relevant tools for managing the immaterial network of information to develop a sustainable territory. Section 4 introduces a case study about the Interreg Italy-Croatia project called E-Chain.

2. Globalization and technological development in tourism

In the current tourism overview, characterized by an increasingly competitiveness and a multitude of services, the balance between the supply and demand is a factor not to be underestimated to maintain a tourist destination sustainable. In the last decades, the digital technology evolution led to a change in the tourism structure; from tourism to e-tourism until smart tourism, where the ICTs (Information and Communication Technologies) are fully integrated into the tourism system [10]. Moreover, also the demand (tourist) and the offer (services) have changed over time.

In the past, the tourism companies only defined and decided about the services to offer and there was no data exchange between the users, whereas nowadays, the tourist can co-create and personalize the services by his/her needs. Therefore "knowledge" data are shared, the innovation is user-driven, and services' offer fits to user needs [11]. Consequently, also the tourist destination, in order to be innovative and competitive, needs a change in the tourism system structure due to the dematerialisation of services. This technological transition can be achieved by introducing the ICT technology in the tourism system because it transforms the tourism industry in an extremely dynamic system able to adapt to the rapid evolution of digital technologies. Furthermore, an approach designed to smartness is needed to be introduced in the tourist destination management.

Since the 2000s, the Smart Tourist Destination concept can be found in the literature and it is closely related to the research on Smart Cities [12]. There is no a single definition for a Smart Tourist Destination. Overall, it is a combination between smart tourism with smart city [14], where the territory considered can be associated with any territorial unit (place, city, region, or country) and the goal is to improve the experiences of tourists [15]

and improve the quality of life of residents [16] as well as introducing a sustainable development and use of the territory [17].

Nowadays, to consider the territory in a sustainable and circular way, it is necessary to introduce the concept: "Destination as a Service", where the destination itself is a service for both tourists and local community. However, to achieve this goal, a change from infrastructure-oriented development to service-oriented development [18] is necessary due to a process of product dematerialisation has begun [19].

Moreover, when the tourism destination is itself a Service, the tourism is just a piece of a more complex network of services (transport, commerce, cultural-heritage, hospitality, etc.) that must go on even if there is no tourism. Indeed, the introduction of integrated services for both residents and tourists would allow the destination to maintain its economy also in front of a global block as for e.g., during the Covid -19 pandemic.

2.1. Tourism Experiences

In the past the tourists used to buy tangible products (such as souvenirs, food, etc.) whereas, nowadays, they have shifted in part their interests from material goods to services and memorable moments, better defined as "experiences" [8]. In the near future, the experience concept has to become the main product of tourist destination and it has to be linked with the pre and post trip. It is well documented in the literature, that the concept of vacation is no longer lived only on the territory, but it is extended also to a pre (planning) and a post trip (memories and publishing of the content on social media).

Moreover, in context of the experience economy, the tourist experience has to be considered as fourth form of economic offer, after commodities, goods and "ordinary" services [20]. In this way, the experience creates value and the destination acquires an intangible, desirable and unique value. Consequently, the destination has to become itself a service and thus having a direct impact on tourist satisfaction.

However, the evolution of tourism demand and the growing competitiveness between destinations lead us to reflect on the dimension (virtual, material or mixed) of the service in which to live the tourist experience. The service could be the space (virtual and/or physical) in which all the interconnections between users take place to create the experience. This is particularly advantageous for the entire destination system, because through the widespread information systems at macro and micro level on the territory or online, the Smart Tourist Destination can take advantage of technological environments to improve the exchange of information / knowledge between users and consequently, respond to needs of the Public Administration, B2B and B2C.

2.1. The importance/necessity of personalization

The main challenge introduced by the new economic era is to develop the customer-oriented services. This consists of a personalization of the experience so that it becomes a memorable and emotional event for those who use the services [21].

Nowadays, the tourist is ever more demanding and he is searching for experiences that are as tailor-made as possible and based on feedback from an increasingly interconnected community. Those changes in the demand are pushing the tourist destinations towards strategies for conquer their clients' loyalty. The most attentive tourist's destinations have been aware of this unstoppable trend for years now, and they know how many opportunities lie within it. Moreover, a Mastercard-sponsored Harvard Business Review report [22] clearly shows that organizations that can successfully deliver personalized experiences have higher revenue and profits if the services are delivered at the right moment. However, this is hard to achieve if we are talking about real-time or short-term services due to the short response time.

The services personalisation is based on co-creation and it takes the users and the territory as a starting point [23]. The dialog with each customer as a single person based

on his/her own behaviours, characteristics, preferences and his/her unique, individual needs, makes the user co-creator of the service. In this context, the user is active in the phases of understanding, prototyping, validation and revision of complex solutions [11].

Therefore, in order to respond to users' personalization needs, the tourist destination has to involve the users in services as well as adopt new solutions, approaches and tools to analyse as many data as possible [11]. Consequently, in the tourist destination, the single data has a value and it has to be part of an intangible network of data associated to the destination, as addressed in the next chapter.

3. The immaterial network of ICT services for a sustainable territorial development

Information and communication technologies (ICTs) have changed the way how travel and tourism industries promote their products and services and the way how tourists purchase those products and services. Especially, smart information and communication technologies have strong influence on tourism experience, providing tourists with helpful information in planning their trips, making purchases, consuming and sharing their experiences. As previously stated, smart tourism evolved from the combination of tourism and ICTs or from tourism and smart technologies that allow collection, integration and utilization of massive amounts of data to be transformed into an improved and more personalized and enjoyable tourism experiences [24]. S. Shen et al. [25] listed different types of smart ICTs that are used in smart tourism, ranging from mobile devices (smartphones, tablet computers, etc.) IoT, Cloud Computing, Big Data, AI to virtual and augmented reality. Each of different type of smart ICTs comprise the immaterial network of ICT services based on code, software solutions, data bases, knowledge, etc. which serve as a basis for the digitalisation process and sustainable territorial development by providing key innovations services, such as digital platforms, web and mobile applications.

Tourists use mobile devices at daily basis as a travel companions to instantly access a wide variety of information (accommodations, attractions, gastronomy, navigation, transportation, weather, etc.) through web and mobile applications, supporting them in their travel and activities, to quickly answer their questions and instantly share their experiences [26, 27, 28]. The Internet of Things (IoT) is a network of various connected devices, sensors and actuators that are designed to collect and exchange data in real time and to interact with each other [29, 30]. IoT will provide always on and responsive situated content and services which will enable new ways of working, interacting, entertainment, and living [31, 32, 33]. IoT will enable travel and tourism service providers to offer location-based services because tourists' locations and their behaviour could be tracked [24]. Cloud Computing have been defined as on demand network of shared configurable computational resources that can be rapidly provisioned [34]. Cloud solutions that are continuously updated, reliable and scalable are the basis for travel and tourism infrastructure and services. Due to the large number of people, processes, and activities involved, travel and tourism data are often big datasets which can be analyzed with big data analytics tools and services to reveal patterns, trends and correlations [35]. An enormous quantity of data about tourist and travel experiences and digital footprint of tourist's presence in travel destinations is constantly generated on social media and big data analytics can be used to find meaningful insights [36, 37]. Big data is used to personalize offering of products and services for a better local tourist experience and to improve the quality of tourism services by public and private organizations [38, 39]. Artificial Intelligence is the scientific study of what problems can be solved, what tasks can be accomplished, and what features of the world can be understood, and then to provide algorithms to show how this can be done efficiently, practically, physically, and ethically [40]. AI has been implemented into many areas of the transport [41], travel and tourism industry such as AI assistants and intelligent chatbots for travel and accommodation booking [42], AI-driven smart price prediction applications [43], smart voice assistant (SVA) for face-to-face customer services

[44]. Virtual reality (VR) gives the user a realistic feeling or a perception of being physically present inside an artificial, computer-generated digital environment where users can interact with virtual objects by the aid of VR hardware and software using 3D computer graphics and real-time rendering. Augmented reality (AR) combines virtual and real environments, where virtual objects are overlaid on real world using head mounted displays or mobile devices. VR and AR can be used as a marketing mediums to promote a touristic destination, creating a positive memorable experience and immersive stimulation to tourists, that can significantly increase satisfaction, destination visit intention, and positive word-of-mouth intention [45, 46, 47, 48, 49, 50, 51].

The web and mobile applications are integral part of the smart ICTs because no matter what type of technology is used applications are essential part of the final product or service. They are launching a new way of using computers and mobile devices on the move which is very popular within the new digital generation of tourists (generation X and millennials) who are technologically highly aware and make travel decisions based on sustainability and innovative ICT tools.

4. E-CHAIN modular software platform for intermodal mobility and sustainable tourism

E-CHAIN (Enhanced Connectivity and Harmonization of Data for the Adriatic Intermodal Network) is an Interreg V IT-HR CBC programme project funded by the European Regional Development Fund.

The main E-CHAIN project objective is to enhance connectivity and harmonization of data for the Adriatic Intermodal Network, through the realization of modular software platform for the management of intermodal transport services in port areas for passenger to improve efficiency, quality, safety and environmental sustainability of marine and coastal transport services [52]. The project aims to implement a unified travel planner system managing both transport and entertainment services for the entire journey between Italy and Croatia through the creation of a searching module based on Google Maps connected with the GTFS (General Transit Feed Specification) info of transport suppliers. During the research for intermodal solutions, the system will show the CO2 consumption based on suppliers' declaration (for car/bus transport) software helping customers to choose the ones with the lighter impact on the environment. Transport and services bookings are managed directly by each supplier (redirect for transport ones, destination management system for the other services.) Software platform is made in the form of a framework based on connectors with local service providers in a modular form to be able to adapt to the different port traffic between Italy and Croatia.

4.1. Software architecture

The E-CHAIN modular software platform is based on server (backend) and client (frontend) architecture, Figure 1. The backend is implemented with the most popular PHP MVC framework Laravel [53] and the backend database is based on MySQL database software [54] with small microservices for certain subtasks (i.e., message management, shorturl, etc.). The frontend is based on web application for administration and public interfaces and is built with the JavaScript framework Angular [55].

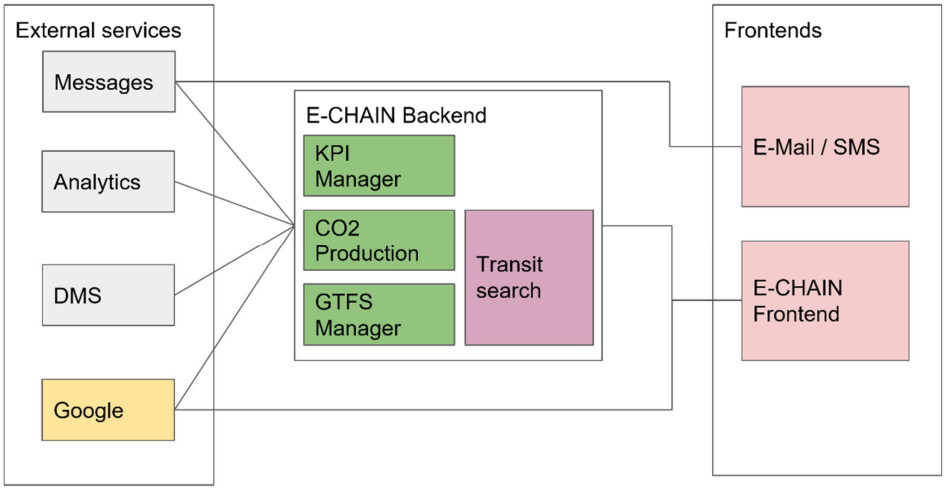

Figure 1. E-CHAIN software architecture

The Transit search is done using web service and it is divided in two main parts: a timetable service and a trip plan. Timetable service aims to provide a way for agents to register and add their stations and timetables. The web service also provides a way to search for all available (unimodal or intermodal) routes between registered stations. Trip plan web service aims to provide a way for travellers to register to a message plan to get information about a trip.

KPI Manager is the visualization system that gets data from E-CHAIN analytics API and shows charts and infographics based on KPIs.

CO2 Production is part of the route search with total length, total duration, total CO2 emission and a list of voyages on the route.

The GTFS Manager is used to share static public transit data GTFS and real time public transit data GTFS-realtime. Both GTFS static and GTFS-realtime show public transit information (stops, routes, schedule, live departure times, service alerts, etc.). The map feature of E-CHAIN software is realized as a custom code in Laravel with the Google Maps API from the frontend application.

4.2. E-CHAIN platform main parts

The E-CHAIN platform is designed and divided in four main parts:

- B2C web page
- B2B web page
- PA web page
- Totem/mobile web page

B2C web page is divided in two main functions:

- Green Travel Planner
- Green Travel Infomobility

Green Travel Planner or before the trip gives the possibility to users traveling between Italy and Croatia to calculate, compare and choose different routes based on their estimated CO2 consumption depending on the distance and the duration of the journey. The users will use the platform to plan the trip, they will insert departure and arrival destination, date of the trip and click on search button, Figure 2.

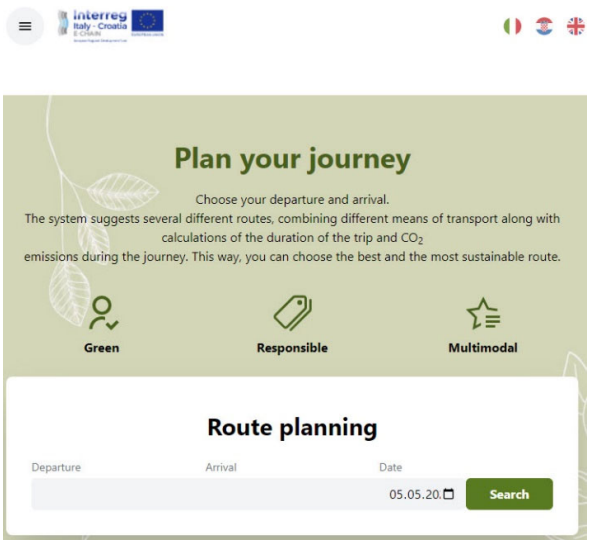

Figure 2. Green Travel Planner – travel preparation

The platform uses Google Maps to show the different travel option to reach the defined arrival destination with the CO2 of the various routes, Figure 3. The platform will promote the greenest travel option during the whole user trip starting from the purchase process to the destination.

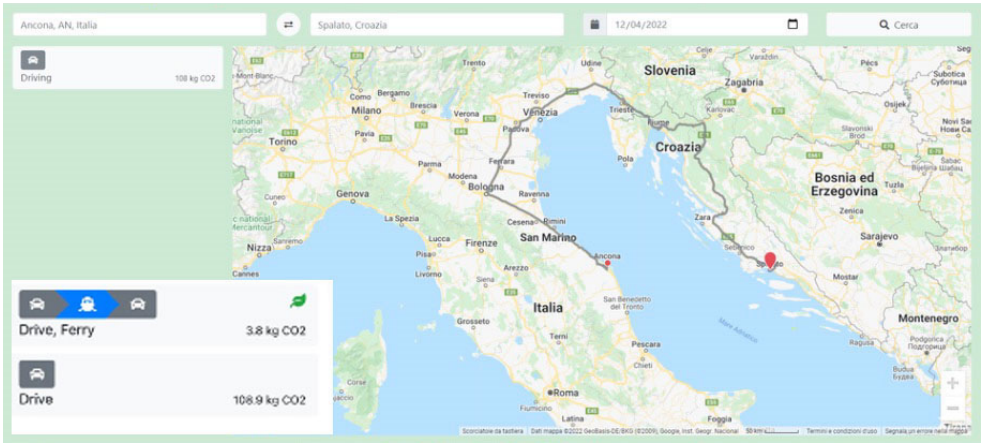

Figure 3. Green Travel Planner – travel options

In addition, the web platform will generate and place a new hyperlink to proceed with the booking on the supplier site to which web platform associates a series of contacts (e.g. ferry tickets from Ancona to Split), Figure 4.

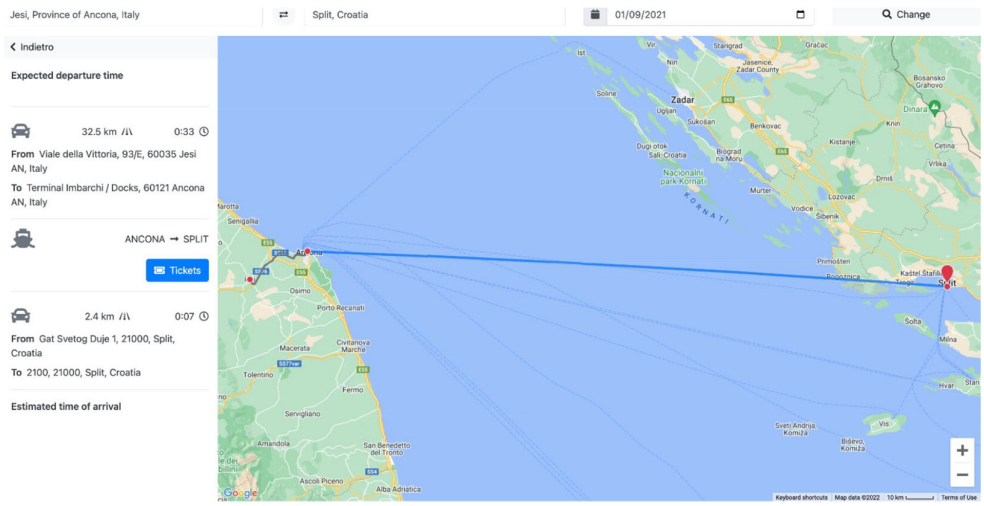

Figure 4. Green Travel Planner – booking

Green Travel Infomobility or during the trip gives the option of subscribing to platform support system which will send users a series of messages about boarding/landing procedures and port mobility services. The use of instant messaging allows the real-time management of any criticality both by users and suppliers, it also ensures a channel of quick and secure contact to avoid crowds. The first message arrives right after the purchase and shows the amount (kilograms) of CO2 consumed compared to the use of private vehicles, then the user must subscribe to the plan according to the GDPR law and will receive the rest of the messages, suggesting virtuous behaviours related to the environment, Figure 5.

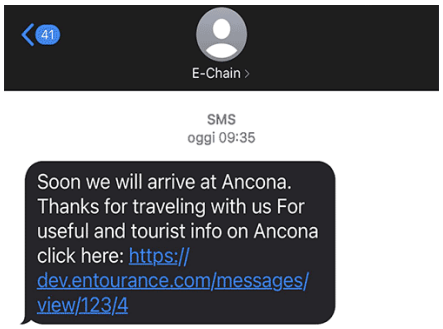

Figure 5. Green Travel Infomobility – sms

The B2B web page is aimed at public transport providers between Italy and Croatia. After registering, transport providers have the chance to monitor the following aggregate usage data: CO2 saved, users search, users point of departure and destination, clicks on the booking link and CRM system usage.

The PA web page is aimed at local authorities (e.g., municipalities) who have access to a series of data and statistics on the use of the platform linked to the services provided in their territory.

Once arrived at the destination, a digital totem will help users plan their stay with useful information about mobility (in and out and around the city), activities, places to visit, assistance (e.g., check arrivals and departures of ferries for that day). Users can also scan the QR code and have that info ready on their phone and when real time data is not available a QR code is provided to connect visitors with the webpage provided the requested information.

At the end of the selection process or after completing the purchase, the web browser returns to the E-CHAIN web page and the web platform suggests in cross-selling or up-selling a list of eco-tourism and low carbon impact activities around the port area that the web platform has managed with the DMS. Green tourism experiences providers can register on web platform to create their company's profile, fill in the general data of their business including geolocation and can start to upload the experiences. Each experience will have basic information for booking including the number of participants (max and min), the discount reserved for intermediaries and the price with its relative reductions (e.g., children, card holders, etc.), availability, therefore the periods of activity, the duration and the days in which the experience is available. When a new experience is published and visible on the E-CHAIN platform frontend, green tourism experiences providers will be able to start receiving bookings.

There are several similar web platforms and solutions as E-CHAIN web platform that already exist on the market. Some platforms are created with the purpose of organizing trips around the world, regardless of the location such as Google Maps [56], Waze [57] and Herewego [58]. Other platforms allow the users to plan their trip through the booking of transportation and accommodation to better organize their stay in the chosen destination such as Booking.com [59], Airbnb [60], Skyscanner [61], etc. There are web platforms which are dedicated to the CO2 calculators and the carbon footprint estimation such as Carbon Footprint calculator [62], Native - Carbon Offset Providers [63], PTV Map&Guide [64], Green Tripper calculator [65] and My climate [66].

E-CHAIN web platform has some competitive advantages because it's focused on the Adriatic area, so it's not a worldwide general platform as most of them are. Web platform integrates the only CO2 calculator that is able to suggest the best way of transport that reduces the emissions. The other calculators available online are not suggesting the best route but ask the user to select from the start the vehicle they intend to use. Also, it's the first co-marketing tourism project in the Adriatic area, aimed to improve the economic impact of the travellers who are just passing by the port areas.

5. Conclusion and Future Works

In the last ten years the tourism industry was in continuous growth until the COVID - 19 pandemic which blocked the tourist's movement, whereas since the 2022 the tourism sector has slowly resumed the previous standards. This transitional period was a good chance to rethink the tourism models to better adapts to people needs (tourists and residents) and to reach the territorial sustainable goals.

Therefore, nowadays, a multidisciplinary tourism structure has to be considered and services that are at the same time socially acceptable, eco-nomically viable, and environmentally appropriate have to be proposed to the tourists. To reach this aim it is necessary to develop a system that considers an integrated offer and demand, with the support of the ICTs tools which facilitates the creation of a personalised tourism experience in the smart destination context.

This paper analyses how difficult is to reach this aim in the context of maritime mass passengers flows and propose the E-Chain project as a first step to create an ICT experience context which considers both people and territory needs. E-Chain through the creation of an info-mobility platform improves the passenger connectivity between the two sides of the Adriatic Sea, allowing to optimize in real time the available services.

The added valued compared to the state of the art is that the E-Chain project proposes an integrated travel planner system managing both transport and entertainment services for the entire journey between Italy and Croatia. Through the creation of a searching mod-

ule based on Google Maps connected with the GTFS info of transport suppliers the travellers could choose a personalized intermodal solution based on his needs. Moreover, the system helps the users to choose the travel solution with the lighter impact on the environment.

Future studies foresee the exportation of E-Chain platform in different Adriatic cities. A set of tests, aimed at validating E-Chain platform capabilities to promote a sustainable territorial use will also be deployed. Moreover, the E-Chain platform will be tested also with different stakeholders' categories to understand their possible acceptance of this technology in the context of providing personalised services. All of this is necessary because there is no question about the profound impact that digitalisation has had and continue to have on millennials tourists which represent the future of tourism demand. Technology adoption is an ongoing challenge for the tourism industry all over the world.

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References

1. UNWTO World Tourism Barometer. Available online: https://www.sciencegate.app/source/313472 (accessed on 14 May 2021).
2. A. Orîndaru, M. Popescu, A. Alexoaei, S. Căescu, M. S. Florescu, and A. Orzan. Tourism in a Post-COVID-19 Era: Sustainable Strategies for Industry's Recovery, Sustainability 13, 2021, no. 12: 6781.
3. World Travel and Tourism Council Economic Impact. Available online: https://wttc.org/Research/Economic-Impact (accessed on 14 May 2021).
4. Giurrandino A., Carciotti S. Il ruolo del riconoscimento UNESCO nel governo del territorio: l'attivazione di nuove forme di governance territoriali diventano strumento per la sostenibilità sociale, economica ed ambientale", in Culture della sostenibilità 25/2020: Politica, Ecologia e Società nell'Antropocene.
5. E. Cacaci, S. Carcotti. Venice landscape: between the world heritage site and cruise tourism, Sustainable Mediterranean Construction, 2020.
6. Koens, K.; Postma, A.; Papp, B. Is Overtourism Overused? Understanding the Impact of Tourism in a City Context. Sustainability 2018, 10, 4384
7. S. Pivčević, L. Petrić, and A. Mandić. Sustainability of Tourism Development in the Mediterranean—Interregional Similarities and Differences, Sustainability 12, 2020, no. 18: 7641.
8. S. Carciotti, A. Marin, W. Ukovich. Smart Cruise Destination: an innovative network governance framework, PORTUSplus_the Journal of RETE, 2019, N. 8, Special Issue "Governance in Port City Regions", RETE Publisher, Venice.
9. Estol, J. European tourism policy: Its evolution and structure. Tour. Manag. 2016, *52*, 230–241.
10. Femenia-Serra F., Baidal J., Neuhofer, B. (2018), Towards a conceptualisation of smart tourists and their role within the smart destination scenario, Service Industries Journal.
11. Del Vecchio P., Ndou V., Passiante G. (2018), Turismo Digitale e Smart Destination. Tecnologie, modelli e strat- egie per la crescita di un sistema turistico integrato, Franco Angeli Editore.
12. Buhalis D., Amaranggana A., (2015), Smart tourism destinations enhancing tourism experience through personalisation of services, in Tussyadiah I., Inversini A. (Eds.), Information and communication technologies in tourism 2015, Springer, (377–389).
13. Koo C., Shin S., Gretzel U., Hunter W.C., Chung N. (2016), Conceptualization of smart tourism destination competitiveness, Asia Pac. J. Inf. Syst., 26, 561–576.
14. Chung N., Lee H., Ham J., Koo C. (2021), Smart Tourism Cities' Competitiveness Index: A Conceptual Model, in Wörndl W., Koo C., Stienmetz J.L. (eds) Information and Communication Technologies in Tourism 2021, Springer, Cham.
15. López de Ávila A., García S. (2015), Destinos Turísticos Inteligentes. Econ. Ind., 395, 61–69.
16. Shafiee S., Ghatari A.R., Hasanzadeh A., Jahanyan S. (2019), Developing a model for sustainable smart tourism destinations: A systematic review, Tour. Manag. Perspect, 31, 287–300.
17. Ismagilova E., Hughes L., Dwivedi Y.K., Raman K.R. (2019), Smart cities: Advances in research—An information systems perspective, International Journal Information Managing, 47, 88–100.
18. Lamsfus C., Alzua-Sorzabal A. (2013), Theoretical framework for a tourism Internet of Things: Smart Destinations, Journal of Tourism and Human Mobility, 0.

19. Mehmetoglu M., Engen M. (2001), Pine and Gilmore's Concept of Experience Economy and its Dimensions: an empirical examination in tourism, Journal of quality Assurance in Hospitality & Tourism, 12(4), 237-255.
20. Pine J., Gilmore J. (2013), L' economia delle esperienze. Oltre il servizio, Edizioni Rizzoli Etas.
21. Oh H., Fiore A., Jeoung M. (2016), Measuring Experience Economy Concepts: Tourism Applications, Journal of Travel Research, 46(2),19-132.
22. The age of personalization report. Available online: https://hbr.org/resources/pdfs/comm/mastercard/TheAgeOfPersonalization.pdf (accessed on 20.05.2022.)
23. S. Carciotti. Ricreare sinergie tra porto e citta: infrastrutture green e reti della conoscenza per la gestione del Turismo, in Proceeding Dare valore ai valori in urbanistica – Worthing values for urban planning, 23-24 june 2022, Brescia.
24. Gretzel, U.; Sigala, M.; Xiang, Z.; Koo, C. Smart tourism: Foundations and developments. *Electronic Markets*, **2015**, 25, 179–188
25. Shen, S.; Sotiriadis, M.; Zhang, Y. The Influence of Smart Technologies on Customer Journey in Tourist Attractions within the Smart Tourism Management Framework. *Sustainability* **2020**, *12*, 4157. https://doi.org/10.3390/su12104157
26. Xiang, Z.; Magnini, V. P.; Fesenmaier, D. R. Information technology and consumer behavior in travel and tourism: Insights from travel planning using the internet. *Journal of Retailing and Consumer Services*, **2015**, 22, 244–249. Advance online publication. doi:10.1016/j.jretconser.2014.08.005
27. No, E.; Kim, J. K. Determinants of the adoption for travel information on smartphone: Travel information on smartphone. *International Journal of Tourism Research*, **2014**, 16(6), 534–545.
28. Wang, D.; Park, S.; Fesenmaier, D. R. The Role of Smartphones in Mediating the Touristic Experience. *Journal of Travel Research*, **2012**, 51(4), 371–387. doi:10.1177/0047287511426341
29. Al-Fuqaha, A.; Guizani, M.; Mohammadi, M; Aledhari, M.; Ayyash, M. Internet of Things: A Survey on Enabling Technologies, Protocols, and Applications. *IEEE Communications Surveys & Tutorials*, **2015**, vol. 17, no. 4, pp. 2347-2376. doi: 10.1109/COMST.2015.2444095.
30. Want, R.; Schilit, B. N.; Jenson, S. Enabling the Internet of Things. *Computer*, **2015**, vol. 48, no. 1, pp. 28-35. doi: 10.1109/MC.2015.12.
31. Miorandi, D.; Sicari, S.; De Pellegrini, F.; Chlamtac, I. Internet of things: vision, applications and research challenges. *Ad Hoc Networks*, **2012**, 10(7), 1497–1516.
32. Zanella, A.; Bui, N.; Castellani, A.; Vangelista, L.; Zorzi, M. Internet of Things for Smart Cities. *IEEE Internet of Things Journal*, **2014**, vol. 1, no. 1, pp. 22-32. doi: 10.1109/JIOT.2014.2306328.
33. Atzori, L.; Iera, A.; Morabito, G. The internet of things: A survey. *Computer Networks*, **2010**, 54(15), 2787–2805.
34. Mell, P.; Grance, T. The NIST definition of Cloud Computing. National Institution for Standards and Technology, **2011**
35. Li, J.; Xu, L.; Tang, L.; Wang, S.; Li, L. Big data in tourism research: A literature review. *Tourism Management*, **2018**, 68, 301–323. https://doi.org/10.1016/j.tourman.2018.03.009
36. Salas-Olmedo, M.H.; Moya-Gómez, B.; García-Palomares, J.C.; Gutiérrez, J. Tourists' digital footprint in cities: Comparing Big Data sources. Tourism Management, **2018**, 66, 13–25. https://doi.org/10.1016/j.tourman.2017.11.001
37. Del Vecchio, P.; Mele, G.; Ndou, V.; Secundo, G. Open Innovation and Social Big Data for Sustainability: Evidence from the Tourism Industry. *Sustainability*, **2018**, 10, 3215. https://doi.org/10.3390/su10093215
38. Gössling, S. Technology, ICT and tourism: from big data to the big picture. *Journal of Sustainable Tourism*, **2021**, 29:5, 849-858, doi: 10.1080/09669582.2020.1865387
39. Buhalis, D.; Amaranggana, A. (2015). Smart Tourism Destinations Enhancing Tourism Experience Through Personalisation of Services. In: Tussyadiah, I., Inversini, A. (eds) Information and Communication Technologies in Tourism 2015. Springer, Cham. https://doi.org/10.1007/978-3-319-14343-9_28
40. Rapaport, W. J. What Is Artificial Intelligence?. *Journal of Artificial General Intelligence*, **2020**, 11(2) 52-56, doi: 10.2478/jagi-2020-0003
41. Abduljabbar, R.; Dia, H.; Liyanage, S.; Bagloee, S.A. Applications of Artificial Intelligence in Transport: An Overview. *Sustainability*, **2019**, 11, 189. https://doi.org/10.3390/su11010189
42. Calvaresi, D.; Ibrahim, A.; Calbimonte, J.P.; Schegg, R.; Fragniere, E.; Schumacher, M. The Evolution of Chatbots in Tourism: A Systematic Literature Review. *Information and Communication Technologies in Tourism*, 2021. Springer, Cham. https://doi.org/10.1007/978-3-030-65785-7_1
43. Doborjeh, Z.; Hemmington, N.; Doborjeh, M.; Kasabov, N. Artificial intelligence: a systematic review of methods and applications in hospitality and tourism. *International Journal of Contemporary Hospitality Management*, **2022**, Vol. 34 No. 3, pp. 1154-1176. https://doi.org/10.1108/IJCHM-06-2021-0767
44. Cao, D.; Sun, Y.; Goh, E.; Wang, R.; Kuiavska, K. Adoption of smart voice assistants technology among Airbnb guests: A revised self-efficacy-based value adoption model (SVAM). *International Journal of Hospitality Management*, **2022**, Volume 101, 103124. https://doi.org/10.1016/j.ijhm.2021.103124.
45. Lee, U.-K. Tourism Using Virtual Reality: Media Richness and Information System Successes. *Sustainability*, **2022**, 14, 3975. https://doi.org/10.3390/su14073975

46. Oncioiu, I.; Priescu, I. The Use of Virtual Reality in Tourism Destinations as a Tool to Develop Tourist Behavior Perspective. *Sustainability*, **2022**, 14, 4191. https://doi.org/10.3390/su14074191
47. Lee, W.-j.; Kim, Y.H. Does VR Tourism Enhance Users' Experience? *Sustainability*, 2021, 13, 806. https://doi.org/10.3390/su13020806
48. Yuce, A.; Arasli, H.; Ozturen, A.; Daskin, M. Feeling the Service Product Closer: Triggering Visit Intention via Virtual Reality. *Sustainability*, 2020, 12, 6632. https://doi.org/10.3390/su12166632
49. Han, S.; Yoon, J.-H.; Kwon, J. Impact of Experiential Value of Augmented Reality: The Context of Heritage Tourism. *Sustainability*, **2021**, 13, 4147. https://doi.org/10.3390/su13084147
50. Barrado-Timón, D.A.; Hidalgo-Giralt, C. The Historic City, Its Transmission and Perception via Augmented Reality and Virtual Reality and the Use of the Past as a Resource for the Present: A New Era for Urban Cultural Heritage and Tourism? *Sustainability*, **2019**, 11, 2835. https://doi.org/10.3390/su11102835
51. Loureiro, S.M.C. Virtual reality, augmented reality and tourism experience. *Handbook of Tourism Experience Management and Marketing*; Kumar, S., Ed.; Routledge: Oxford, UK, 2020; pp. 439–452. ISBN 978-0-429-20391-6. https://doi.org/10.4324/9780429203916
52. E-CHAIN official website. Available online: https://www.italy-croatia.eu/web/e-chain (accessed on 20.05.2022.)
53. Laravel. Available online: https://laravel.com/docs/9.x (accessed on 23.05.2022.)
54. MySQL database server. Available online: https://dev.mysql.com/doc/refman/8.0/en/introduction.html (accessed on 23.05.2022.)
55. Angular. Available online: https://angular.io/guide/what-is-angular (accessed on 25.05.2022.)
56. Google Maps. Available online: https://maps.google.com/ (accessed on 25.05.2022.)
57. Waze. Available online: https://www.waze.com/ (accessed on 25.05.2022.)
58. Herewego. Available online: https://wego.here.com/ (accessed on 25.05.2022.)
59. Booking.com. Available online: https://www.booking.com/ (accessed on 26.05.2022.)
60. Airbnb. Available online: https://www.airbnb.com/ (accessed on 26.05.2022.)
61. Skyscanner. Available online: https://www.skyscanner.com/ (accessed on 26.05.2022.)
62. Carbon Footprint calculator. Available online: https:// calculator.carbonfootprint.com/ (accessed on 27.05.2022.)
63. Native - Carbon Offset Providers. Available online: https://www.native.eco (accessed on 27.05.2022.)
64. PTV Map&Guide. Available online: https://www.ptvgroup.com/en/solutions/products/ptv-mapandguide/ (accessed on 27.05.2022.)
65. Green Tripper calculator. Available online: https://www.greentripper.org/ (accessed on 27.05.2022.)
66. My climate. Available online: https://CO2.myclimate.org/ (accessed on 27.05.2022.)