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OJP4Danube

Deliverable D.T1.1.1

Ex-ante report

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Preface

Acronym:	OPJ4Danube
Title:	Coordination mechanisms for multimodal cross-border traveller information network based on OJP for Danube Region
Project Code:	DTP3-447-3.1
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Abbreviations

Abbreviation	
TISP	Travel Information Service Provider
LJP	Local Journey Planner
ITS	Intelligent Transport System
MMTIS	Multimodal Travel Information Service
OJP	Open Journey Planner
NAP	National Access Point
NB	Nominated Body
API	Application Programming Interface
POI	Point Of Interest
JP	Journey Planner
NeTEx	Network and Timetable Exchange
IATA	International Air Transport Association
SIRI	Standard Interface for Real-time Information
TAF-TAP-TSI	Telematics Applications for Freight/Passenger Services
IFOPT	Identification of Fixed Objects in Public Transport

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1. Introduction

1.1. Aim of the deliverable

The main objective of the OJP4Danube project is the development of more connected, harmonised, and eco-friendly multimodal journey planners (JPs) within and across the Danube Region, enabling travellers to make well-informed travel decisions. The first step in this context is to investigate the status of current multimodal travel information service providers (TISPs) and to identify existing gaps in information provision, with specific focus on the integration of cycling and rail. This ex-ante analysis is based on input data provided by travel information service operators (TISPs) within the project. Deliverable D.T1.1.1 presents the results of this analysis, which also serves as input to WP2 D.T2.1.1 on Use cases and to following project tasks such as WP3 A.T3.1 on pilot preparation.
In order to improve travel information systems to enable cross-border and multimodal travel, the key objective of this deliverable is to balance between defining desirable features from the traveller perspective with plans and limitations of current journey planner systems.

1.2. OJP4Danube local journey planners

Table 1 introduces basic information about OJP4Danube LJPs. Each LJP provides travel information in terms of different eco-friendly modes of transport and different geographical area. In this document, we use the acronyms introduced in Table 1 to refer to individual LJPs.

Table 1: Local journey planners involved in the OJP4Danube project.

LJP	Acronym	Country	Eco-friendly modes of transport[1]	Link to public GUI
Verkehrsauskunft Österreich	VAO	Austria	• Walking • Cycling *city bike, nextbike, other specialised bikes (mountain, racing, trekking, or cargo bikes), bike as a carry-on (onboard public transport)* • Micro-scooter / E-scooter *E-scooter sharing (public system)*	https://routenplaner.verkehrsauskunft.at/
KORDIS JMK	IDSJMK	Czech Republic	*The LJP at the moment supports only public transport connections. But it will be supplemented by eco-friendly-modes within OJP4Danube project.* • *Walking* • *Cycling* *(all type of bikes are considered to be to same category - city bike, electric bike, foldable bike, other specialised bikes (mountain, racing, trekking), bike as a carry-on (onboard public transport)*	https://www.idsjmk.cz/index

[1] Modes are supported, for finding routes and/or for combining eco-friendly modes with public transport.

			• *Micro-scooter / E-scooter scooter as a carry-on (onboard public transport)*	
GLI Solutions LLC	TERKEPEM	Hungary	• *Walking routing for walking is part of the public transport routing* • *Cycling city bike (there is no specific routing, and the system can provide city bike stations map)*	terkepem.hu utvonalterv.hu
Timisoara Journey Planner	TJP	Romania	• *Walking*	-
National Traffic Management Centre	NCUP	Slovenia	• *Walking* • *Cycling city bike, electric bike, bike sharing (public system),* bike and ride (bike parking at stations), bike as a carry-on (onboard public transport)	https://www.ncup.si/sl
IKVC Slovak Railways	IKVC	Slovakia	• *Walking*	https://predaj.zssk.sk/

1.3. Methodology

To perform the ex-ante analysis, as the first step, a comprehensive questionnaire was prepared and distributed among the travel information service providers (VAO, ZSSK, PRA LUR, UM-FGPA, GYS, GLI, ELS, PUT, KOR) involved in the project. The questionnaire[2] was designed to update the information about the status of Local Journey Planners (LJPs), complement the preliminary information about LJPs, to extend the travel information that is related to the cycling and walking features of LJPs and to collect information about the existing or planned features and the wished extensions of TISPs in terms of supporting integration with walking and cycling. Further to collecting information through the questionnaire, aiming at improving the accuracy and quality of the input data, an online face-to-face interview with each TISP was conducted. Assessment and gap analysis of operating TISPs are reported in Section 4.

1.4. Glossary

The definition of a common glossary is an important step to clarify the terminology used across the OJP4Danube project. This list covers the terms used for the tasks within the scope of this deliverable as well as D.T2.1.1 on use cases. This list can feed into the production of a Glossary at project level at a later stage.

Table 2: Glossary of terms used in the OJP4Danube project.

Term	Definition in OJP4Danube

[2] All filled questionnaires for each travel information service provider (TISP) are attached as supplementary information files.

Active/Semi-active mobility	This term is synonymous to Eco-friendly modes which is used in this project. It includes all modes that require the traveller to actively contribute to the journey with a physical effort, such as Walking, Jogging/Running, Wheelchair, Bicycle, Electric Bicycle, Cargo Bike, Bike Sharing, Micro Scooter, or Skateboard.
Cross-border trip	Although this term could implicitly refer to 'international cross-border' travel, in the scope of OJP4Danube it refers to the virtual geographical borders of each Local Journey Planner participating in the project. The spatial scope of each LJP differs and can be municipal, regional or national. A cross-border trip therefore implies a trip which would require data from at least two different LJPs. Since there is only one LJP per country, such trip would therefore be by extension also international.
Eco-friendly mode	The term 'Eco-friendly mode' encompasses all types of active or semi-active transport (e.g. electric assisted bicycles), including walking as well as newer forms of personal transport in the micro mobility category (e.g. scooters).
Demand responsive mode	This term originates from regulation 2017/1926 and refers to the following modes: Shuttle bus, shuttle ferry, taxi, car-sharing, car-pooling, car-hire, bike-sharing, bike-hire. It refers broadly to types of public transport that are not operating on a fixed schedule. It is also synonymous to On-demand transport.
Intermodality	Intermodality refers to quality of the experience of the transfer portion between two different modes in a multimodal trip. This is typically enabled by specific infrastructure and services such as parking for bicycles at train stations, level platforms, or simply the availability of certain services such as ticketing or bike-sharing. It is synonymous to interconnectivity.
Local Journey Planner (LJP)	A system with a routing engine and access to multimodal data with a particular local, regional or national coverage; "local" underlines its focus on a specific coverage that is limited. LJPs have no OJP routing capabilities.
Multimodal trips	A multimodal trip is a trip that is taken using different transport modes. These are usually assumed to be 'motorised' modes. In this project, a multimodal trip refers more specifically to a trip consisting of both a public transport leg and an eco-friendly mode leg (including walking to a bus stop).
Personal transport	This term originates from regulation 2017/1926 and refers to the following modes: Car, motorcycle, cycle. It broadly refers to transport modes that are privately owned and operated by the traveller, independently of its propulsion system.
Private motorised mode	This term is similar to personal transport but includes only modes that are fully motorised i.e. do not require an active physical effort to operate the vehicle, such as: Private Car (both as driver or passenger), Taxi/Ride

	Hailing, Car Sharing/Rental, Moped, Motorcycle, or Electric Wheelchair/Cart.
Public transport (PT)	This term refers to all motorised land modes operating on a fixed schedule, such as: Metro, Tram, Bus/Trolley Bus, Coach/Long-distance Bus, Urban Train, Regional/Intercity Train, High-speed Train, Ferry/Boat. These are typically publicly operated but not necessarily so: 'public' here refers to 'the public' and is therefore synonymous to collective transport.
Transport Information Service Provider (TISP)	This term refers the OJP4Danube partners responsible for the implementation of their respective Local Journey Planners.
Traveller Preference	This term is synonym to Travel options, User-related parameters or User (search) criteria. This term is selected because it refers to the traveller, which is closer to the aim of the project i.e. to get people to travel multimodally and to include their preferences in journey planning. In other words, this term takes a traveller perspective, but from a coding perspective these can correctly be called user parameters or criteria

2. Background

2.1. European ITS Directive 2010/40/EU

The ITS Directive (2010/40/EU)[3] provides a legal framework for deployment of Intelligent Transport Systems and has emerged from the Action Areas defined in 2008 in the ITS Action Plan. Being a legally binding instrument, the Directive had to be transposed into national law by all European Member States. In order to support the coordinated and coherent deployment and use of ITS within the European Union, the European ITS Directive 2010/40/EU defines a framework including the following priority areas:

1) Optimal use of road, traffic, and travel data,
2) Continuity of traffic and freight management ITS services,
3) ITS road safety and security applications,
4) Linking the vehicle with the transport infrastructure.

In accordance with the Lisbon Treaty, the European Commission has the mandate to adopt specifications of functional, technical, organisational, or service provision-related nature under the ITS Directive in order to improve compatibility, interoperability, and continuity of ITS applications throughout the whole European Union in the form of Delegated Regulations, each for one of the six following priority actions

a. The provision of EU-wide multimodal travel information services,
b. The provision of EU-wide real-time traffic information services,
c. Data and procedures for the provision, where possible, of road safety related minimum universal traffic information free of charge to users,
d. The harmonised provision for an interoperable EU-wide eCall,

[3] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010L0040&from=EN

e. The provision of information services for safe and secure parking places for trucks and commercial vehicles,

f. The provision of reservation services for safe and secure parking places for trucks and commercial vehicles.

Additionally, to establish a list of specifications necessary for accessibility, exchange and update of standardised travel and traffic data to further support the harmonised implementation of the specification under the Directive 2010/40/EU for all modes, Commission Delegated Regulation (EU) 2017/1926[4] on the provision of EU-wide multimodal travel information services (MMTIS) was adopted. The Delegated Regulation clearly sets out particular standards to be used, like NeTEx[5] or the technical specification on Open Application Programming Interface (API) for distributed journey planning (the OJP standard) and defines single points of access to make scheduled travel data available. Furthermore, there are several standards in the domain of public transport (TRANSMODEL[6], SIRI[7]) and Technical Specifications in the railway domain, like the TAF-TAP-TSI[8]. These standards are issued by European standardisation bodies and the European Commission in order to guarantee interoperability in passenger information.

Pursuant to the provision of the Delegated Regulation 2017/1926, which is supplementing the European ITS Directive 2010/40/EU, development of transnational multimodal journey planning system in the form of the OJP in the Danube and Alpine Regions are considered through implementing LinkingDanube[9] and LinkingAlps[10] pilot projects. Feasibility and functionality of a uniform exchange of information based on OJP have proven within the recently completed LinkingDanube project while LinkingAlps project is aimed at creating a standardised exchange service of travel information between the individual travel information service providers and compiling them into a continuous travel chain enabling travellers to view the entire trip from origin to destination on a single service.

2.1.1. Commission Delegated Regulation (EU) 2017/1926

In the context of multimodal information services, Delegated Regulation 2017/1926 on priority action a) defines National Access Point (NAP) as “a digital interface where at least the static travel and historic traffic data together with corresponding metadata are made accessible for reuse to users, or where the sources and metadata of these data are made accessible for the reuse to users”[11]. With a functional NAP, service providers are being offered a possibility to use and integrate additional data into their services. This is at least an encouragement for increasing/harmonising the quality of services (before talking about linking) and thus can lead to improved continuity at a higher quality in the context of linking services. To speed up the development of successful and efficient NAPs, following specifications set out in the commission delegated regulation:

[4] https://eur-lex.europa.eu/eli/reg_del/2017/1926/oj
[5] http://netex-cen.eu/
[6] http://www.transmodel-cen.eu/
[7] http://www.transmodel-cen.eu/standards/siri/
[8] https://rne.eu/it/taf-tap-tsi/
[9] http://www.interreg-danube.eu/approved-projects/linking-danube
[10] https://www.alpine-space.eu/projects/linkingalps/en/home
[11] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015R0962&from=EN

1. Each Member State shall set up a national access point.
2. Existing national access points that have been set up to comply with other delegated acts adopted under Directive 2010/40/EU may be used as national access points, if deemed appropriate by the Member States.
3. National access points shall provide discovery services to users.
4. Transport authorities, transport operators, infrastructure managers or transport on demand service providers shall ensure that they provide the metadata in order to allow users to discover and use the datasets made accessible through the national access points.
5. Two or more Member States may set up a common access point.

Moreover, the Delegated Regulation contains measures supporting linking local, regional and national travel information services aim at enhancing the full door-to-door network geographical coverage to meet travelling requirements of end-users across the Union and to maximise full potential of multimodal travel information. To connect local, regional, and national travel information systems, use of technical interfaces providing routing results or other application programming interfaces (APIs) results based on static and/or dynamic travel and traffic information is recommended.

In order to enable full door-to-door routing services across Member State territory, the linking of services will be a key solution. Delegated Regulation 2017/1926 requires travel information service providers to share routing results with another service provider, including alternative routes and connections as well as handover points. While the functioning on technical level will of course be a matter of proper interface design, a harmonised data basis – as provided by a NAP – will be an important enabler prior to the actual linking.

Concerning the use of travel and traffic data in forms of static and dynamic, the following categories of transport modes are addressed within the delegated regulation:

1. ***Scheduled:*** Air, rail including high speed rail, conventional rail, light rail, long-distance coach, maritime including ferry, metro, tram, bus, trolleybus.
2. ***Demand-responsive:*** Shuttle bus, shuttle ferry, taxi, car-sharing, car-pooling, car-hire, bike-sharing, bike-hire.
3. ***Personal:*** Car, motorcycle, cycle.

2.2. Open API for distributed journey planning CEN/TC 278 standard

Full door-to-door routing services providing by the existing multimodal travel information service providers across the Union are mainly limited to the territory within a Member State. In order to extend geographical coverage of travel information services and to provide multimodal travel information across the EU, the Delegated Regulation recommends linking local, regional and national travel information services through technological tools including interfaces to link existing information systems to exchange routing results. Based on this recommendation, to meet required specifications in relation to linking travel information services, travel information services should use the European Technical Specification entitled ‘Intelligent Transport Systems — Public Transport — Open API for distributed journey planning[12].

The technical specification defines a schema for establishing an Open API for distributed journey planning (OJP) that can be implemented by any local, regional or national journey planning system in order to exchange journey planning information with any other participating local, regional or national journey planning system. In many domains, like social media and e-commerce, APIs are well known and operated on daily basis. Also in the travel information domain APIs are already used for the purpose of information gathering. However up to now propriety APIs have been applied, leading to a high diversity of APIs. Therefore there was a need for an Open API that provides an opportunity for just one universal channel to exchange information. OJP schema contains four key roles in the distributed journey planning process:

- **Enquirer** – representing the user asking for information
- **Home system of the enquirer** – the journey planner used by the enquirer to enter an enquiry and receive a result
- **Distributing system** – the system receiving a cross-border request, appropriately splitting it into sub-requests and distributing those to responding systems as well as reassembling the partial routing results into one result and handing it back to the enquiring home system. The distributing system duties can be handled by an enquiring or responding system which is capable of that.
- **Responding systems** – any system responding with routing results to enquiries forwarded by the distributing system

The Open API technical specification can be considered an important basis of all work related to implementing distributed journey planning. Together with a functional NAP, these two are important enablers in the field of linking services as they cover the proper processing of data and the access to services on metadata and actual data level, thus contributing significantly to harmonised linking of services. In this context, for the purpose of improving harmonisation and standardisation, travel information service providers are called to make data available through NAPs in common formats using recommended standards or at least other machine-readable and compatible formats. Figure 1 illustrate data publication through NAP based on technical specifications that can be used by transport authorities, transport operators, infrastructure managers or transport on demand service providers to provide the static travel and traffic data and historic traffic data of the different transport modes.

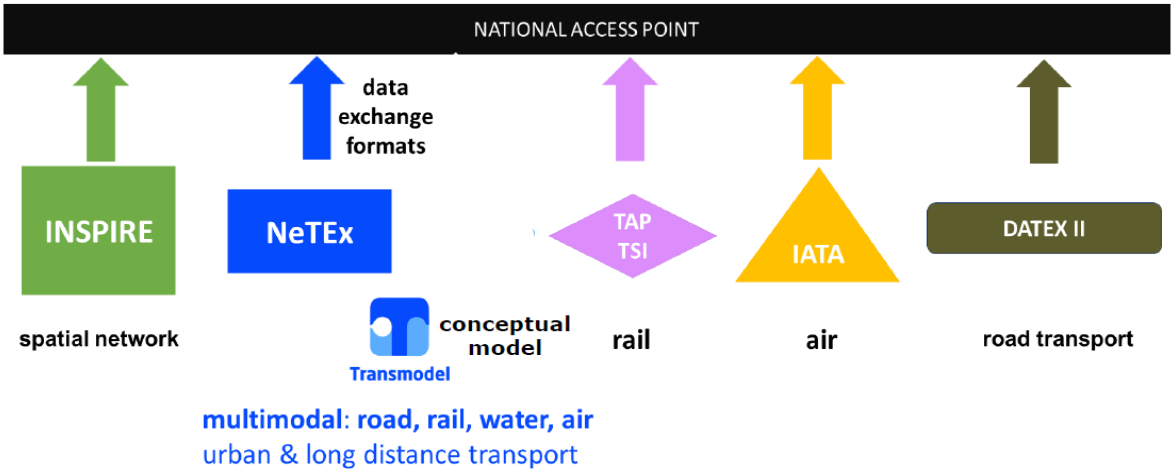


Figure 1: Data publications through NAP using recommended standards for the Delegated Regulation (EU) 2017/1926.

2.3. OJP CEN/TC 278 standard and its relation to OJP4Danube

The OJP standard is built heavily upon the SIRI (Service Interface for Real-time Information) standard, which in turn is based on several other pre-existing standards:

- **IFOPT** (Identification of Fixed Objects in Public Transport) defines a reference model for describing fixed objects required for public transport (i.e. transportation hubs such as stations, bus stops and other points of interest),
- **ACSB** defines a standardised format for referencing accessibility limitations,
- **DATEX2** defines traffic exchange formats but is not relevant in the scope of OJP4Danube.

2.3.1. Support for eco-friendly travel modes

OJP v1.0 has limited support for the definition of environmentally friendly travel modes, the following table summarises such current supported travel modes:

Table 3: Summary of OJP standards for eco-friendly travel modes.

Travel mode	Support	Comment
walking	Full	
running/jogging	No	Support may be simulated by the end user application setting custom walk speed.
cycling	Partial	While public travel sub modes are present in the schema, there is no such support for individual travel modes, so non-standard extensions are required to differentiate between different bike types (i.e. city bike, electric bike, foldable bike, mountain, racing, trekking, cargo bikes etc) should the need arise.
carpooling	Yes	
scooter	No	Implemented in v1.1
ferries	Yes	
bike/car/scooter/etc. sharing	Yes	In regard to the schema, sharing services are not considered custom travel modes per se; any travel mode can be presented to the end user as offered by a sharing service
rail	Yes	Including InterCity and urban rails, also a subtype of the following rail modes: loca, highSpeedRail, suburbanRailway, regionalRail, interregionalRail, longDistance, international, sleeperRailService, nightRail, carTransportRailService, touristRailway, railShuttle, replacementRailService, specialTrain, crossCountryRail, rackAndPinionRailway
Bike as carry-on	Yes	

2.3.2. Possible extension entry points in the OJP schema

The OJP schema defines well formatted messages which in themselves are only moderately customizable; pre-defined structures and enumeration types are not directly extensible; however most data structures allow for an additional extension with freely customizable content.

The somewhat limited nature of this extensibility might require:

- Having to apply partial redundancy within messages (e.g. iterable data structures that are not extensible might need to be extended in parent structures)
- Using agreed upon fallback values for enumeration types missing required values (e.g. using 'undefined' as the travel mode in lieu of 'scooter', and extending the trip leg structure with the custom, as of now unsupported travel modes).

Any extension deemed inevitable to ensure the success of the OJP4Danube project must be well documented and standardised among all project partners.

2.3.3. Dynamic identification of exchange points and its impact on our OJP specification

Our previous project introduced three separate actor types implementing OJP services within the distributed system: Local Journey Planners, an International Routing Service and a Central Node. Due to the somewhat decentralised nature of the OJP4Danube system design, the IRS (as well as the concept of a singular Central Node) will be deprecated, and thus the previously defined Exchange Point message formats will need to be superseded by much more customized, non-standard formats to accommodate for our preliminary plans regarding the dynamic identification of exchange points.

2.3.4. OJP v1.1

A new version of OJP (v1.1) has been in the works as of Jan 29, 2020 and is currently under active development, adding support for internationalization, amongst other small improvements, including an extended selection of private travel modes (such as scooter, carpooling, car, bike and scooter sharing).

It remains to be seen whether this new version will be finalized in time to be used in the OJP4Danube project.

2.4. Background information available from the LinkingDanube and LinkingAlps projects

The OJP4Danube project is directly building on the LinkingDanube project that integrated six journey planners collectively referred to as local journey planners (LJPs), namely: VERKEHRSAUSKUNFT OSTEREICH (VAO), IDSJMK, TERKEPEM, TIMISOARA JOURNEY PLANNER (TJP), IKVC, and NCUP (see Section 1.2). As all TISPs among the OJP4Danube partners participated also in the LinkingDanube project these JPs remain available and the information collected about them can be reused and if needed updated. Furthermore, project LinkingAlps is concerned with the integration of journey planners in Alpine space, while implementing OJP standard. To avoid duplicities between this deliverable the work that was already done by other projects, we collected possibly relevant documents and analysed their content. Table 4 provides the overview of the source documents and summarizes already available information.

Table 4: Overview of available documents related to OJP4Danube LJPs prepared within the LinkingDanube and LinkingAlps projects.

Document	Available information	TISP coverage	Date of preparation
LinkingDanube: Deliverable 3.1.1 State-of-the-art Analysis	Short characterization of the JP; information in a nutshell (URL, type of traveller information service, coverage); information on data level, information on service level	VAO – section 2.1.1; IDSJMK – section 2.2.2; TERKEPEM (formally referred to as UTVONALTERV) – section 2.3.4; TJP – 2.4.2, IKVC – section 2.5.1 NCUP – 2.6.1 TJP	06/2017
LinkingDanube: Deliverable 3.3.1 Report on specifications	Mapping of OpenAPI technical specification with the LJPs. Information is organized along four categories defying availability of information related to: specification of the local routing systems, location information request, service exchange point request and parameters for the trip request	Tables 2 – 28 present information collected for each TISP	12/2017
LinkingDanube: Input form used to survey travel information service providers presented in the deliverable D3.1.1	Tables, checkboxes and text fields used to collect information on organisational level, data level and service level.	The form was distributed to each journey planner provider.	01/2017- 03/2017
LinkingDanube: Input form used to survey travel information service providers presented in deliverable D3.3.1	Tables used to collect information needed to map OpenAPI technical specification with LJPs.	The form was distributed to each journey planner provider.	08/2017
LinkingAlps: Deliverable D.T1.1.1 Ex-ante analysis of current journey planners (short version)	Summary of main features and OJP requests supported by journey planners used in the LinkingAlps project.	Document covers travel information service providers involved in the LinkingAlps project, among them VAO is participating also in OJP4Danube project	09/2020

LinkingAlps: Deliverable D.T1.2.1 Case Definition (short report)	The report provides structured presentation of use cases proposed for the Linking Alps project, explains how they are linked to relevant target groups and gives information regarding a planned end user service,	NA	09/2020
LinkingAlps: Deliverable T3.1.1Organisational requirements for pilot service (short report)	The document lays down the organisational requirements for the LinkingAlps pilot and collects open issues in order to facilitate the alignment and decision-making process in the development of the organisational requirements.	NA	08/2020
LinkingAlps: Requirements Document System architecture V0.5 - Excerpt from draft version (status 29/10/2020)	This document was provided as an input for the OJP4Danube Core Development Team. The document discusses the concept of the LikingAlps distributed journey planner, including system architecture, description of system components and information flow diagrams.	NA	10/2019

3. Journey planner traveller preferences

This section is concerned with defining the list of parameters relevant for enhancing the capabilities of journey planners to better support organising trips involving a combination of eco-friendly modes and public transport. As described in the Glossary of section 1, we refer to these parameters as Traveller preferences to emphasise the traveller perspective. In practice, these are essentially data points which are relevant for users to plan their door-to-door, multimodal and transnational trips. When relevant as input or output in journey planner tools, these can be referred to as input or output parameters.

3.1. Method

The approach consisted of two phases. In the first, we conducted a desk review of traveller preferences which the literature or previous research projects on similar topics have considered relevant for enabling multimodal trips. Once this first list of preferences was settled, we then conducted a consultation with OJP partners (Travel Information Service Providers) to find out their current level of support and the importance of each traveller preference in their future OJP implementation plans. This consultation consisted of a long questionnaire followed by interviews to review their answers (the full answers to the questionnaires are attached to this deliverable).

Traveller preferences are a key part of the gap analysis of this report as well as D.T2.1.1 about use cases: they serve as a prioritised list of features which are seen as desirable to support eco-friendly mode and public transport integration in any journey planner (section 3.4), they serve as a benchmark for determining this level of support in current journey planners (section 4.4), and they are used to vary and distinguish between use cases in D.T2.1.1 (section 3).

3.2. Literature review

This section provides a review of aspects and factors relevant for multimodal travel and multimodal trip planning found in the literature. This review is more specifically based on recently published research work carried out by Esztergár-Kiss et al.[13] (section 3.2.1) and Cornet et al.[14] as part of the Mobility and Time Value Project (MoTiV) (section 3.2.2). Together, this research has consolidated together the most recent literature on the topic of multimodal travel from a traveller and journey planning perspective.

3.2.1. Multimodal journey planner aspects

This research consisted of a pan-European review of current journey planners and based on its results it proposed a framework of aspects that are more typically covered. This framework was then used in a multi-criteria analysis to determine the degree of maturity (i.e. feature implementation) of each of the journey planners in the study. The following table summarises the various aspects and related information that journey planners supported.

One important finding relevant for consideration in the OJP4Danube project is the distinction between information as input or output: some data types are to be used as input to a trip search, whereas some types of data are only relevant to present as part of trip search results. We will adopt this distinction in the final list of traveller preferences.

Table 5: Summary of multimodal journey planner aspects and related information.

Route planning services	
Ways of data input	Address, name of stop, service facilities (e.g.,museums, restaurants, offices), GPS coordinates, pointing out on the map
Planning aspects	Departure and arrival time, duration, costs, number of transfers, walking distance, and other aspects (e.g., preferred transportation mode, P+R, B+R, crowding)
Displayed data and visualization	Compact design and easy understanding, visualization on the map (e.g., zoom function and transport lines, transfer location plans), travel information (e.g., travel duration with waiting times and distance), walking time and distance, alternative routes
Booking and payment	
Tariff information	Prices, reduced fares, fee calculation of the planned route, way of data input for booking, possibility of choosing seats

[13] Esztergár-Kiss, D. (2019). Framework of aspects for the evaluation of multimodal journey planners. *Sustainability* (Switzerland), 11(18). https://doi.org/10.3390/su11184960

[14] Esztergár-Kiss, D., & Csiszár, C. (2015). Evaluation of Multimodal Journey Planners and Definition of Service Levels. *International Journal of Intelligent Transportation Systems Research*, 13(3), 154–165. https://doi.org/10.1007/s13177-014-0093-0

Payment options	Types of accepted bank cards, payment per mobile phones, location of ticket buying opportunities (e.g., ticket automats), types of vouchers (e.g., SMS, code per e-mail, paper ticket printed at home or at the station)
Handled data	
Static data and personal information	Timetables, creating a profile, setting personal preferences, saving searches and favorites, export features (e.g., PDF, printing)
Dynamic and estimated data	List of planned restrictions, visualization of planned restrictions, use of crowd sourcing data, information about actual traffic situations (e.g., accidents, real-time travel information), providing alternative routes
Supplementary information	
Comfort services	Wi-Fi at the station, Wi-Fi on board, electrical supply, sightseeing, weather forecast, booking a room, car rental, opening times of shops, other services (e.g., newsagent's, bakery)
Customer service	Information in foreign languages, contact information via e-mail and via telephone, feedback opportunities (e.g., reporting a bug), forum
Environmental impact and equal opportunity	Degree of air pollution and energy consumption, comparison of transport modes, routes for disabled passengers, information about vehicles (e.g., low floor), webpage for visually impaired people

3.2.2. H2020 MoTiV project travel experience factors

The Mobility and Time Value (MoTiV http://www.motivproject.eu/) research project focused on capturing all the factors that would lead to a more positive travel experience on all modes of transport. The aim of the research was to provide empirical data on what makes travel time to be considered either wasted or worthwhile by travellers. It was done by having pan-European travellers use a dedicated app (https://www.woorti.com/) that automatically detected movement (i.e. the start and end of a trip) as well as their transport mode (car, bus, train, cycling or walk). It then proceeded to ask several questions about the quality of the travel experience on these specific trips.

One of the app-survey questions was based on a long list of 'experience factors', itself extracted from an extensive literature review on the experience of travel time across transport modes. The following table lists those factors, distinguishing between three main types of transport modes based on the notion that each mode type implies a significantly different travel experience from the traveller perspective. It is therefore suggested that these factors be considered for determining a list of input or output parameters in a multimodal journey planner search tool.

Table 6: Travel experience factors across transport modes for determining input or output parameters in a multimodal journey planner search tool.

Factor	Public transport	Active/Semi-active	Private motorised
Travel-related factors	Simplicity/difficulty of the route Reliability of travel time Security and safety Space for luggage/pram/ bicycle etc. Ability to take kids or pets along Payment and tickets Good accessibility (lifts, boarding etc.) Route planning/ navigation tools Information and signs Check-in, security and boarding (ferry/plane only)	Simplicity/ difficulty of the route Road/path availability and safety Good accessibility (lifts, ramps etc.) Traffic signals/ crossings Route planning/ navigation tools Information and signs Ability to carry bags, luggage etc. Ability to take kids or pets along Crowding/ congestion Predictability of travel time Benches/toilets etc. Facilities (shower, lockers) Parking at end points	Simplicity/ difficulty of the route Traffic congestion/ delays Predictability of travel time Security and safety Space for luggage/pram/bicycle etc. Ability to take kids or pets along Route planning/ navigation tools Information and signs Parking at end points
Comfort and pleasantness factors	Crowdedness/seating Internet connectivity Charging opportunity Tables Toilets Food/drink allowed Food/drink available Shopping/retail Entertainment Car/bike parking at transfer point Vehicle ride smoothness Seating quality / personal space Other people Privacy Noise level Air quality/temperature Cleanliness	Road/path quality Road/path directness Noise level Air quality Lighting/visibility Nature and scenery Other people Cars/other vehicles	Road quality/ vehicle ride smoothness Vehicle quality Charging opportunity Privacy Seat comfort Noise level Air quality/temperature Nature and scenery Other passengers Other cars/vehicles Today's weather Ability to do what I want while I travel

	General atmosphere/ design Nature and scenery Today's weather Ability to do what I want while I travel		

3.2.3. Initial list of relevant journey planner parameters per mode

As an intermediary step, the OJP4Danube team produced the following list of input and output parameters under consideration for project. This list is only provided as background information as the final list is presented in section 3.4.

Table 7: Initial list of relevant journey planner parameters.

	All modes	Bicycle	Public transport	Train-specific	Walking	Car
Data input	Address Name of facility GPS coordinate on the map Departure time Arrival time	Cycling speed Cycling distance Cycling time B+R locations	Name of stop Number of transfers	Name of stop Number of transfers	Walking speed Walking distance Walking time	Driving speed Driving distance Driving time P+R locations
Trip planning	Travel time Travel distance Cost Emission	Bike friendly routes Avoid ascents	Number of transfers	Number of transfers	Avoid stairs	Avoid road toll Avoid parking cost
Visualisation	Travel time Travel distance Cost Emission Design Map details Alternatives	Burned calories	Number of transfers Waiting time Timetable Fare	Number of transfers Waiting time Timetable Fare	Burned calories	Fuel cost Parking time Parking cost Road toll

Added value	Preferences Favourites Re-planning Live view Export features Safety level Feedback option	Bike lane type Height profile Road quality Air quality Noise level Street lighting Stairs	Real-time info Deviation info Bike carriage Ticket automat Online payment Online ticket Accessibility Security	Real-time info Deviation info Bike carriage Ticket automat Online payment Online ticket Accessibility Security Booking	Height profile Road quality Air quality Noise level Street lighting Stairs	Traffic information Parking information Road quality
Comfort	Weather Speaking	Lockers Showers	Crowdedness Vehicle condition Air condition Cleanliness	Crowdedness Vehicle condition Air condition Cleanliness WiFi on board charging onboard		
Travel experience	Scenery Nature Eating options Drinking options Sightseeing options Shopping options Entertainment options	Service options Charging options			Benches parks	Fuel station

3.3. A typology of multimodal journey planner maturity level

The previous list also provides a more detailed categorisation of parameters, although typically missing from most of the literature are parameters relevant for multimodal integration. Nevertheless, the literature review section 3.2 allows to create a typology which may be relevant for assessing the maturity of existing (or planned) multimodal journey planners based on the extent of support to the following categories of data:

Level 1 - Multimodal routing: this is the basic requirements for all journey planners and remains in many ways the ongoing challenge for multimodal integration. The journey planner should be able to suggest accurate door-to-door routes across all modes, including first- and last-mile options, as well as total distances, travel times, transfer points, waiting time, and estimated trip costs.

Level 2 - Mode-specific comfort and service preferences: this is the first level of journey planner extended features which is concerned with providing travel planner users with search options relevant for meeting their needs in terms of improving the travel experience for each mode. For cycling, this could mean the option of searching only for routes with protected cycle lanes (as an input parameter) or to be informed about which portion of their trip will be on protected lanes (as output information). For public transport, this could mean providing the option of searching for a seat with internet connectivity or charging opportunity for example, or the possibility to take luggage or a bicycle as a carry-on.

Level 3 - Intermodal comfort and service preferences: this third level of maturity in journey planning services is concerned with improving the door-to-door reliability and comfort of the trip, with a particular focus on providing search options and features that improve the intermodal connectivity of a multimodal trip. This could be about providing visibility to the availability of bike parking at train stations or bus stops, platform access details, and any other factors that can facilitate (or impede) using an eco-friendly mode in combination with public transport.

Level 4 – Additional and real-time information: while this may overlap with level 2, journey planners could also provide additional information that would be normally considered as 'external factors' by travellers. These factors could include real-time information about weather, traffic, noise or air pollution, an estimate of calories burned for active modes, or an estimate of carbon emissions for motorised transport.

Level 5 – Integrating traveller feedback: finally, it must be recognised that all data mentioned so far is expected to be provided 'top-down' i.e. by the journey planner service itself or from external databases. But as we are essentially concerned about providing a positive traveller experience, the last level of data provision could be crowd-sourced from travellers themselves i.e. 'bottom-up'. This level is therefore concerned with providing journey planner users with the possibility to contribute directly to sharing relevant door-to-door information with fellow travellers. This could take the form of a basic 5-star qualitative assessment of specific aspects of trip planning or trip routes (which could be particularly relevant for tourist trips), or to enable travellers to report themselves on the presence of various services or points of interest along the way.

Within the scope of OJP4Danube, we have decided to address primarily Level 2 and 3, although the questionnaire that was distributed to Travel Information Service Providers also prompted reflections on Levels 4 and 5.

3.4. Summary of desirable traveller parameters for OJP4Danube

One finding that emerged from the literature review section is that although there is a number of criteria relevant for journey planning for each mode, there has been a lack of focus in research on intermodality i.e. traveller preferences and journey planner parameters relevant for integrating between modes.

Joining together the traveller perspective in conducting multimodal trips with the need be clear about whether traveller preferences should be implemented as input or output parameters in journey planners, we conclude on two main dimensions to categorise parameters:

1) Mode-specific vs intermodal traveller preferences: from the traveller perspective, we distinguish between traveller preferences relevant for conducting a trip using any eco-friendly mode only, with traveller preferences relevant for integrating eco-friendly modes with public transport.

   Mode-specific parameters that were kept for further interrogation by TISPs in the survey are:

- Type of cycling infrastructure e.g. bicycle lane (on-street, painted), bicycle track (on-street, protected), bicycle path (off-street)
- Quality of the cycling infrastructure e.g width, smoothness, uni/bidirectional, continuity, green waves, speed limits etc.
- Trade-off between cycling distance and cycling comfort
- Avoiding ascents or total elevation (altitude profile of the route)
- Point of interests (POIs) e.g. shopping on the route
- Scenery on the route e.g. greenery, sights, landmarks etc.
- Services on the route e.g. public toilets, benches, ATMs, info-points, maps etc.
- Health effects (e.g. number of steps, calories burnt)
- Weather conditions on the route
- Lighting conditions on the route
- Air quality on the route
- Noise levels on the route

Intermodal parameters that were kept for further interrogation by TISPs in the survey are:

- Walking or cycling distance to a public transport stop
- Whether taking an eco-friendly vehicle onboard is permitted
- Availability and characteristics of dedicated bicycle parking at end points e.g. covered, protected, etc.
- Platform access facilities e.g. elevators, stairs
- Level platforms (for rolling in heavy bicycles directly onboard)
- Reliability of the route (risk of delays, capacity limits etc.)
- Total carbon emissions
- Additional ticket requirements

2) Input vs output parameters: From a journey planning perspective, we distinguish between traveller preferences to be used as input parameters in the search tool and output parameters to a multimodal and cross-border trip search to be presented as search results.

The questionnaire distributed to TISPs formulated the question as follows:

Question 1: Which traveller preferences should be available in the OJP4Danube multimodal journey planner to define expectations in terms of preferences and route information regarding the use of eco-friendly modes?
Some options might only be relevant to display to the traveller as additional output information together with results provided by the journey planner (e.g. weather conditions on the route), others might also be relevant as input preferences to the trip planning (e.g. preferred cycling infrastructure). Please indicate the priority for each option (1 low, 5 high). Please also specify whether each option should be made available as input preference, output information, or both.

The following table presents the final list of traveller preferences in a matrix covering the above two dimensions. The list also includes responses from TISPs on the desirability of each parameter as input or output data in journey planning on a scale from 1 (low priority) to 5 (high priority). Requirements that are kept for defining the uses cases in D.T2.1.1 are highlighted in **bold**.

Table 8: List of traveller preferences including responses from TISPs on the desirability of each parameter as input or output data in journey planning.

	VAO			IDSJMK			TERKEPEM			TJP			IKVC			NCUP			
Traveller preferences *(same list as in the previous section)*	**Input (Y/N)**	**Output (Y/N)**	**Priority (1 -low, 5 -high**	**Input (Y/N)**	**Output (Y/N)**	**Priority (1 -low, 5 -high**	**Input (Y/N)**	**Output (Y/N)**	**Priority (1 -low, 5 -high**	**Input (Y/N)**	**Output (Y/N)**	**Priority (1 -low, 5 -high**	**Input (Y/N)**	**Output (Y/N)**	**Priority (1 -low, 5 -high**	**Input (Y/N)**	**Output (Y/N)**	**Priority (1 -low, 5 -high**	
Options relevant for the journey on an eco-friendly mode itself																			
Type of cycling infrastructure e.g. bicycle lane (on-street, painted), bicycle track (on-street, protected), bicycle path (off-street)	**YES**	**NO**	**4**	**YES**	**YES**	**3**	**YES**	**YES**	**4/5[1]**	**YES**	**YES**	**5**	**NO**	**NO**	**1**	**NO**	**YES**	**1**	**3.1**
Quality of the cycling infrastructure e.g width, smoothness, uni/bidirectional, continuity, green waves, speed limits etc.	NO	NO	1	YES	YES	1	YES	YES	2/3[1]	NO	NO	1	NO	NO	1	NO	NO	1	1.1
Trade-off between cycling distance and cycling comfort	NO	NO	1	YES	YES	5	YES	YES	2/5[1]	NO	YES	3	NO	NO	1	NO	NO	1	2.4
Avoiding ascents or total elevation (altitude profile of the route)	**YES**	**YES**	**4**	**YES**	**YES**	**3**	**YES**	**YES**	**2/5[1]**	**YES**	**YES**	**1**	**NO**	**NO**	**1**	**YES**	**YES**	**3**	**2.6**
Point of interests (POIs) e.g. shopping on the route	-	-	-	NO	YES	1	YES	YES	4/1[1]	YES	YES	5	NO	NO	1	NO	YES	2	2.3
Scenery on the route e.g. greenery, sights, landmarks etc.	**YES**	**YES**	**2**	**NO**	**YES**	**3**	**YES**	**YES**	**4/1[1]**	**YES**	**YES**	**5**	**NO**	**NO**	**1**	**YES**	**YES**	**3**	**2.75**
Services on the route e.g. public toilets, benches, ATMs, info-points, maps etc.	**YES**	**YES**	**2**	**NO**	**YES**	**4**	**YES**	**YES**	**4/1[1]**	**YES**	**YES**	**5**	**NO**	**NO**	**1**	**YES**	**YES**	**4**	**3.1**
Health effects (e.g. number of steps, calories burnt)	-	-	-	NO	YES	1	NO	NO	1	NO	NO	1	NO	NO	1	NO	NO	1	1
Weather conditions on the route	NO	NO	1	NO	YES	2	NO	NO	1	NO	NO	1	NO	NO	1	NO	YES	1	1.2
Lighting conditions on the route	NO	NO	1	NO	NO	1	NO	NO	1	NO	NO	1	NO	NO	1	NO	YES	2	1.2
Air quality on the route	NO	NO	1	NO	NO	1	NO	NO	1	YES	YES	3	NO	NO	1	NO	YES	2	1.5
Noise levels on the route	NO	NO	1	NO	NO	1	NO	NO	1	NO	NO	1	NO	NO	1	NO	YES	2	1.2
Other, please specify:	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

	VAO			IDSJMK			TERKEPEM			TJP			IKVC			NCUP			
Traveller preferences *(same list as in the previous section)*	**Input (Y/N)**	**Output (Y/N)**	**Priority (1 -low, 5 -high**	**Input (Y/N)**	**Output (Y/N)**	**Priority (1 -low, 5 -high**	**Input (Y/N)**	**Output (Y/N)**	**Priority (1 -low, 5 -high**	**Input (Y/N)**	**Output (Y/N)**	**Priority (1 -low, 5 -high**	**Input (Y/N)**	**Output (Y/N)**	**Priority (1 -low, 5 -high**	**Input (Y/N)**	**Output (Y/N)**	**Priority (1 -low, 5 -high**	
Options relevant for a multimodal trip involving both an eco-friendly mode and public transport																			
Walking or cycling distance to a public transport stop	**YES**	**YES**	**5**	**YES**	**YES**	**5**	**NO**	**YES**	**-/5[1]**	**YES**	**YES**	**5**	**YES**	**YES**	**3**	**YES**	**YES**	**5[2]**	**4.7**
Whether taking an eco-friendly vehicle onboard is permitted	**YES**	**YES**	**5**	**YES**	**YES**	**4**	**YES**	**YES**	**5**	**NO**	**NO**	**5**	**YES**	**YES**	**5**	**YES**	**YES**	**5[3]**	**4.8**
Availability and characteristics of dedicated bicycle parking at end points e.g. covered, protected, etc.	**YES**	**YES**	**4**	**NO**	**YES**	**3**	**YES**	**YES**	**2/3**	**NO**	**NO**	**2**	**NO**	**NO**	**1**	**YES**	**YES**	**5**	**2.9**
Platform access facilities e.g. elevators, stairs	**YES**	**YES**	**4**	**NO**	**YES**	**2**	**YES**	**YES**	**5**	**NO**	**NO**	**1**	**NO**	**NO**	**1**	**YES**	**YES**	**5[3]**	**3**
Level platforms (for rolling in heavy bicycles directly onboard)	NO	NO	1	NO	YES	3	YES	YES	2	NO	NO	1	NO	NO	1	YES	YES	5[3]	2.2
Reliability of the route (risk of delays, capacity limits etc.)	NO	NO	1	NO	YES	2	NO	NO	1	NO	YES	3	NO	NO	1	YES	YES	1	1.5
Total carbon emissions	-	-	-	NO	YES	1	NO	NO	1	NO	NO	1	NO	NO	1	NO	YES	1	1
Additional ticket requirements	**YES**	**YES**	**1**	**NO**	**YES**	**5**	**YES**	**YES**	**2/5[1]**	**YES**	**YES**	**1**	**YES**	**YES**	**5**	**NO**	**YES**	**4[3]**	**3.3**
Other, please specify:	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

[1] For the UTNOVALTERM LJP were provided two weights, first for the input and the second for the output.
[2] Already included.
[3] Currently not supported but would like to implement.

Table 9: Summary of TISPs responses on the type of traveller feedback.

Question 2: What type of traveller feedback should be considered and how? (e.g. actual trip experiences from travellers, satisfaction with the journey planner etc.)	
VAO	Satisfaction with the JP for the JP operator is important. Feedback on touristic cycling routes could be of interest for some regional governments.
IDSJMK	Satisfaction with the journey planner: - Difficult question: currently they receive feedback if something is wrong with the journey planner, no need to measure the quality of the journey planner; will this bring something to users? - Star system with journey as a whole: e.g. satisfied with the journey to POI, should this be only for long distance trips, but it's bothering to always get a question from transport operators on satisfaction. If this is to be added it should be added in a very simple and non-intrusive way. But how to give feedback on a journey that was not saved or done yet, i.e. we don't have the mail or the confirmation that the trip was done - Currently users report feedback by email (but usually users complaints are not very precise), simple but effective
TERKEPEM	Feedback on the planned route based on actual trip experiences by like / dislike or possibly by rating with stars 1-5.
TJP	Useful but not necessary. This would require a different platform but could be integrated.
IKVC	Satisfaction with the journey planner.
NCUP	Would be great to have such features, e.g. rating with stars or with 1-5 for overall satisfaction, arrival time, delay and comfort

In general, in terms of enabling bottom-up traveller feedback, TISPs concur that it would be a useful feature to implement in the future but that it is currently outside the scope of this project.

4. Assessment of OJP4Danube local journey planners

4.1. Data collection method

To gather information about the local journey planners we applied the sequence of steps illustrated in Figure 2. To avoid duplicities with projects LinkingDanube and LinkingAlps, we explored the available documentation. Separately, we have explored the feature related to cycling and walking by inspecting the public GUI of OPJP4Danube Local Journey Planners. To investigate into depth the information about the integration of Local Journey, available cycling related features and future development plans the comprehensive questionnaire was designed and distributed to TISPs. Following the completion of the questionnaire the bilateral interviews with TIPS were conducted. Sections 4.3-4.6 summarize the findings obtained from the survey and bilateral interviews.

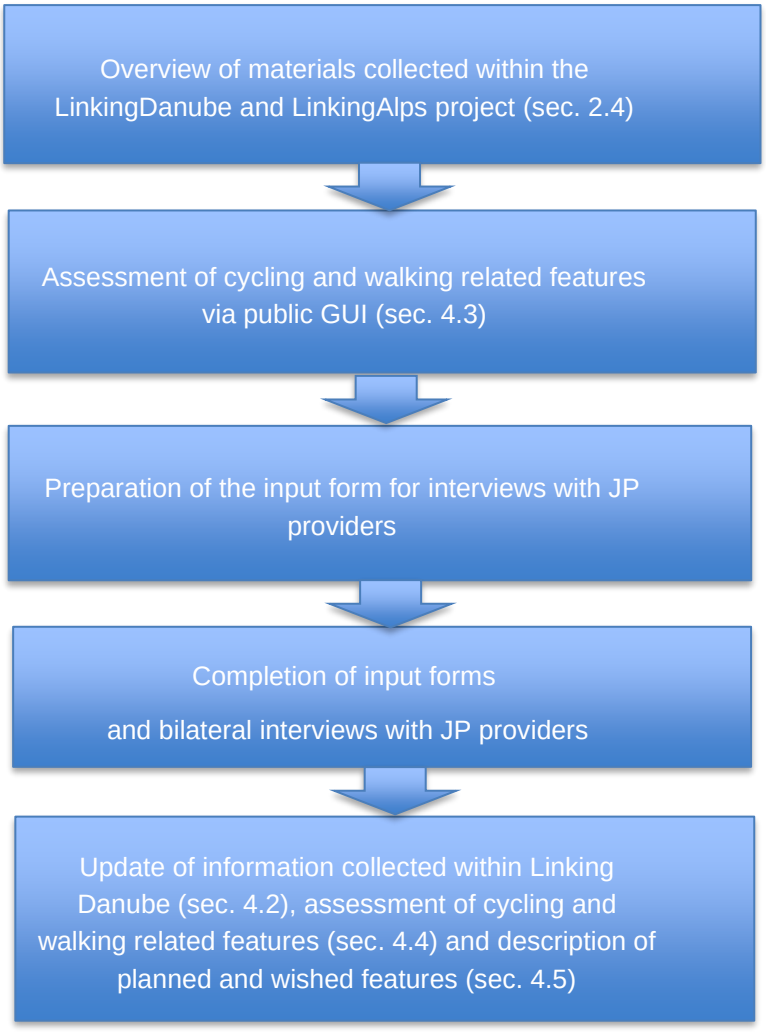


Figure 2: Schematic illustrating the data collection methodology applied to the OJP4Danube journey planners.

4.2. Update of information about the local journey planners from the LinkingDanube project

As Table 4 indicates, most of the information about the status of OJP4Danube LJPs was collected in the second half of 2017. Since then, the features of LJP could have been developed further. This subsection introduces the initial update covering the development of LJP from 2018 to 2020.
Based on the discussion with members of the Core Development Group of the OJP4Danube it was decided that update of the LinkingDanube deliverable D3.1.1 will be performed at the later stages to ensure that up to date information is available when the software development activities take place. Thus, the update of information from the LinkingDanube project was limited to the deliverable D3.1.1, which provides information about each journey planner on organisational and service levels. TISPs were provided with the questionary which was used to collect information for the LinkingDanube deliverable D3.1.1 and they were kindly asked to confirm whether all information reported in the LinkingDanube deliverable D3.1.1 is up to date and there is no need to extend it. Table 10 summarizes collected answers.

Table 10: Replies collected from TISPs regarding the need to update the LinkingDanube deliverable D3.1.1.

VAO	Update concerns only minor amendments and the form was filled in.
IDSJMK	Update concerns only minor amendtments and the form was filled in.
TERKEPEM	Update concerns only minor amendments and the form was filled in.
TJP	Update concerns only minor amendments and the form was filled in.
IKVC	Update is not needed.
NCUP	Update concerns only minor amendments and the form was filled in.

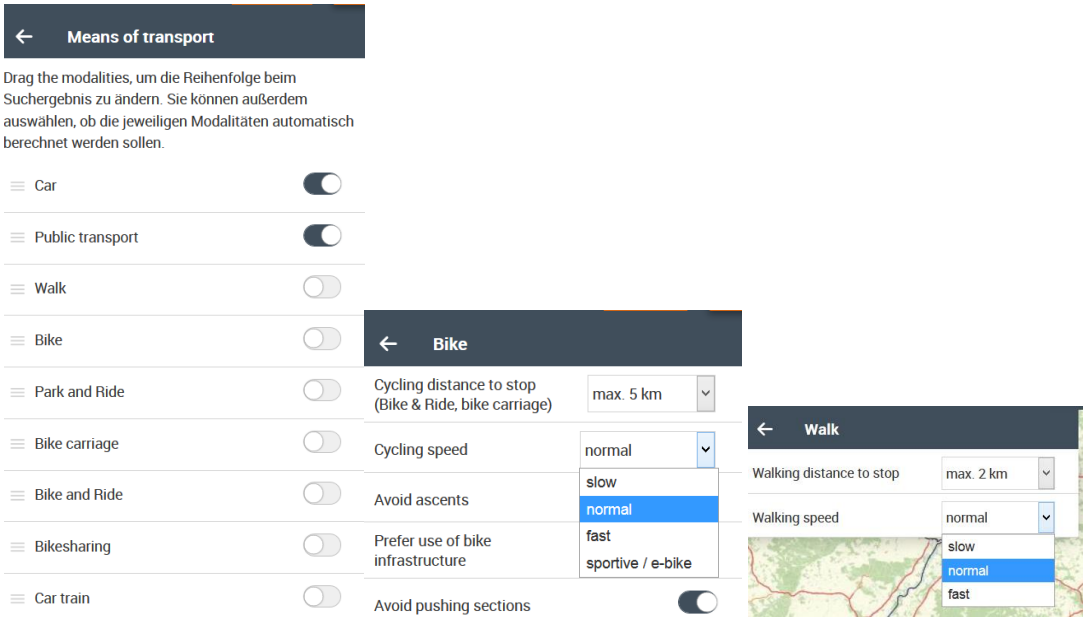
The section 4.6 of the survey form has been dedicated to the update of LinkingDanube information and all provided responses can be find in the attached supplementary information files.

4.3. Assessment of cycling and walking related features of local journey planners via public GUI

In this subsection we focus on the description of LJP features that are related to cycling, walking and other active modes and can be accessed by users via the graphical user interface.

4.3.1. VAO (AT)

The GUI of the LJP can be accessed via the link https://routenplaner.verkehrsauskunft.at/. LJP operated by VAO has a reach support of eco-friendly modes. When defining a request it is possible to specify “Walk”, “Bike”, “Bike carriage” (transport of bike), “Bike and Ride” and “Bikesharing” and modes of transport (see Figure 3a). Furthermore, traveller can adjust the expectation about the cycling and walking by defining the maximum distance to the stop, the speed and in addition for cycling it is possible to modify cycling comfort by options “Avoid comfort”, “prefer use of bike infrastructure and “avoid pushing sections” (see Figure 3b and Figure 3c).



(a) (b) (c)

Figure 3: Available options in the VAO journey planner to define (a) a set of relevant modes of transport (b) user preferences on biking and (c) user preferences on walking.

Trips that include an eco-friendly mode (e.g. cycling or walking) can be used exclusively (see Figure 4) or combined with other modes of transport (see Figure 5). A route is visualized on the map and information about the estimated duration, the length, detailed itinerary and altitude profile (for the cycling part of the route) are provided.

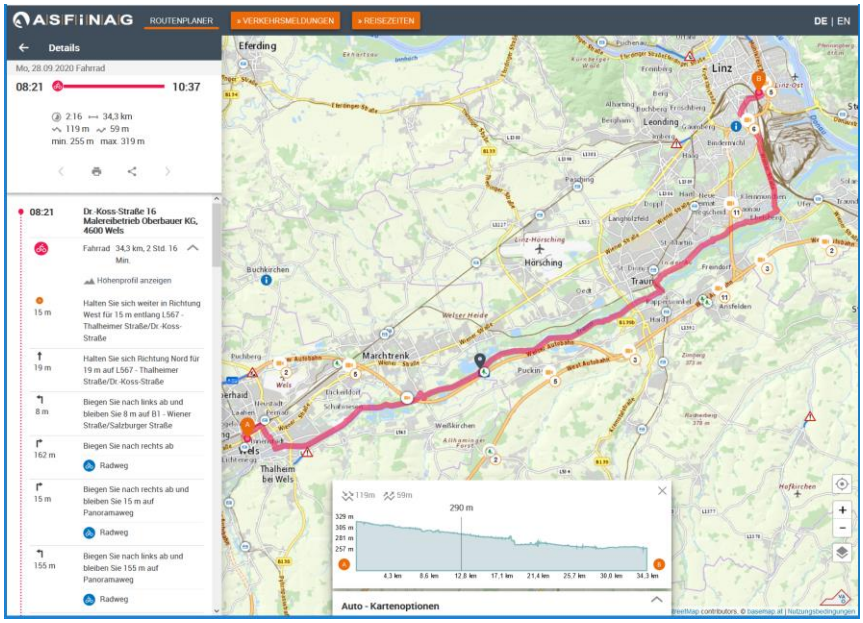


Figure 4: Outputs obtained after searching for a cycling trip include estimated duration and length of the trip, total uphill and downhill elevation, maximum and minimum altitude, interactive graph showing the altitude at a given point of the trajectory, and detailed itinerary with instructions.

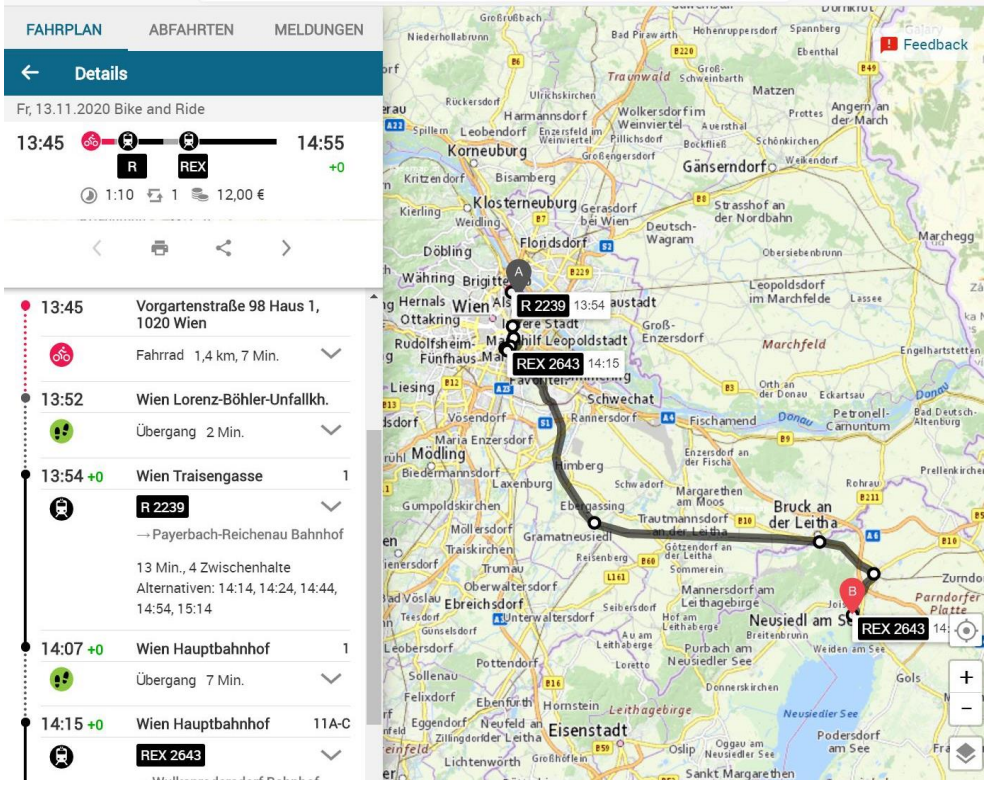


Figure 5: Outputs of the VAO LJP obtained after searching for a trip that combines first-mile trip done by cycling with a train trip.

A notable LJP, which belong to the VAO's family of journey planners is the Rad Tirol service (see Figure 6), which specializes in cycling information for tourist geographically covering the province of Tirol. The available information includes cycling routes displayed on the map organized in three categories: mountain bike, racing bike and trekking bike. Each cycling route has a details description (not available in English), is assigned a difficulty level and detailed information about the surface and elevation along the whole track. Via the buttons "Travel to" and "Travel from" the Rad Tirol app is integrated with the VAO journey planner that include public transport.

The VAO LJP supports search for a "Bike carriage" (bike transport) trips (see Figure 7). As an output, user obtains a trip that is partly covered by cycling (typically the first and the last miles) and public transport. For trip section covered by cycling a detailed itinerary is available. Information on the public transport includes basic information about the bike carriage. Another feature of VAO LJP facilitating the use of cycling is the embedding of links to the stations of Nextbike and e-Scooters for more information and booking (see Figure 8).

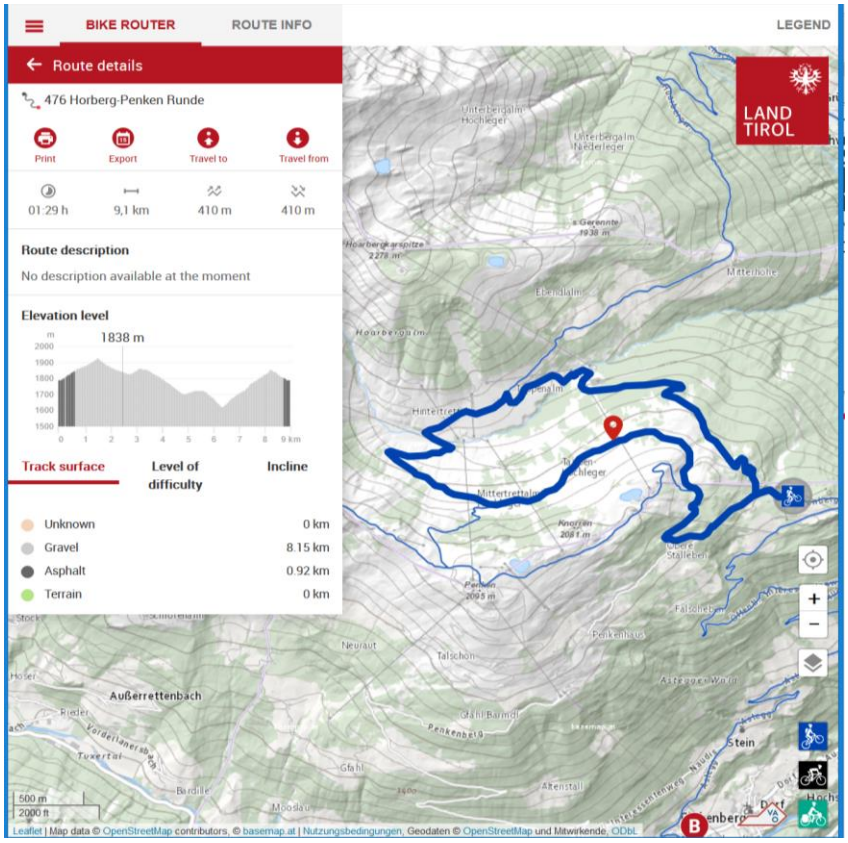


Figure 6: The screenshot illustrating outputs (cycling route, estimated duration, length, altitude profile and track surface information) provided by the Rad Tirol LJP.

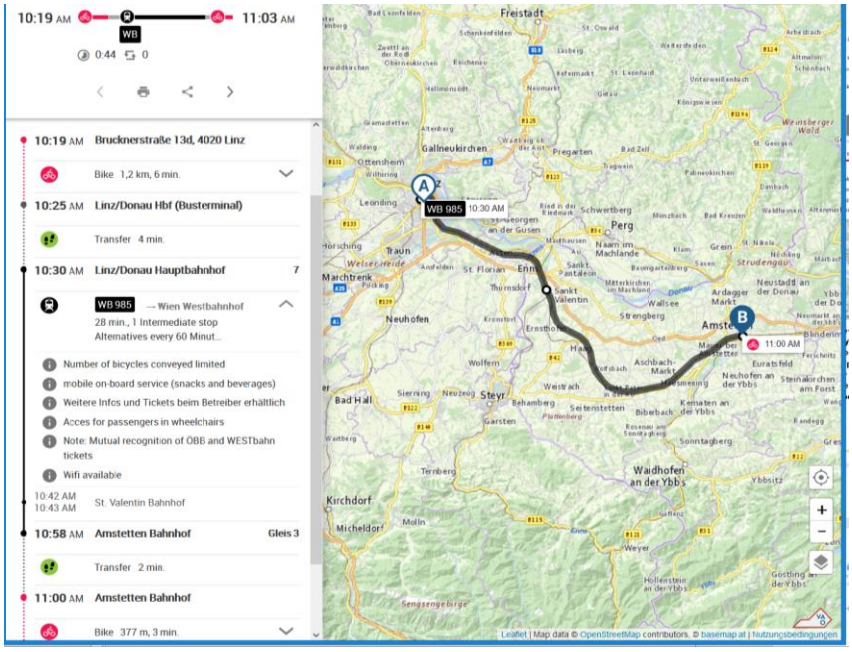


Figure 7: Illustration of an output obtained in response to a search for a trip that includes cycling (first and last mile) and bicycle transport in a train.

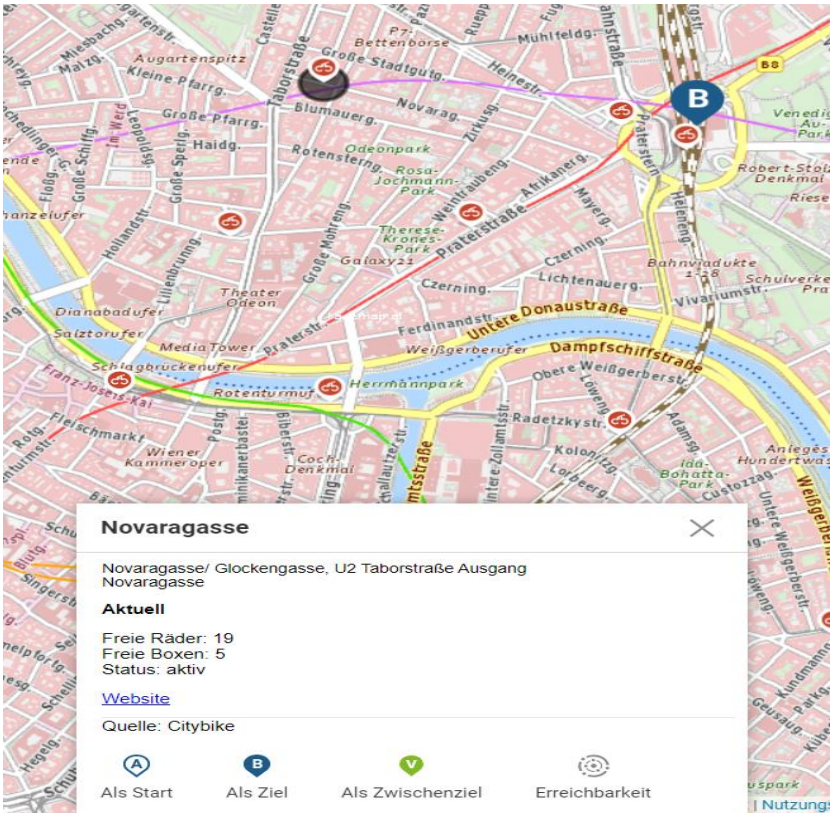


Figure 8: The location of a docking station Is associated with the information about the number of free bicycles and the link which can be used to access more information.

4.3.2. IDSJMK (CZ)

The cycling is broadly promoted by the South Moravian Region. In the Brno city, bicycles, scooters etc. can be transported for free in the public transport. The bicycle transport is allowed in the most of the regional trains. Nevertheless, IDSJMK journey planner in the present form provides only limited support of cycling and walking. When defining a search, a traveller can indicate the preference of “Low floor connections only” or “No-barrier connections only” (see Figure 9), which can be used to increase the comfort when traveling with a bicycle.

Cycling and walking are currently not supported by the IDSJMK as modes of transport, even not for the first and the last mile of a trip. When browsing the offered connection, a traveller can get more detailed information about connections (see Figure 10), though the static and dynamic information about bicycle transport is not available.

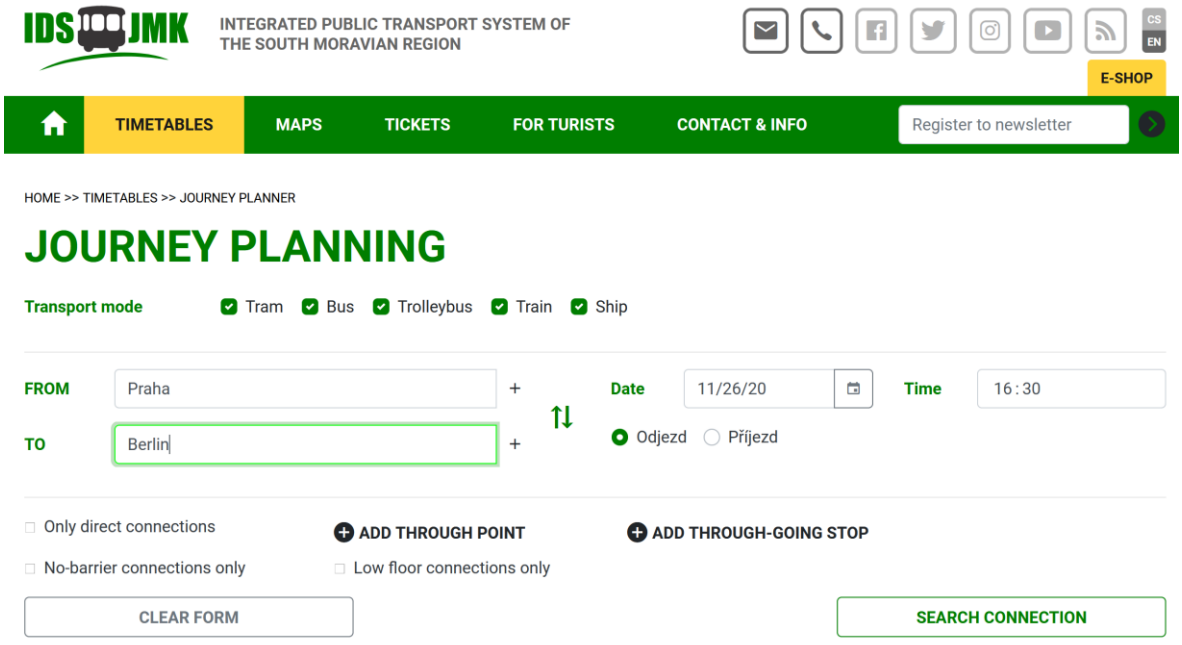


Figure 9: IDSJMK journey planner does not include cycling and walking as separate modes of travel. Cycling is promoted by enabling to a user to indicate that traveller requires low floor connections only.

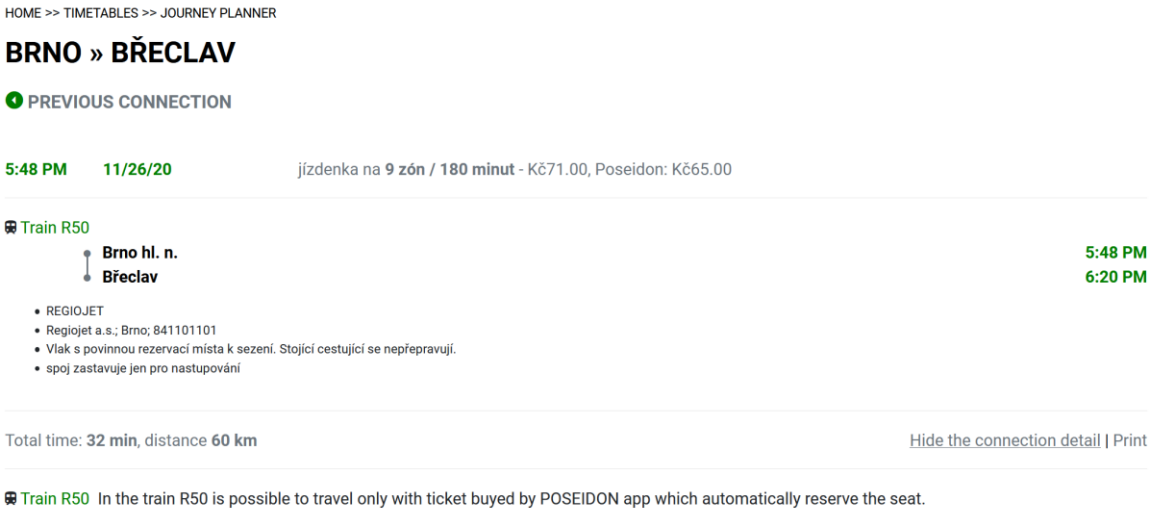


Figure 10: IDSJMK planner provides information about each offered connection, however, information about the possibilities to combine public transport with cycling and walking is not included as a part of a travel offer.

The static information about the possibilities to combine cycling and public transport is available on the IDSJMK website (https://www.idsjmk.cz/en/a/turisti-preprava-kol.html). Moreover, to promote cycling, IDSJMK website provides a map of regional transport connections, which are bicycle friendly.

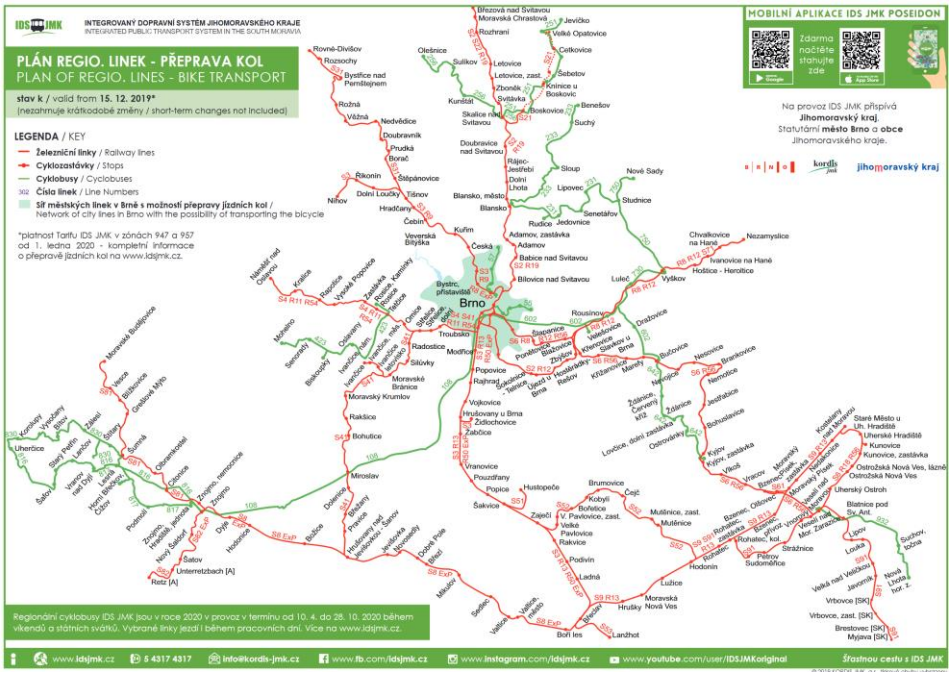


Figure 11: To promote cycling, IDSJMK web site provides detailed information about the possibilities to transport bikes in public transport (https://www.idsjmk.cz/en/a/turisti-preprava-kol.html) and provides a map of public transport connections which are bicycle friendly.

4.3.3. TERKEPEM (HU)

Among the features that can be linked to eco-friendly modes, the TERKEPEM LJP enables the search for cycling routes connecting an origin with a destination. As a result, the user is provided with the route visualised on the map (see Figure 12), estimated duration and length of the trip and altitude profile. In the altitude profile, colours are used to mark the steepness.

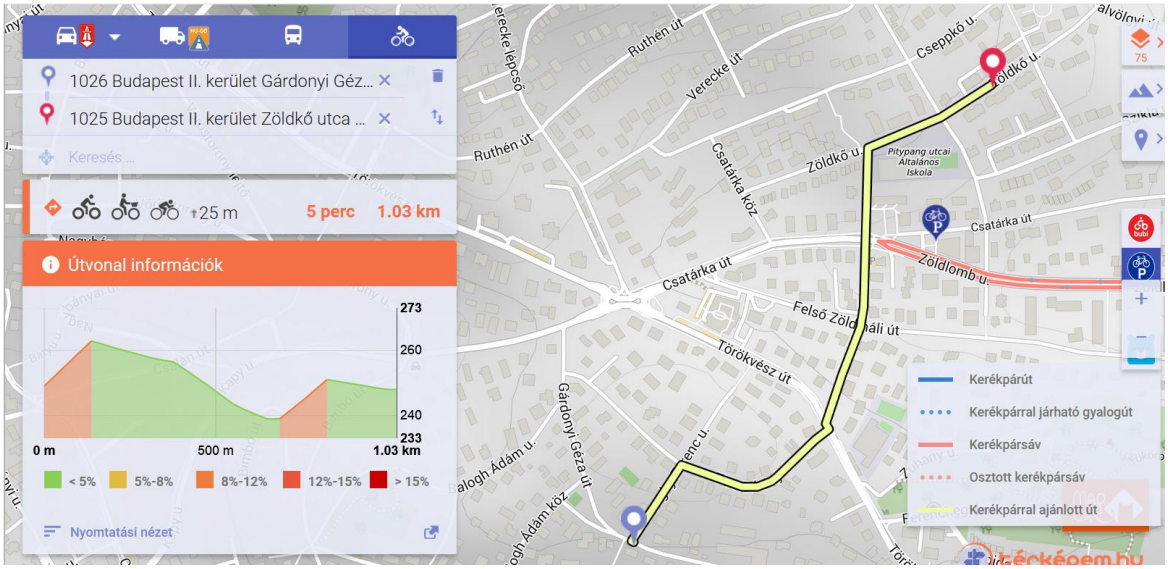


Figure 12: Illustration of the output provided by the TERKEPEM LJP when searching for a cycling trip.

In some situations, the TERKEPEM LJP offers two or three cycling routes each having a different difficulty level (Easy, Medium or Difficult), which is indicated by icons of cyclists (see Figure 13).

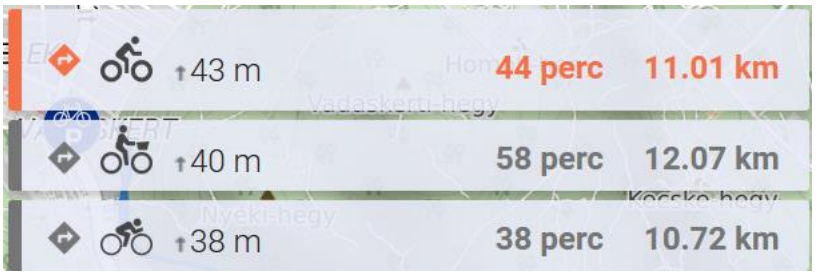


Figure 13: Information about difficulty level of a cycling trip (Easy, Medium and Difficult) is indicated by the icon of cyclist.

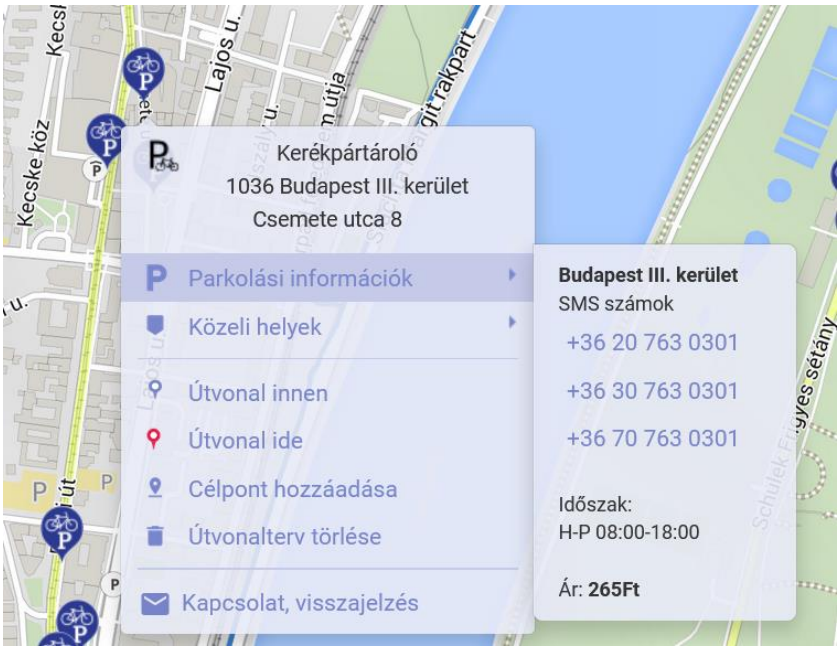


Figure 14: Illustration of information (contact details, opening hours and prices) that is associated with parking places for bicycles.

Parking facilities that allow for parking of bicycles are highlighted on the map with icons (see Figure 14). When clicking on the icon by mouse more detailed information is displayed. A similar information is available about bike sharing stations and it is accessible via the red icon of the bicycle that can be seen on the left margin of Figure 14. However, as the bike sharing system is not operating during the winter season, it was not possible to prepare an illustration snapshot.

4.3.4. TJP (RO)

The Timisoara journey planner does not have a public GUI.

4.3.5. IKVC (SK)

IKVC journey planner has been specifically designed to search for train connection, hence, the information about the availability of other modes of transport, is limited. When a traveller defines a connection search, she/he can indicate the requirement to transport the bicycle (see Figure 15).

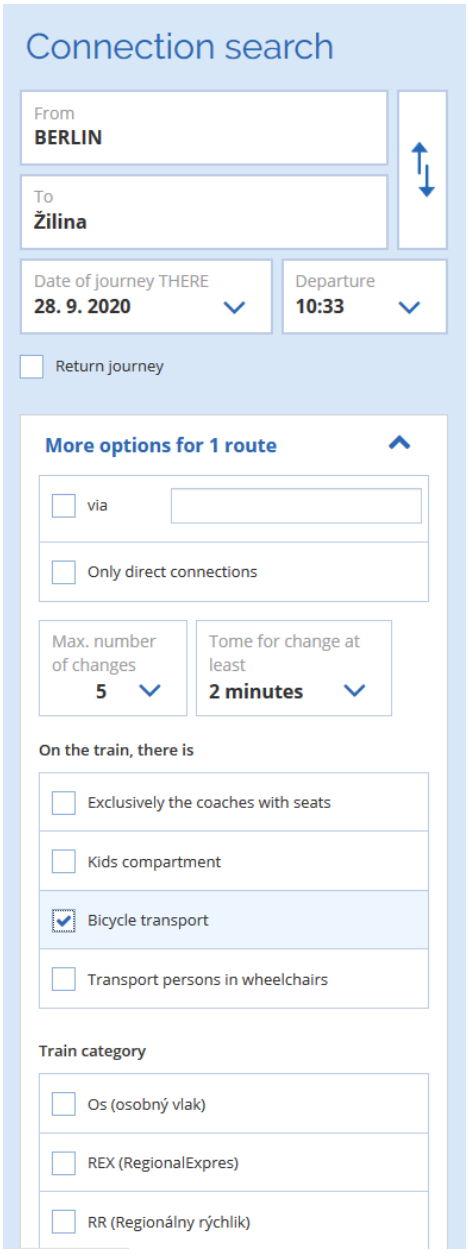
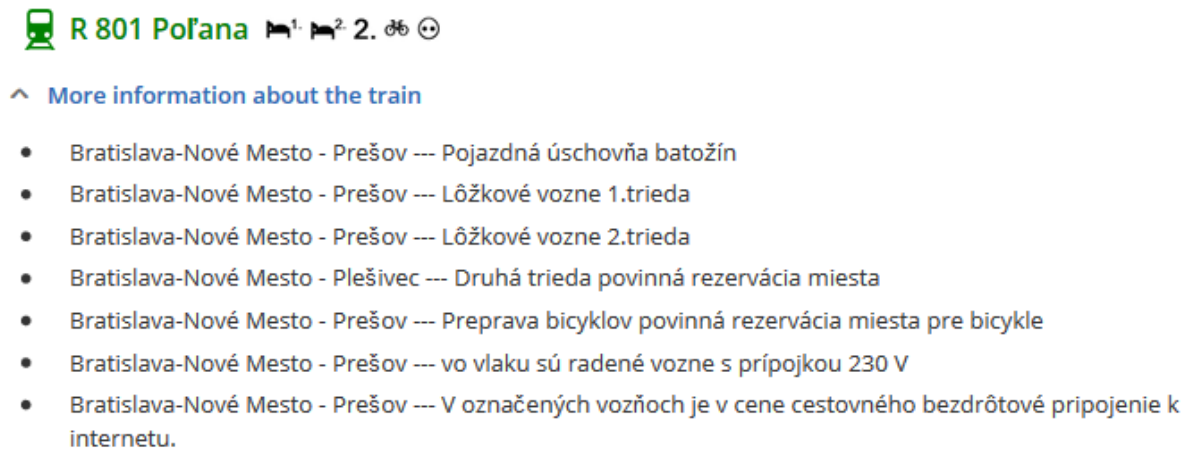


Figure 15: IKVC journey planner does not include cycling and walking as separate modes of travel. Cycling is promoted by enabling to a user to indicate the transport of the bicycle.

If a traveller indicates the bicycle transport, in response only connections where the transport of bicycles is allowed are listed. Furthermore, more detailed information (e.g. information about the compulsory reservation of a slot for bicycle transport) about the conditions is available, when a train

connection is selected (see Figure 16a). Unfortunately, this information is available only in Slovak language, even though the English has been selected. In addition, the dynamic information about the occupancy of a train is available (see Figure 16b). Regarding bike transport, the overall maximum capacity is provided and the currently available capacity is indicated by labels “Free”, “Unavailable” and “Last capacity”.



(a)

(b)

Figure 16: (a) As an outcome IKVC journey planner provides basic information about the possibilities to travel with bicycles (the legend is available in Slovak only) in a train. (b) If the reservation of a space for bicycles is needed, the user can see the overall number of bicycle storage spaces and the availability is indicated by displaying to the used one out of the three possible labels “Free”, “Unavailable” and “Last capacity”.

4.3.6. NCUP (SI)

At the time of the preparation of this report, there was available only the ALPHA version of the public GUI of the NCUP local journey planner. Thus, the information provided in this section is likely to be influenced by the future developments of the NCUP tool.

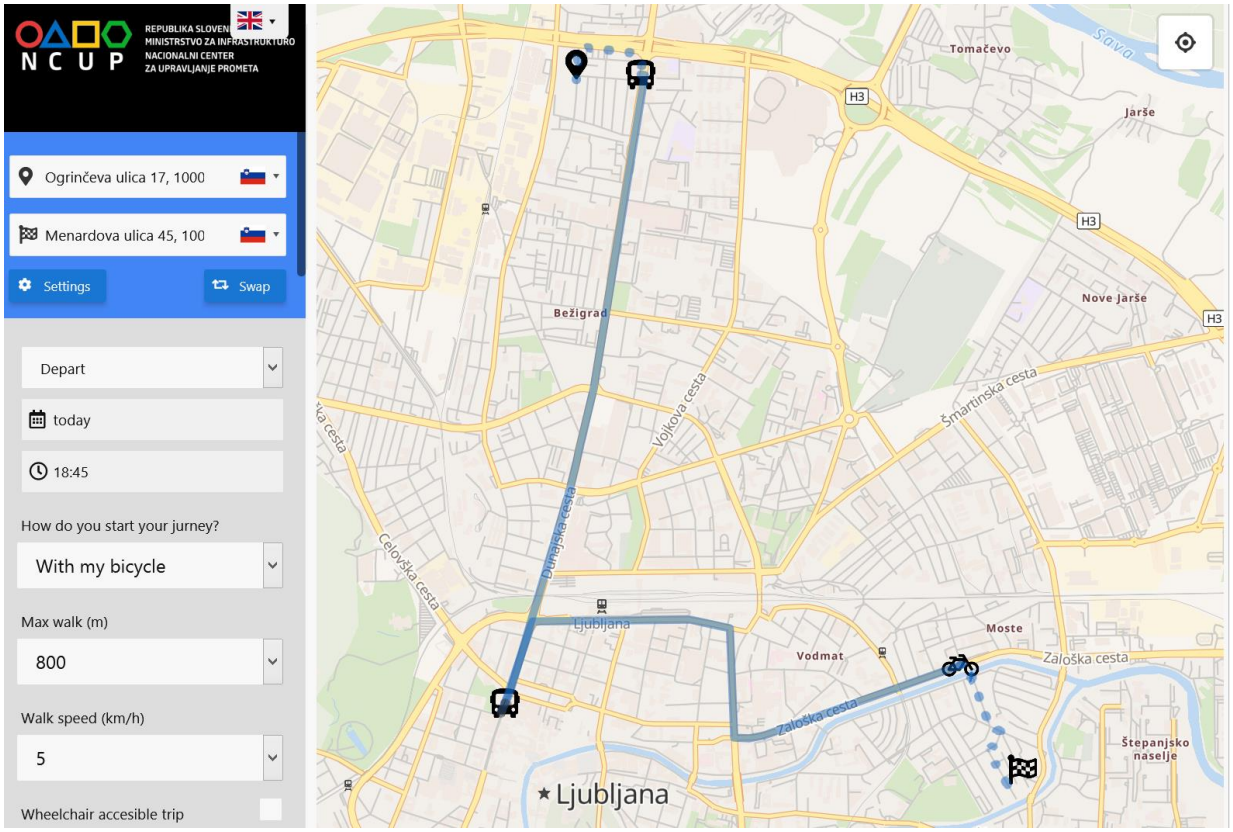


Figure 17: The GUI of NCUP local journey planner.

Before searching for a trip, expectations regarding how the traveller will get to the public transport stop (“Walking”, “With my bicycle” and “with my car”), maximum distance to walk, walking speed and wheelchair accessibility can be specified using the panel shown in Figure 17. The suggested trip is visualised on the map, while the first and last mile are indicated by a dashed line. The traveller can switch between different travel offers and modes of transport using a panel shown in Figure 18. For each travel offer, information about the estimate duration, length and travel itinerary of public transport connections is available.

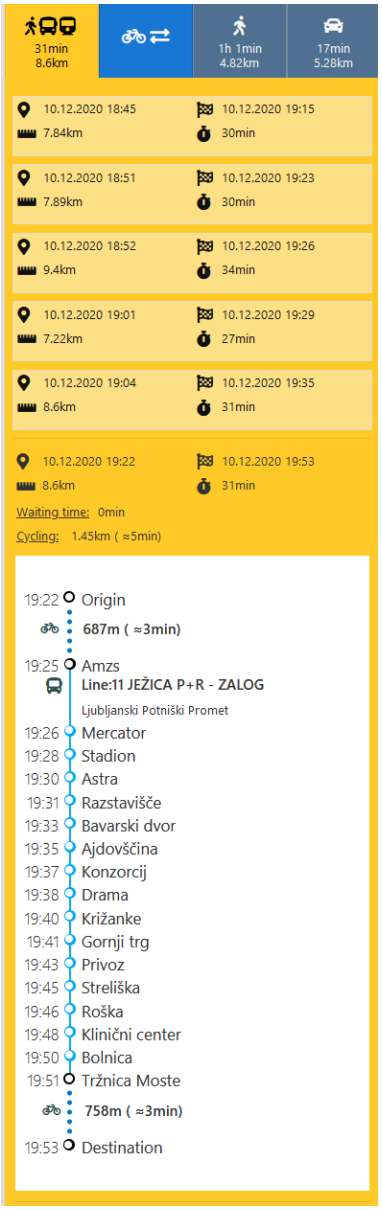


Figure 18: The panel enabling navigation over the offered connections and modes of transport in the NCUP local journey planner.

4.4. Assessment of cycling and walking related features of local journey planners from the survey

The analysis conducted in Section 2 identified possibly relevant traveller preferences for the OJP4Danube project, including the eco-friendly modes of transport that could be integrated with the public transport. To investigate, which of these eco-friendly modes are already supported by the OJP4Danube local journey planners we asked TISPs the following question:

"Which eco-friendly modes of transport are specifically considered by the LJP in your responsibility? How are these modes supported, for finding routes and/or for combining eco-friendly modes with public transport?"

To simplify the collection and evaluation of answers, TISPs were provided with a table that had the same structure as Table 11 where we summarized all collected answers. TISPs could provide separate answers regarding the possibility to compute a routing and regarding the possibility to combine an eco-friendly mode with public transport.

Table 11: Answers provided by OJP4Danube TISPs regarding the availability of eco-friendly modes of transport within their local journey planner.

	VAO		IDSJMK		TERKEPEM		TJP		IKVC		NCUP	
Eco-friendly transport mode	**Routing support (Y/N)**	**Combined with public transport (Y/N)**	**Routing support (Y/N)**	**Combined with public transport (Y/N)**	**Routing support (Y/N)**	**Combined with public transport (Y/N)**	**Routing support (Y/N)**	**Combined with public transport (Y/N)**	**Routing support (Y/N)**	**Combined with public transport (Y/N)**	**Routing support (Y/N)**	**Combined with public transport (Y/N)**
- Walking	YES	YES[4]	NO	YES	YES[5]	YES[6]	YES	YES	NO	NO	YES	YES
○ Jogging/Running	NO	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO
- Cycling	YES	YES	NO[7]	YES	YES	NO	NO	NO	NO	NO	YES	YES
○ City Bike	NO[8]	YES[9]	NO	YES	NO[10]	NO	NO	NO	NO	NO	YES[11]	YES
○ Electric Bike	NO	NO	NO[7]	YES	NO	NO	NO	NO	NO	NO	YES[12]	YES
○ Foldable Bike	NO	NO	NO[7]	YES	NO	NO	NO	NO	NO	NO	NO	NO
○ Other specialised bikes (Mountain, Racing, Trekking, or Cargo bikes)	YES	YES[13]	NO[7]	YES	NO	NO	NO	NO	NO	NO	NO	NO
○ Bike Sharing (public system)	NO[14]	YES[15]	NO[7]	NO	NO	NO	NO[16]	NO[16]	NO	NO	YES	YES
○ Bike and Ride (bike parking at stations)	NO[17]	NO	-	YES	-	NO	NO	NO	NO	NO	NO[18]	NO[18]
○ Bike as a carry-on (onboard public transport)	YES	YES	-	YES	-	NO	NO	NO	YES	YES	NO[18]	NO[18]

	VAO		IDSJMK		TERKEPEM		TJP		IKVC		NCUP	
Eco-friendly transport mode	**Routing support (Y/N)**	**Combined with public transport (Y/N)**	**Routing support (Y/N)**	**Combined with public transport (Y/N)**	**Routing support (Y/N)**	**Combined with public transport (Y/N)**	**Routing support (Y/N)**	**Combined with public transport (Y/N)**	**Routing support (Y/N)**	**Combined with public transport (Y/N)**	**Routing support (Y/N)**	**Combined with public transport (Y/N)**
- Micro-scooter / E-scooter	YES	YES	NA[19]	YES	NO	NO	NO	NO	NO	NO	NO[18]	NO[18]
○ E-scooter Sharing (public system)	-	YES	NA[19]	NO	NO	NO	NO[16]	NO[16]	NO	NO	NO[18]	NO[18]
○ Scooter as a carry-on (onboard public transport)	NO	NO	-	YES	-	NO	NO	NO	NO	NO	NO[18]	NO[18]
- Other, please specify:	-	-	-	-	-	-			-	-	-	-

[4] for the first and last mile to reach PT station and to interchange
[5]the routing for pedestrians is done based on the public transport routing, as first/last mile planning
[6] as first/last mile
[7] planned in OJP4
[8] there is no separate mode for City Bike
[9] city bike and next bike
[10] partly, there is no specific routing for cycling; the system can provide info (show on the map) city bike stations
[11] as a city bike here, we consider the bike sharing system
[12] it is available only in some cities
[13] only for special cycling applications (racing cycling, mountain bike, daily life cycling)
[14] there is no separate mode for City bike
[15] City bike and next bike
[16] In development
[17] no stations
[18] there is a willingness to implement it, but there is no data
[19] no need, possible in all vehicles

A brief inspection of results presented in Table 11 reveals the following findings:

- Walking as a model of transport is fully supported by four local journey planners (IKVC does not support it and IDSJMK supports it only in combination with public transport).
- Cycling is supported by all LJPs, except TJP, however the level of support is very diverse:
  - VAO broadly supports walking and cycling. Both can be separately used as modes of transport or combined with public transport, including bike transport. Interesting functionalities are provided by the cycling specialized module, Rad Tirol, that facilitates the use of cycling routes for tourism.
  - IDSJMK enables to combine cycling with public transport, but it does not provide routing for cycle trips at the moment.
  - TERKEPEM provides direct support only for walking.
  - IKVC supports bike transport only, as it was already concluded based on the analysis of public GUI in Section 4.3.5.
  - NCUP supports walking and certain forms of cycling can be combined with public transport, however, bike transport is currently not supported.

Furthermore, we investigated which traveller preferences can be expressed as an input, when defining a search request and which traveller preferences are covered by the output information that is provided LJPs. To investigate on this issue the following questions was asked during surveys:

"What travel options can the traveller use to customize preferences regarding the utilization of eco-friendly modes prior to searching for transport connections?"

To facilitate provision of answers, TISPs were provided with a table of identical structure as Table 12 where we present the collected results. The provided options are organized in two categories: those that are relevant to an eco-friendly mode only (top part) and those that are relevant in the conjunction with a public transport (bottom part).

Table 12: Answers provided by OJP4Danube TISPs regarding the possibilities to express travelling preferences (input preference) and information that is provided as an outcome of the trip search (output information) in connection with eco-friendly modes of transport.

	VAO		IDSJMK		TERKEPEM		TJP		IKVC		NCUP	
Travel options	**Input preference (Y/N)**	**Output information (Y/N)**	**Input preference (Y/N)**	**Output information (Y/N)**	**Input preference (Y/N)**	**Output information (Y/N)**	**Input preference (Y/N)**	**Output information (Y/N)**	**Input preference (Y/N)**	**Output information (Y/N)**	**Input preference (Y/N)**	**Output information (Y/N)**
Options relevant for the journey on an eco-friendly mode itself												

Travel options	VAO		IDSJMK		TERKEPEM		TJP		IKVC		NCUP	
	Input preference (Y/N)	Output information (Y/N)	Input preference (Y/N)	Output information (Y/N)	Input preference (Y/N)	Output information (Y/N)	Input preference (Y/N)	Output information (Y/N)	Input preference (Y/N)	Output information (Y/N)	Input preference (Y/N)	Output information (Y/N)
Type of cycling infrastructure e.g. bicycle lane (on-street, painted), bicycle track (on-street, protected), bicycle path (off-street)	NO	YES	NO	NO	NO	YES[1]	NO	NO	NO	NO	NO	NO
Quality of the cycling infrastructure e.g width, smoothness, uni/bidirectional, continuity, green waves, speed limits etc.	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Trade-off between cycling distance and cycling comfort	NO	NO	NO	NO	NO	YES[1]	NO	NO	NO	NO	NO	NO
Avoiding ascents or total elevation (altitude profile of the route)	YES	NO	NO	NO	NO	YES	NO	NO	NO	NO	NO	NO
Point of interests (POIs) e.g. shopping on the route	NO	NO	NO	NO	NO	NO Error! Bookmark not defined.	NO	NO	NO	NO	NO	NO
Scenery on the route e.g. greenery, sights, landmarks etc.	NO	NO	NO	NO	NO	NO Error! Bookmark not defined.	NO	NO	NO	NO	NO	NO
Services on the route e.g. public toilets, benches, ATMs, info-points, maps etc.	NO	NO	NO	NO	NO	NO Error! Bookmark not defined.	NO	NO	NO	NO	NO	NO
Health effects (e.g. number of steps, calories burnt)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Weather conditions on the route	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Lighting conditions on the route	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Air quality on the route	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Noise levels on the route	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other, please specify:	-	-	-	-	-	-	-	-	-	-	-	-
Options relevant for a multimodal trip involving both an eco-friendly mode and public transport												
Walking or cycling distance to a public transport stop	YES	YES	NO	NO	NO	YES	YES	YES	NO	NO	YES	YES
Whether taking an eco-friendly vehicle onboard is permitted and available	YES	YES	NO	NO	NO	NO	NO	NO	YES[1]	YES[1]	NO[1]	NO

	VAO		IDSJMK		TERKEPEM		TJP		IKVC		NCUP	
Travel options	**Input preference (Y/N)**	**Output information (Y/N)**	**Input preference (Y/N)**	**Output information (Y/N)**	**Input preference (Y/N)**	**Output information (Y/N)**	**Input preference (Y/N)**	**Output information (Y/N)**	**Input preference (Y/N)**	**Output information (Y/N)**	**Input preference (Y/N)**	**Output information (Y/N)**
Availability and characteristics of dedicated bicycle parking at end points e.g. covered, protected, etc.	NO	NO	NO	NO	NO	NO[1]	NO	NO	NO	NO	NO	NO
Platform access facilities e.g. elevators, stairs	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO**Error! Bookmark not defined.**	NO
Level platforms (for rolling in heavy bicycles directly onboard)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Reliability of the route (risk of delays, capacity limits etc.)	NO	MO	NO	NO	NO	NO	NO	NO	NO	YES[1]	NO	NO
Total carbon emissions	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Additional ticket requirements	NO[1]	NO**Error! Bookmark not defined.**	NO	NO	NO	NO	NO	NO	YES	YES	NO	NO
Other, please specify:	-	-	-	-	-	-	-	-	-	-	-	-

In summary following observation can be made about the possibilities to express travelling preferences (input preference) and information that is provided as an outcome of the trip search (output information) in connection with eco-friendly modes of transport:

- Most out of the potential travelling preferences are neither supported on the input nor on the output side of OJP4Danube
- Several LJPs support walking or cycling distance to the public transport and information about the possibility to take eco-friendly vehicle on board of public transport
- Some LJPs provide information about cycling infrastructure, platform access facilities and additional ticket requirements.

Furthermore, we investigated the availability of real-time information/data by asking TISPs the following question:

"Which real-time information/data about the possible combination of public transport with eco-friendly modes (e.g. bike, walk etc.) is currently provided in search results (e.g. dynamic information about free capacity to transport a bicycle, additional services, rules and restrictions etc.)?"

Collected information is presented in Table 13.

Table 13: Information about the availability of real-time information/data to combine eco-friendly modes with public transport.

VAO
As illustrated in Figure 7, for city bike and e-scooter there is information on the availability at stations (not for free-floating services).
IDSJMK
Real-time information includes: • real time departures, • parameter, if specific connection transports bikes, could be included, • dynamic information of is not relevant in the regional system, • rules and restrictions are available in pdf, only in Czech but could be translated into English.
TERKEPEM
At this point, real-time information is not provided, although the system is capable to process and visualize on the map SIRI-based real-time position information of vehicles/trains. When data of this type are fed to the system (like in the GYSEV application powered through our API), the system can also provide info on the expected arrival of the train.
TJP
None.
IKVC
Only information about the total capacity to bicycles transport and information whether there is currently any place of transport available (not a number of available places of transport) is supported.
NCUP
Real time data currently provided are: • Data about free parking spots on stations– bike sharing system • Data about free bicycles - bike sharing system

LJPs could make use of links with other online service and extend the level of information they provide about eco-friendly modes of transport. To gain a better understanding to what extent are external services utilized by LJPs we asked TISPs the following questions:

"Does the LJP provide links to other online services which are able to provide more detailed information about the utilization of eco-friendly transport modes? How is the linking between systems ensured? Which other LJPs are supported?"

Answers are presented in Table 14.

Table 14: Information about the availability of real-time information/data to combine eco-friendly modes with public transport.

VAO
As illustrated in Figure 7, there is a link embedded to the stations of Nextbike and e-Scooters for more information and booking.
IDSJMK
No, such services do not exist but within OJP4Danube, we are going to try to involve them.
TERKEPEM
No.
TJP
No.
IKVC
No.
NCUP
The data about bikes are linked at the level business to business.

4.5. Planned and wished local journey planner features

To assure that future development plans of TISPs regarding support of eco-friendly modes of transport, frontend, backend, API, connectivity to other systems and availability of data, can be considered by the OJP4Danube we asked the following questions:

"Are you aware of currently planned extensions of the LJPs that is/are under your responsibility in the OJP4Danube project? If so, please describe them in the table below while using the proposed categories."

Table 15 summarizes the provided answers. The most intensive developments can be expected regarding IDSJMK and TJP LJPs.

Table 15: Future development plans of TISPs regarding LJPs that could be relevant for OJP4Danube.

Eco-friendly transport modes:	
VAO	We are looking to include all sharing services that are available in Austria, but the services provision is quite "dynamic" and not very stable.
IDSJMK	We will try to implement within OJP4.
TERKEPEM	No.
TJP	Bike sharing and e-scooter sharing integration.
IKVC	No.
NCUP	Bicycle as mode together with bicycle paths will be included in the LJP.

Frontend (user interface):	
VAO	Already solved.
IDSJMK	No.
TERKEPEM	No.
TJP	No.
IKVC	No.
NCUP	User interface will be upgraded to requirements that will be specified in the project.
Backend (server-side):	
VAO	The integration is complex as many different interfaces exists at the service providers and there is no “standard”. So the connection to VAO is a technical individual connection which is costly.
IDSJMK	No.
TERKEPEM	No.
TJP	No.
IKVC	No.
NCUP	The system is planned to be active node with distributed routing capabilities.
Application programming interface (API):	
VAO	Many different APIs are used and there is no “standard”.
IDSJMK	No.
TERKEPEM	No.
TJP	Development of the OJP interface with a public interface at the end of the project but at minimum the system will be able to exchange data with other OJP4 active nodes.
IKVC	No.
NCUP	No.
Connectivity to other systems:	
VAO	For availability of vehicles and stations.
IDSJMK	We will try to implement within OJP4Danube.
TERKEPEM	No.
TJP	Connection with the central node / active system to be done in-house.
IKVC	No.
NCUP	The LJP will be connected to IJPP (national database for PT topology network and timetables).
Availability of data:	
VAO	It is very heterogeneous.
IDSJMK	We will try to implement within OJP4DAnube.
TERKEPEM	No.
TJP	No.
IKVC	No.
NCUP	LJP will be publicly available.
Other:	
VAO	-
IDSJMK	-
TERKEPEM	-
TJP	-
IKVC	-
NCUP	-

5. Recommendations and conclusions

5.1. Contrasting desirability and availability of eco-friendly modes of transport

Here we shortly summarize the information presented in Section 2.2.1 of the OJP4Danube deliverable D.T2.1.1 about the desirability to differentiate OJP4Danube use cases based on modes of transport. The average desirability scores assigned to eco-friendly modes of transport by TISPs from Table 16 is interpreted as a proxy for the collective desirability to support these modes of transport by LJPs. To analyse the gap between what is desirable and what is available, we contrast them with the results presented in Section 4 where the current support of eco-friendly modes by OJP4Danube LJPs is analysed.

Table 16: Average scores on the scale from 1 (low) to 5 (high) assigned by TISPs to eco-friendly modes of transport expressing the perceived importance of differentiating OJP4Danube use cases by them and the number of LJPs (out of 6) providing support for routing and combination with PT, respectively.

Eco-friendly mode of transport	Average desirability assigned by TISPs	Number of LJPs supporting routing	Number of LJPs supporting combination with PT
- Walking	4.2	4	5
○ Jogging/Running	1.7	0	1
- Cycling	4.8	3	3
○ City Bike	3.5	1	3
○ Electric Bike	3.8	1	2
○ Foldable Bike	2.8	0	1
○ Other specialised bikes (Mountain, Racing, Trekking, or Cargo bikes)	2.7	1	1
- Bike Sharing (public sharing system)	4.2	1	2
- Bike and Ride (bike parking at stations)	4.2	0	1
- Bike as a carry-on (e.g. bike onboard a train)	5.0	2	3
- Micro-scooter / E-scooter	4.3	1	2
○ E-scooter Sharing (public system)	3.5	0	1
○ Scooter as a carry-on (onboard public transport)	3.7	0	1

The comparison of desirability with the number of OJP4Danube LJPs supporting eco-friendly modes of transport reveals the following gaps:

- Cycling was assigned the highest desirability (4.8) while the routing and combination of cycling with other public transport modes are to some extend supported by only 3 out of 6 OJP4Danube LJPs.
- Walking was assigned high desirability (4.2), while the routing and combination with public transport are to some extend supported by 4 and 5 LJPs, respectively.
- There is a high desirability (5.0) for bike transport, however, the routing and combination with public transport are to some extend supported by only 2 and 3 LJPs, respectively.
- Some specialized modes of transport such as Electric bike, Bike Sharing, Bike and Ride and Micro-scooter have been assigned high desirability, but their support by LJPs is rather low.

5.2. Contrasting desired and available traveller preference LJP features

In this section, we compare the priorities given by TISPs (see Section 3) to traveller preferences with the existing support of traveller preferences by OJP4Danube LJPs (see Section 4). The results derived from the survey are summarised in Table 17.

Table 17: Average scores on the scale from 1 (low) to 5 (high) assigned by TISPs expressing the desirability to make the traveller preferences available in the OJP4Danube multimodal journey planner and the number of OJP4Danube LJPs (out of 6) supporting the expression of the traveller preference as an input or outputting information about the traveller preference.

Traveller preferences	Average desirability assigned by TISPs	Number of LJPs supporting expression of the preference as an input	Number of LJPs providing output information about the traveller preference
Options relevant for the journey on an eco-friendly mode itself			
Type of cycling infrastructure e.g. bicycle lane (on-street, painted), bicycle track (on-street, protected), bicycle path (off-street)	3.1	0	2
Quality of the cycling infrastructure e.g width, smoothness, uni/bidirectional, continuity, green waves, speed limits etc.	1.1	0	0
Trade-off between cycling distance and cycling comfort	2.4	0	1
Avoiding ascents or total elevation (altitude profile of the route)	2.6	0	1
Point of interests (POIs) e.g. shopping on the route	2.3	0	0
Scenery on the route e.g. greenery, sights, landmarks etc.	2.75	0	0
Services on the route e.g. public toilets, benches, ATMs, info-points, maps etc.	3.1	0	0
Health effects (e.g. number of steps, calories burnt)	1	0	0
Weather conditions on the route	1.2	0	0
Lighting conditions on the route	1.2	0	0
Air quality on the route	1.5	0	0
Noise levels on the route	1.2	0	0
Options relevant for a multimodal trip involving both an eco-friendly mode and public transport			
Walking or cycling distance to a public transport stop	4.7	3	4
Whether taking an eco-friendly vehicle onboard is permitted	4.8	2	2
Availability and characteristics of dedicated bicycle parking at end points e.g. covered, protected, etc.	2.9	0	0
Platform access facilities e.g. elevators, stairs	3	1	1
Level platforms (for rolling in heavy bicycles directly onboard)	2.2	0	0
Reliability of the route (risk of delays, capacity limits etc.)	1.5	0	1
Total carbon emissions	1	0	0
Additional ticket requirements	3.3	0	1

The comparison of desirability of traveller preferences with the number of OJP4Danube LJPs that support them makes the following gaps visible:

- The highest desirability (4.8) was assigned to bicycle transport onboard public transport, while only 2 LJPs support it as an input and output.
- Similar to what was reported in the eco-friendly modes analysis, walking distances received high desirability, while the input / output support for walking is 3 / 4.
- Several traveller preferences, e.g. type of cycling infrastructure, services on the route, information about dedicated bicycle parking and additional ticket requirements received reasonably high desirability score, however, they are currently supported to a very small extent.

Analyses of eco-friendly modes of transport together with the analyses of traveller preferences suggest that more development is required on cycling than on walking features of LJPs. To handle the diverse level of support of eco-friendly modes of transport and traveller preferences across LJPs, the OJP4Danube should take a robust approach, which enables to integrate LJPs providing high level of support with LJPs that provide low level of support of eco-friendly modes and traveller preferences. Moreover, use cases need to be carefully selected to consider these existing limitations and ambitions.

Appendix - Review of External Data Sources

Following tables present the status of implementations of NAPs contribute to the expansion of geographical coverage of multimodal travel information services within and across the member states in the Danube region.

Current Status on NAPs Deployments

Table 18: Current status of implementation of NAP in Austria.

Country	National Access Point Link	Contact National Body	
Austria	https://www.mobilitydata.gv.at/	AustriaTech	
NAP Common Features		**Result**	**Comments**
NAP is available over the Internet		☒	
NAP can be navigated easily and is design compliant with web design standards/ accessibility		☒	
NAP is provided in the national language and commonly used language(s) of the Danube region		☒	It is available in German and English versions.
NAP provides clear descriptions of each dataset		☒	
NAP provides appropriate discovery services		☐	
The NAP provides machine readable metadata		☐	
The NAP content is maintained and makes best effort is made to keep content up to date		☒	

Table 19: Current status of implementation of NAP in Czech Republic.

Country	National Access Point Link	Contact National Body	
Czech Republic	https://data.gov.cz/datov%C3%A9-sady	Ministry of the Interior of the Czech Republic	
NAP Common Features		**Result**	**Comments**
NAP is available over the Internet		☒	
NAP can be navigated easily and is design compliant with web design standards/ accessibility		☒	
NAP is provided in the national language and commonly used language(s) of the Danube region		☒	It is available in Czech and English versions.

NAP provides clear descriptions of each dataset	☐	
NAP provides appropriate discovery services	☒	
The NAP provides machine readable metadata	☐	
The NAP content is maintained and makes best effort is made to keep content up to date	☐	

Table 20: Current status of implementation of NAP in Hungary.

Country	**National Access Point Link**	**Contact National Body**	
Hungary	https://napportal.kozut.hu		
NAP Common Features		**Result**	**Comments**
NAP is available over the Internet		☐	Not Available.
NAP can be navigated easily and is design compliant with web design standards/ accessibility		☐	
NAP is provided in the national language and commonly used language(s) of the Danube region		☐	
NAP provides clear descriptions of each dataset		☐	
NAP provides appropriate discovery services		☐	
The NAP provides machine readable metadata		☐	
The NAP content is maintained and makes best effort is made to keep content up to date		☐	

Table 21: Current status of implementation of NAP in Romania.

Country	**National Access Point Link**	**Contact National Body**	
Romania			
NAP Common Features		**Result**	**Comments**
NAP is available over the Internet		☐	In progress.

NAP can be navigated easily and is design compliant with web design standards/ accessibility	☒	
NAP is provided in the national language and commonly used language(s) of the Danube region	☐	
NAP provides clear descriptions of each dataset	☐	
NAP provides appropriate discovery services	☐	
The NAP provides machine readable metadata	☐	
The NAP content is maintained and makes best effort is made to keep content up to date	☐	

Table 22: Current status of implementation of NAP in Slovenia.

Country	**National Access Point Link**	**Contact National Body**	
Slovenia			
NAP Common Features		**Result**	**Comments**
NAP is available over the Internet		☒	
NAP can be navigated easily and is design compliant with web design standards/ accessibility		☐	
NAP is provided in the national language and commonly used language(s) of the Danube region		☐	
NAP provides clear descriptions of each dataset		☐	
NAP provides appropriate discovery services		☐	
The NAP provides machine readable metadata		☐	
The NAP content is maintained and makes best effort is made to keep content up to date		☐	

Table 23: Current status of implementation of NAP in Slovakia.

Country	**National Access Point Link**	**Contact National Body**
Slovakia	https://odoprave.info/wps/portal/pub/Home/uvod	Ministry of Transport, Construction and Regional Development of the Slovak Republic and the Operational Programme Transport

NAP Common Features	Result	Comments
NAP is available over the Internet	☒	
NAP can be navigated easily and is design compliant with web design standards/ accessibility	☒	
NAP is provided in the national language and commonly used language(s) of the Danube region	☒	Slovak, English, German, and Hungarian.
NAP provides clear descriptions of each dataset	☐	
NAP provides appropriate discovery services	☐	
The NAP provides machine readable metadata	☐	
The NAP content is maintained and makes best effort is made to keep content up to date	☐	

Implementation Status Annex I of Commission Delegated Regulation (EU) 2017/1926

Although the regulation is not directly connected to the OJP4Danube project implementation, the table below gives an idea of the type of data that should be publicly available at national level, and when. For example, member states committed to making the type of cycling network infrastructure (segregated, on-road, or shared with pedestrians) in December 2019, which may be relevant for filling the gap in missing data from existing journey planners if other sources are not readily available. However it must be said that the level of implementation of the delegated regulation by member states still varies greatly, particularly when data is not directly relevant to conventional motorised road traffic.

Table 24: Implementation status of Annex I of the delegated regulation in the Danube region.

Service of NAPs	*Austria*	*Czech Republic*	*Hungary*	*Romania*	*Slovenia*	*Slovakia*	Comments
Static travel data – level of service 1 *(must be established and in operation at the latest December 1, 2019 in all member countries)*							
Address identifiers (building number, street name, postcode)	☐	☐	☐	☐	☐	☐	
Topographic places (city, town, village, suburb, administrative unit)	☐	☐	☐	☐	☐	☐	
Points of interest (related to transport information) to which people may wish to travel	☐	☐	☐	☐	☐	☐	

Identified access nodes (all scheduled modes)	☐	☐	☐	☐	☐	☐	
Connection links where interchanges may be made, default transfer times between modes at interchanges	☐	☐	☐	☐	☐	☐	
Network topology and routes/lines (topology)	☐	☐	☐	☐	☐	☐	Topology is relevant for elevation calculations
Transport operators	☐	☐	☐	☐	☐	☐	
Timetables	☐	☐	☐	☐	☐	☐	
Planned interchanges between guaranteed scheduled services	☐	☐	☐	☐	☐	☐	
Hours of operation	☐	☐	☐	☐	☐	☐	
Stop facilities access nodes (including platform information, help desks/information points, ticket booths, lifts/stairs, entrances and exit locations)	☐	☐	☐	☐	☐	☐	
Vehicles (low floor; wheelchair accessible.)	☐	☐	☐	☐	☐	☐	
Accessibility of access nodes, and paths within an interchange (such as existence of lifts, escalators)	☐	☐	☐	☐	☐	☐	
Existence of assistance services (such as existence of on-site assistance)	☐	☐	☐	☐	☐	☐	
Road network	☐	☐	☐	☐	☐	☐	
Cycle network (segregated cycle lanes, on-road shared with vehicles, on-path shared with pedestrians)	☐	☐	☐	☐	☐	☐	
Pedestrian network and accessibility facilities	☐	☐	☐	☐	☐	☐	
Static travel data - level of service 2 *(must be established and in operation at the latest December 1, 2020 in all member countries)*							
Bike sharing stations	☐	☐	☐	☐	☐	☐	
Secure bike parking (such as locked bike garages)	☐	☐	☐	☐	☐	☐	
Where and how to buy tickets for scheduled modes, demand responsive modes and car parking (all scheduled modes and demand-responsive incl. retail channels, fulfilment methods, payment methods)	☐	☐	☐	☐	☐	☐	
Vehicle facilities such as classes of carriage, on-board Wi-Fi	☐	☐	☐	☐	☐	☐	
Static travel data - level of service 3 *(must be established and in operation at the latest December 1, 2021 in all member countries)*							
Passenger classes	☐	☐	☐	☐	☐	☐	
How to book car sharing, taxis, cycle hire etc.	☐	☐	☐	☐	☐	☐	
Detailed cycle network attributes	☐	☐	☐	☐	☐	☐	

Parameters needed to calculate an environmental factor such as carbon per vehicle type or passenger mile or per distance walked	☐	☐	☐	☐	☐	☐	
Estimated travel times by day type and time-band by transport mode/combination of transport modes	☐	☐	☐	☐	☐	☐	
Dynamic travel and traffic data - level of service 1 *(must be established and in operation at the latest December 1, 2020 in all member countries)*							
Disruptions (all modes)	☐	☐	☐	☐	☐	☐	
Real-time status information-delays, cancellations, guaranteed connections monitoring (all modes)	☐	☐	☐	☐	☐	☐	
Status of access node features (including dynamic platform information, operational lifts/escalators, closed entrances and exit locations-all scheduled modes)	☐	☐	☐	☐	☐	☐	
Dynamic travel and traffic data - Level of service 2 *(must be established and in operation at the latest December 1, 2020 in all member countries)*							
Estimated departure and arrival times of services	☐	☐	☐	☐	☐	☐	
Current road link travel times	☐	☐	☐	☐	☐	☐	
Cycling network closures/diversions	☐	☐	☐	☐	☐	☐	
bike sharing availability	☐	☐	☐	☐	☐	☐	
Dynamic travel and traffic data - level of service 3 *(must be established and in operation at the latest December 1, 2020 in all member countries)*							
Future predicted road link travel times	☐	☐	☐	☐	☐	☐	