OJP4Danube

Deliverable D.T2.1.1

Use case report

Version: **v0.5**

Dissemination level: **Restricted (partners only)**

WP: **WPT2**

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Funding: The project is funded by the European Regional Development Fund (ERDF), Instrument for Pre-Accession Assistance II (IPA II) and European Neighbourhood Instrument (ENI).

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Document History

Date	Version	Summary of changes	Dissemination
20.10.2020	0.1	First draft of the structure	Project partners
22.12.2020	0.2	Full version ready for review	Partner review
29.1.2021	0.3	Version with amendments arising from the review by project partners	Peer review
24.2.2021	0.4	Version with amendments arising from the review by travel information service providers	Peer review
15.4.2021	0.5	Added annex following additional transport information service provider (TISP) questionnaire on implementability of top features	Project partners

Preface

Acronym:	OJP4Danube
Title:	Coordination mechanisms for multimodal cross-border traveller information network based on OJP for Danube Region
Project Code:	DTP3-447-3.1
Start date:	01.07.2020
End date:	31.12.2022
Budget:	3.005.633,42 € (ERDF Contribution: 2.460.625,09 €)
Objective:	SO 3.1 Support environmentally-friendly and safe transport systems and balanced accessibility of urban and rural areas

Abbreviations

Abbreviation	
TISP	Travel Information Service Provider
LJP	Local Journey Planner
PT	Public Transport

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1. Introduction

1.1. Aim of this document

The main objective of the OJP4Danube project is to enable seamless, multimodal, transnational, cross-border journey planning across the Danube region, with a particular focus on integrating eco-friendly modes such as cycling. The aim of this document is to present a structure as well as concrete use cases to guide the upcoming work in the project. Use cases break the project objectives down into concrete implementation scenarios. These aim to broaden and synchronise between journey planners the variety of parameters relevant for travellers to plan such a trip (described in deliverable D.T1.1.1 section 3). The use cases take into consideration the various levels of development of each of the OJP4Danube journey planners at the onset of the project (described in deliverable D.T1.1.1 section 4). In other words, the use cases presented here are expected to serve as a reference for the ambitions set by the OJP4Danube project.

1.2. Methodology

This deliverable is closely connected to deliverable D.T1.1.1 where travel parameters for improving information provision of existing journey planners were defined and assessed. To address both deliverables, an extensive questionnaire was designed and sent to Travel Information Service Providers (TISPs). The questionnaire investigated three key areas: 1) review existing and planned features of OJP4Danube journey planners, particularly in terms of support for walking and cycling 2) assess both the relevance and feasibility of new features supporting a better integration of eco-friendly modes in cross-border journey planning 3) define the key characteristics relevant to differentiate between use cases. Questionnaire results for (1) and (2) are presented in D.T1.1.1; results for (3) are presented in this document section 2.2. The questionnaire also served as a basis to structure interviews with each of the TISP to better understand their answers and define initial use cases relevant for their region. The list of TISPs, their journey planner solution and related acronyms are detailed in D.T1.1.1 section 1.2

1.3. 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)*	https://routenplaner.verkehrsauskunft.at/

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

			• Micro-scooter / E-scooter *E-scooter sharing (public system)*	
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)* • *Micro-scooter / E-scooter* *scooter as a carry-on (onboard public transport)*	https://www.idsjmk.cz/index
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/

1.4. Background information

This section reviews background information related to the definition of use cases in the two previous projects: LinkingDanube and LinkingAlps.

1.4.1. Use cases in Linking Danube project

The main goal of the LinkingDanube project was to create a continuous and transnational operative environment, hence, a group of specific use cases for multimodal traveller information and required integration was designed. Deriving it from the OJP standard, the proposed use cases are organized in two categories:

- adjacent use cases (involving two local journey planners), and
- remote use cases (involving more than two local journey planners).

A choice of examples of use cases that are given by the "From" and "To" locations and the list of required local journey planners are illustrated in Figure 1.

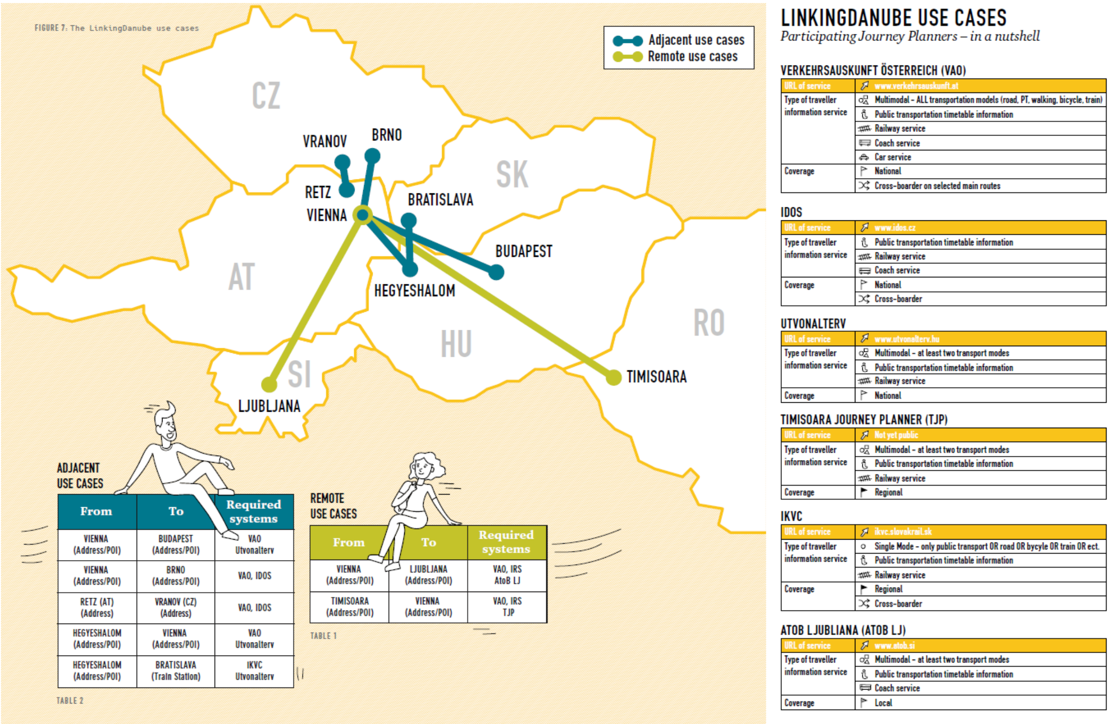

Figure 1: Illustration of use cases that were applied in the LinkingDanube project[2].

1.4.2. Use cases in LinkingAlps project

The main use cases of LinkingAlps cover different scenarios that provide the basis for demonstrating cross-border and transnational (multi-region) linking of services in the Alpine region. The defined scenarios provide the basis for end user application tests performed in the course of the demonstration and evaluation activities. Similarly to LinkingDanube, two main use cases (see Figure 2) has been defined. The goal of the short distance scenario is to linking service between two different regions covering short distance journey planning to show a typical commuting routing service. In contrast, the goal of the long-distance scenario is linking a minimum of two journey planners with a long-distance routing option. Both use cases are defined by the following aspects: title, identifier, goal of the use case, description, actors, covered information and data, process flow and scenarios. Scenarios are used to define alternative examples of use-case.

[2] http://www.interreg-danube.eu/approved-projects/linking-danube

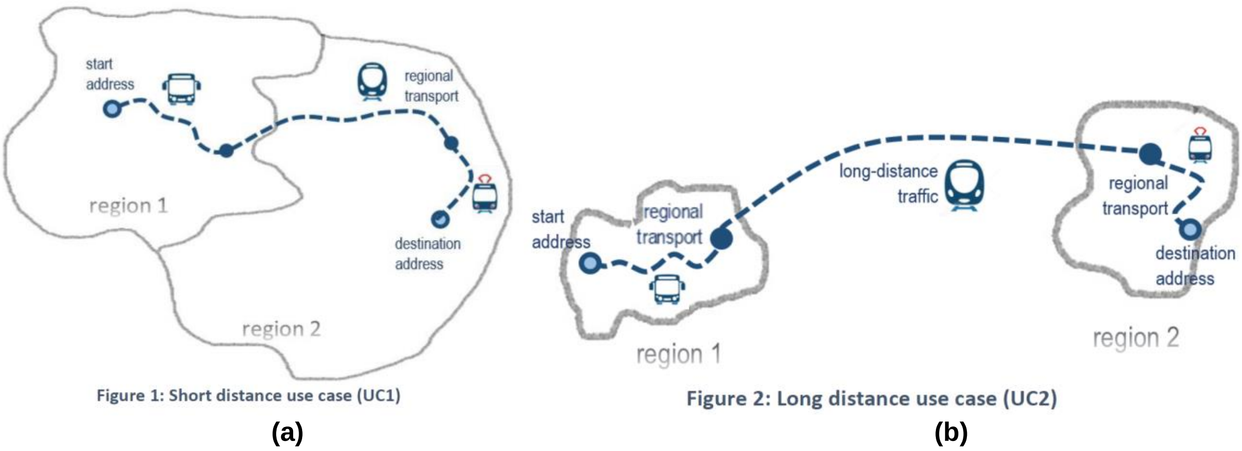

Figure 2: Illustration of the initial design of use cases that have been proposed in the LinkingAlps project[3].

For the short distance use-case the LinkingAlps defines three scenarios: real-time routing (routing with real time information for every leg of trip), static routing (routing based on the static information only) and cross-border walking route between two exchange points (routing demonstrating the crossing of regional borders with a short walking distance between public transport trip legs). The long-distance use case contains two scenarios: two-part long-distance journey planning (linking of two journey planners including long-distance routing) and multi journey planning (minimum of three journey planners involved).

2. Use cases

2.1. Scope of use cases

According to the description of the OJP4Danube project and based on the discussions among project partners, the definition of the use cases needs should integrate multiple requirements, which can be summarised as such:

1) Trips must be multimodal, should facilitate bicycle use and other sustainable modes such as walking and should include demand-responsive transport
2) Trips must be cross-border, meaning they should involve at least two or more Local Journey Planner data
3) Use cases should cover both adjacent and separated (remote) LJP geographical areas; special attention should therefore be paid to the information gaps between LJPs in terms of routing
4) Use cases should cover all project geographical areas and their combination
5) Trips may be for commuting or for tourism purposes, which are the two broad categories suggested
6) Use cases should balance between the perspective of the travellers and the perspective from the Transport Information Service Providers: varying use cases on Traveller preferences should therefore be relevant from a LJP perspective. For example, an urban or rural destination, the number of travellers, or distances and days travelled, all matter from the perspective of the traveller in terms of the expectations regarding the trip experience. But these may not be

[3] https://www.alpine-space.eu/projects/linkingalps/en/home

obviously relevant aspects to consider as input or output parameters in LJPs. These types of parameters are secondary and should be used only to provide context, but not as parameters to vary use cases.

7) Use cases should be implementable in the current context, and therefore be tailored to each LJP's planned capabilities within the timeline of the project to the extent possible.
8) Besides geographical scope, LJP capabilities consist of supported modes, traveller preferences to be used as input, and trip data provided as output by the LJP
9) Use cases should be selective and limited in number: they should vary on key parameters and cover the most frequent or sought-after characteristics
10) Unless explicitly stated, trips are one-way only, with the return portion of a trip assumed to be a new trip from a journey planning perspective.

2.2. Inputs on the definition of uses cases collected from TISPs

The survey and the follow up interviews were used to investigate about the views of TISPs on the definition of use cases. This Section summarizes the inputs received from TISPs.

2.2.1. Evaluation of questionnaires

To reveal the views of TISPs regarding the organization and the content of use cases, several aspects have been identified:

- traveller information;
- trip information (consisting of type, purpose, geographical scope and mode of transport);
- journey planning context;
- detailed examples on those aspects that could be potentially considered in the definition of use cases.

The TISPs were asked the following question to assess the importance of these aspects by assigning to them a score:

Question: *Please assess the importance of including the following aspects in the definition of a use case, particularly for differentiating between use cases, by assigning to them a value from 1 (low importance) to 5 (high importance). High priority aspects will be used to define the main goal for each use case, while lower priority aspects may be used to define scenarios within use cases.*

The results of surveys are summarized in Table 2. To provide a quick overview of the aspects which were most often selected with high prioroty, we calculated in the last column the average scores. In summary, the results indicate that TISPs consider as relevant:

- number of travellers,
- trip purpose (commute, trourism),
- origin and destination,
- cross-borders,
- modes of transport (train, bus, walking, cycling, bike sharing, bike and ride, bike as carry-on, microscooter/e-scooter), and
- journey planning context (in advance and real time).

Table 2: The weights (1-low, 5-high) assigned by TISPs expressing their view of importance of including corresponding aspects in the definition of use cases. The last column presents the average of row values.

Aspect considered in the definition of a use case	Importance for use case definition (1-low, 5-high)						
	VAO (AT)	**IDSJMK (CZ)**	**TERKEPEM (HU)**	**TJP (RO)**	**IKVC (SK)**	**NCUP (SI)**	**Average**
Traveller information	-	-	-	-	-	-	
- number of travelers	5	5	5	1	5	5	4.3
- demographic profile of traveler(s)	1	2	3	1	3	1	1.8
- socio-economic profile fo traveler(s)	1	2	2	1	2	1	1.5
- information about luggage	1	2	3	1	2	4	2.2
- accessibility issues	2	2	5	3	3	4	3.2
Trip information	-	-	-	-	-	-	-
- Trip purpose	-	-	-	-	-	-	-
o commute	3	5	5	2	4	4	3.8
o tourism	3	5	5	2	3	4	3.7
- Type of the trip		-	-	-	-	-	-
o one way	1	3	2	1	4	1	2.0
o return	1	3	2	1	4	1	2.0
o recurrent	1	3	2	1	4	1	2.0
- Temporal and other characteristics	-	-	-	-	-	-	-
o Period of the day	1	3	5	3	2	3	2.8
o Period of the week	1	3	4	3	4	3	3.0
o Season	1	3	2	5	3	3	2.8
o Duration of the trip	-	-	-	-	-	-	-
▪ One-day trip	1	3	2	1	2		1.8
▪ Multiple-day trip	1	3	2	1	2		1.8
o Weather	1	2	2	1	1	3	1.7
- Geographical scope	-	-	-	-	-	-	-
o Origin	5	4	4	-	-	2	3.8
▪ Origin in an urban area	3	4	4	2	2	2	2.8
▪ Origin in an rural area	3	4	4	2	2	2	2.8
o Destination	5	4	4	-	-	2	3.8
▪ Destination in an urban area	3	4	4	2	4	2	3.2
▪ Destination in a rural area	3	4	4	2	4	2	3.2
o Countries	5	5	2	2	3	3	3.3
o Cross-borders	-	-	-	-	-	-	-
▪ Single cross-border	5	5	4	3	2	-	3.8
▪ Multiple cross-border	5	5	4	1	2	-	3.4
- Mode of Transport	-	--	-	-	-	-	-
o Train (all types)	5	5	5	5	5	5	5
o Bus/Trolleybus	5	5	5	3	1	5	4
o Tram	5	5	5	3	1	1	3.3
o Subway	5	5	5	1	1	1	3
o Ferry	5	5	5	1	1	1	3
o Car	5	3	5	1	1	5	3.3
o Walking	5	3	5	3		5	4.2
▪ Jogging/Running	1	1	5	1	1	1	1.7
o Cycling	5	4	5	-	-	5	4.8

Aspect considered in the definition of a use case	Importance for use case definition (1-low, 5-high)						
	VAO (AT)	IDSJMK (CZ)	TERKEPEM (HU)	TJP (RO)	IKVC (SK)	NCUP (SI)	Average
▪ City Bike	5	1	5	3	2	5	3.5
▪ Electric Bike	5	1	5	3	2	5	3.8
▪ Foldable Bike	1	1	5	3	2	5	2.8
▪ Other specialised bikes (Mountain, Racing, Trekking, or Cargo bikes)	4	1	5	3	2	1	2.7
o Bike Sharing (public sharing system)	5	1	5	5	4	5	4.2
o Bike and Ride (bike parking at stations)	3	5	5	3	4	5	4.2
o Bike as a carry-on (e.g. bike onboard a train)	5	5	5	5	5	5	5
o Micro-scooter / E-scooter	3	5	5	-	-	4	4.3
▪ E-scooter Sharing (public system)	3	2	5	3	4	4	3.5
▪ Scooter as a carry-on (onboard public transport)	1	2	5	5	5	4	3.7
- Journey planning	-	-	-	-	-	-	-
o In advance	5	5	5	5	5	5	5
o Real time	5	5	5	3	5	5	4.7
o Reliability of the door-to-door routing	1	5	3	2	5	5	3.5

2.2.2. Evaluation of interviews

Following the survey, bilateral interviews with all TISPs were conducted. Key observations and requirements regarding the definition of use case derived from interviews are summarized below.

Conclusions from interview with **VAO (AT)**:

1. There needs to be the right balance between commuter and tourism use cases.
2. Use cases focused on target groups are needed to show the funding institutions and the public that OJP4Danube is bringing added value to the mobility and to living situation of people in the Danube region. These use cases should involve commuters and tourists.
3. Technical use cases are needed to illustrate what kind of services should be linked together, what travel preferences should be supported, how the end user services UI should be defined, etc.
4. The following travel scenarios could be considered:
    a. Route 1: bike to train station + train allowed to take bicycle with you + cycling route at the end. Examples of touristic use case could build on Danube cycling routes, e.g. Eurovelo routes.
    b. Route 2: a trip that involves cross-border cycling, to show that OJP4Danube journey planner can calculate a consistent cycling route between two neighbouring areas served by OJP4Danube local journey planers. It could be a commuter use case.
    c. Route 3: Tourist trips between two big cities located in different OJP4Danube countries.

Conclusions from interview with **NCUP (SI)**:

1. Use cases should focus on commuters and tourists.
2. Traveling scenarios could include cross-border commuting between Austria and Slovenia, e.g., between Maribor and Graz. Many people from Slovenia work around Graz and most of them commute by car; distance is big enough not to take a bike, thus both options (bike onboard or bike parking) could be considered. An alternative example of travel scenario could consider commute between Ljubljana and Klagenfurt (in this case PT is almost non-existent).
3. As tourism related example of travel scenarios could be considered a bus trip from Budapest to Ljubljana combined with a local bike sharing, or public buses at the destination and of course walking (20min walk can cover the whole centre of Ljubljana). Alternatively, a visit of Ljubljana could be combined with a trip to the Lake Bled, e.g., to cycle or walk around.

Conclusions from interview with **TERKEPEM (HU)**:

1. Use cases should cover commuting and tourist trips.
2. A typical commuting cross-border use case could involve triangle Vienna, Gyor and Bratislava.
3. A tourist trip could include as a destination Neusiedler See or Lake Balaton. These destinations bring the possibility to combine train, bike and ferry.
4. A possible destination for tourist trips originating outside Hungary is Visegrad.
5. Other possible destinations of tourist trips originating in Hungary are Maribor and Lake Bled.

Conclusions from interview with **TJP (RO)**:

1. Considering the current travel habits, to go by bike to neighbouring countries (e.g., Hungary or Serbia) would be more like a hobby (tourist trip). Touristic bike usage is only a very small part of the modal split.
2. Commuting is becoming increasingly popular, but usually it is not multimodal and does not involve more than one journey planner.
3. There could be a use case where foreign tourists come to Timisoara and/or travel to near vicinity of Timisoara and bring their bike or use bike sharing:
    a. A tourist could come by train and explore the city by bicycle (very realistic use case). Using the public transport would require buying a special pass. From Budapest or from Vienna there are direct train connections (and buses with motorway connections but it is not possible to bring the bike on the bus).
    b. Public bike sharing system could be introduced as a part of a use case (such a use case could be extended to cover e-scooter sharing). The docking stations in Timisoara are co-located with public transport stations and could be used as an addition to the public transport. There could be a possibility to provide real-time information on availability of docking stations. POIs (museums, concert halls and main shopping centres) are normally in the vicinity of public transport stops.

Conclusions from interview with **IDSJMK (CZ)**:

1. The following examples of tourist trips involving cycling could comprise realistic use case:
    a. One day trip from Brno to wine region (with many tourist attractions) between Retz and Znojmo, possibility to use a tourist train in Austria (runs only in summer season).
    b. A trip from Mikulov to Poysdorf making use of tourist buses in Austria (runs only in summer season).

2. A typical commuting involves only bike or public transport and only very little of commuting combines both. A commuting use case could consider Břeclav and Brno, Znojmo – Retz or Břeclav – Wien.

Conclusions from interview with **IKVC (SK)**:

1. Two use case ideas have been proposed:
   a. The Bratislava-Vienna commuter line is particularly relevant for many travellers. The line Bratislava-Budapest could be used as well; however, it is used by smaller number of commuters (most people commute via the Hungarian border by private car).
   b. A tourist trip from Zilina (or another origin in Slovakia) to Tirol by train undertaken by a group of travellers who wish to transport several bikes could be considered.

2.3. Use case model

The use case model is the generic structure of a use case, which includes all the details about the parameters the use cases will vary on.

Following interviews with TISPs, it was decided to organize use cases in two broad categories based on trip purpose: Commuting and Tourism. From a traveller (and therefore trip planning) perspective, this categorisation brings most opportunities for differentiation between use cases. In other words, it is expected that the needs of a commuting traveller will likely vary significantly from the needs of a tourist traveller. For example, a commuter may be more interested about the comfort on the public transport leg (e.g. to sleep or work) and the availability of safe bicycle parking at transfer nodes, whereas a tourist traveller may be more interested in the elevation profile and potential tourist sites of their cycling route.

Distinguishing trips based on work (commuting) versus leisure (tourism) is also a very common approach in transportation science. Another advantage of distinguishing use cases between Commuter and Tourism is that they imply two broad categories of expected travel distances. Commuter trips are typically short and consist of a return trip of about 70 minutes (this is what empirical data on commuting across all modes tell us[4]). Cross-border tourist trips typically cover a longer distance, and possibly span over multiple days.

There is no clear-cut way to categorise trips, and we contend that the differences might not be very relevant for developers in terms of back-end data flows and requirements; yet grounding the use cases in trips that normal travellers can relate to can best inform down the line the ambitions of the OJP4Danube project.

Within a use case, there is a need to vary some categories and specify more details. In particular this applies to 'travelling scenarios' and 'and examples of travelling scenarios'. The approach adopted is to keep the number of scenarios and examples to the minimum required to cover all the relevant combinations of input and output parameters. Relevant parameters were extracted from the questionnaire results with TISPs. Use case variations follow the following structure:

- Use case type varies based on trip purpose (commuting or tourism);

[4] Ahmed, A., & Stopher, P. (2014). Seventy Minutes Plus or Minus 10 - A Review of Travel Time Budget Studies. *Transport Reviews*, September 2014, 1-19. https://doi.org/10.1080/01441647.2014.946460

- Use case travelling scenarios vary on origin-destinations pairs (and associated LJPs), combinations of modes of transport, and whether the eco-friendly mode is or is not taken onboard during the public transport portion of the trip;
- Examples of traveling scenarios are concrete traveling scenario instances, they can vary on all other trip characteristics (e.g. number of travellers, season etc) and traveller preferences. These can be either parameters used as input preferences for a trip search in a LJP (input information) or key information relevant for the journey presented to the traveller in search results (output information):
    - Mode-specific preferences: key preferences specific to each mode, as expressed by interview respondents e.g. services available, route characteristics, comfort levels etc.
    - Intermodal preferences: key preferences relevant for modal integration, as expressed by interview respondents

How use case examples vary and how these variations cover all possible combinations is detailed in Table 3. We also provide a storyline for each use case examples in order to provide a clearer picture for the trip as seen from the perspective of the traveller.

Table 3: Use case model.

Category	Descriptions
Use case type	Name of the use case.
Goal	Description of the goal that is supposed to be achieved by the use case.
Traveling scenarios (multimodal, including an eco-friendly mode portion):	Specification of possible traveling scenarios by listing their characteristic features.
Parameters of the trip from the traveller perspective (input data)	Characterisation of the trip request by specifying mandatory and optional input data.
Expected responses from the system (output data)	Characterisation of the output information received from the JP specifying mandatory and optional data.
Examples of traveling scenarios:	Examples of concrete geographical context situated in the Danube region, where the traveling scenarios could be realized. When introducing traveling scenarios, symbol "->" indicates one way trip, while symbol "<->" is used for return trips.
Execution of scenarios:	One out of two possibilities: a) Adjacent use case (linking of two geographically adjacent LJPs enabling a multi-modal trip that includes an eco-friendly mode), b) Remote use case (linking of two geographically separated LJPs enabling a multi-modal trip that includes an eco-friendly mode). An execution scenario is supposed to be assigned to each example of a traveling scenario.

In the following sections, we use the proposed use case model to define two use cases (Tables 4 and 5). Each use case introduces several examples of concrete travel scenarios. The description of user preferences that are associated with each travel scenario is given in Table 6.

2.4. Commuting use cases

In Table 4 we provide the description of commuting uses case while utilising the use case model introduced in Table 3.

Table 4: Commuting use cases.

Category	Description
Name	Commuting use cases
Goal	The goal of the use case is to showcase applications of the OJP4Danube journey planner to commuting trips that include active use of an eco-friendly mode of transport in the multimodal environment.
Traveling scenarios (multimodal, including an eco-friendly mode portion)	One-way trip to work: commuting by public transport from LJP A area to LJP B, and: **Scenario 1 – PT + own eco-friendly mode onboard:** transporting own bicycle, e-bike, foldable bike or scooter onboard public transport and using it for the first and last mile. **Scenario 2 – PT + eco-friendly mode at destination:** walking to the nearest public transport stop for the first mile, then walking or using shared micromobility for the last mile. **Scenario 3 - Parking own bicycle at first PT stop:** cycling and parking to the nearest public transport stop for the first mile and walking for the last mile.
Parameters of the trip from the traveller perspective (input data)	Specification of parameters (inputs) for each traveling scenario is provided in Table 6.
Expected responses from the system (output data)	Specification of responses (outputs) for each traveling scenario is provided in Table 6.
Examples of traveling scenarios	**Relevant for all three scenarios:** a: Bratislava, Slovakia -> Vienna, Austria b: Breclav, Czechia -> Vienna, Austria c: Győr, Hungary -> Vienna, Austria d: Maribor, Slovenia -> Graz, Austria
Execution scenarios	All traveling scenarios and examples are adjacent use cases.

2.5. Tourism use cases

In

Table 5 we provide the description of tourism uses case while utilizing the use case model introduced in Table 3. The routes of selected examples of use cases are illustrated in Figure 3.

Table 5: Tourism use cases.

Category	Descriptions
Name	A tourism use cases
Goal	The goal of the use case is to showcase applications of the OJP4Danube journey planner to touristic trips that include active use of an eco-friendly mode of transport in the multimodal environment.
Traveling scenarios	**Scenario 4 – Outbound by bicycle, inbound by PT:** one day touristic trip leaving by own bicycle from LJP A area to LJP area B, and returning from area B to area A by public transport while transporting own bicycle. **Scenario 5 – Weekend City trip:** weekend touristic trip to a neighbouring city made by a small group of travellers using public transport between LJP A and LJP B areas, while exploring the destination city by walking, or by using *shared* bicycles or scooters (and being confirmed about their availability at destination). A longer 'remote case' scenario can include three LJP areas. **Scenario 6 – Scenic bicycle tour at destination:** multiday touristic trip made by a group of travellers to a scenic area, using public transport and transporting *their own* bicycles between LJP A and LJP B areas, and complete a tour by bicycle around the LJP B area. A longer 'remote case' scenario can include three LJP areas. **Scenario 7 – Long distance touristic trip** crossing all OJP4Danube areas by bicycle using a combination of European Velo[5] routes and public transport while transporting own bicycle.
Parameters of the trip from the traveller perspective (input data)	Specification of parameters (inputs) for each traveling scenario is provided in Table 6.
Expected responses from the system (output data)	Specification of responses (outputs) for each traveling scenario is provided in Table 6.
Examples of traveling scenarios	**Examples of scenario 4:** E4: Bratislava (Slovakia) <-> Neusiedl am See (Austria) (2 trains) (not illustrated on the map) **Examples of scenario 5:** E5a: Budapest (Hungary) -> Timisoara (Romania) (train+bus) (**green** route on map) E5b: Budapest (Hungary) -> Maribor (bus) (**yellow** route on map) E5c: Vienna (Austria) -> Ljubljana (Slovenia) (train) (**red** route on map) E5d: Žilina (Slovakia) -> Maribor (Slovenia) (remote case, not illustrated) **Examples of scenario 6:** E6a: Combination of bike / train / bus routes between Brno and Towns Mikulov

[5] Please refer to section 2.7 for more details about the availability of Euro-Velo information.

	(Czech Republic) – Poysdorf (Austria) - Znojmo (Czech Republic) – Retz (Austria) - Drosendorf (Austria) (**purple** route on map) E6b: Budapest (Hungary) <-> Neusiedler See tour (Austria) with ferry crossing (**blue** route on map) E6c: Žilina (Slovakia) -> Tyrol (Austria) (**orange** route on map) E6d: Vienna (Austria) -> Timisoara (Romania) (remote case, not illustrated) **Example of scenario 7:** E7: Combination of Eurovelo routes[6] and public transport across all LJP regions, e.g. Prague -> Brno (#4) -> Vienna (#9) -> Bratislava (#6) -> Budapest (#6) -> Timisoara (#13) -> Maribor/Ljubljana (#13/#9) -> Graz (#9/#14) -> Salzburg/Linz (#14/#7) -> Prague (#7).
Execution scenarios	All traveling scenarios and examples are adjacent and remote use cases

Figure 3 shows the examples for the travelling scenarios of tourism use cases:

- green line: Budapest (Hungary) -> Timisoara (Romania);
- yellow line: Budapest (Hungary) -> Maribor (Slovenia);
- red line - Vienna (Austria) -> Ljubljana (Slovenia);
- purple line: combination of bike / train / bus routes between Brno and Towns Mikulov (Czech Republic) – Poysdorf (Austria) - Znojmo (Czech Republic) – Retz (Austria) - Drosendorf (Austria);
- orange line: Žilina (Slovakia) -> Tyrol (Austria);
- blue line: Budapest (Hungary) <-> Neusiedler See tour (Austria).

[6] Relevant Eurovelo routes are those crossing one or more of the OJP4Danube countries (Austria, Czechia, Hungary, Romania, Slovakia, Slovenia): #4 (Central Europe), #6 (Atlantic Black Sea), #7 (Sun route), #9 (Baltic-Adriatic), #11 (East Europe), #13 (Iron Curtain), and #14 (Waters of Central Europe). https://en.eurovelo.com/

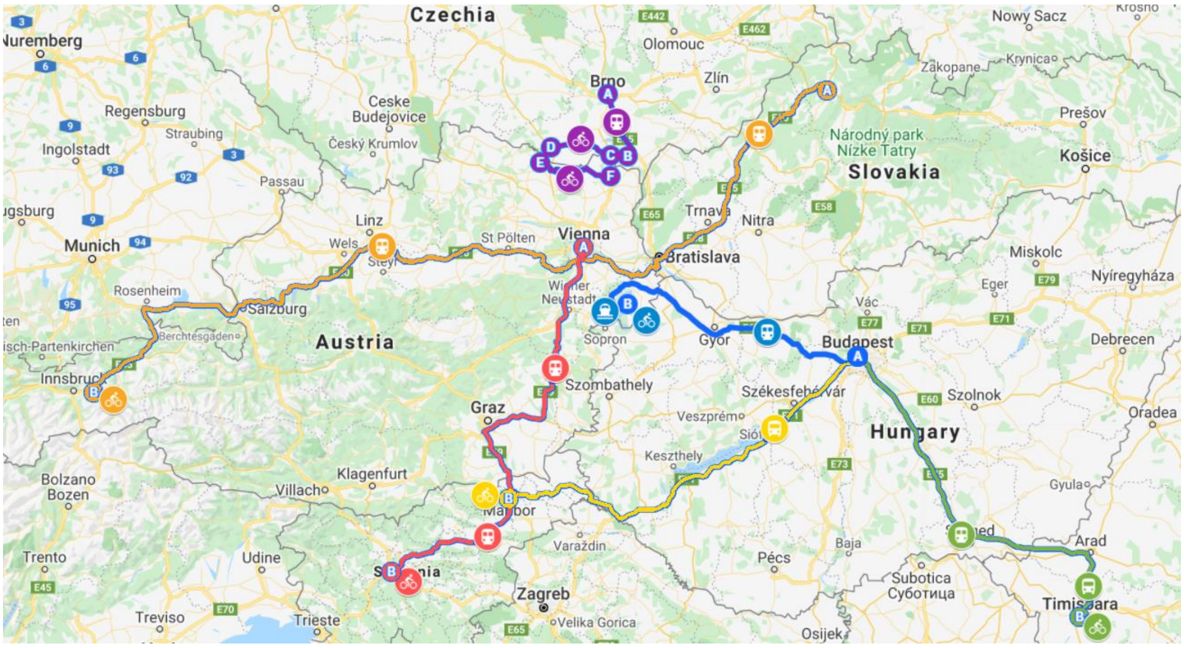

Figure 3: Illustration of examples of traveling scenarios of tourism use cases

2.6. Specification of traveller preferences for use case scenarios

The use case model proposed two categories of use cases (commuting and tourism), each consisting of several use case scenarios. The purpose of this section and the following Table 6 is to accommodate the variations in use case scenarios based on our selected top traveller preferences and trip characteristics. These traveller preferences were defined and prioritised in Deliverable D.T1.1.1 section 3.4 (Table 8) and relevant trip characteristics based on the questionnaire results were listed in this document section 2.2. Traveller preferences are subdivided in two types and are listed in the table in order of priority based on questionnaire results. The two types are:

1. Intermodal preferences: parameters relevant for a multimodal trip involving both an eco-friendly mode and public transport
2. Eco-friendly preferences: parameters relevant for the journey on an eco-friendly mode itself

Furthermore, to follow the matrix approach adopted in D.T1.1.1 section 3.4, the table specifies whether the traveller preference is to be used as an input search parameter (I) or as output information only (O) by the journey planner.

The main benefit of this approach is to ensure that all traveller preferences are covered by one or more of the use case scenarios. However, it remains also a potential limitation at this stage, which relates to whether all traveller preferences mentioned in one scenario can be accommodated in all examples of travelling scenarios. As far as possible, the table was produced while respecting the capabilities of each journey planner involved and travelling scenario examples were defined with that in mind. For example, the commuting scenario example Bratislava -> Vienna cannot be done in the opposite direction because the Slovak journey planner does not plan to provide last-mile information on eco-friendly modes. But in general, the table is more representative of the type of information that each scenario would require from a traveller perspective than from the current capabilities of journey planners.

There is therefore a need to review each scenario in detail together with TISPs, and to fine-tune the priority between mandatory or optional traveller preference, perhaps down to the level of actual travelling scenario examples (e.g. specifically for E5a from Budapest to Timisoara). In a similar vein, 'Services or POIs on the route' could be further refined to detail which precise output would be expected for each route example.

For now, and respecting the scope of this report, our analysis suggests that all OJPs could align to the extent possible to supporting the following features, in this order (based on desirability scores established in D.T1.1.1 Table 8). This approach is also in line with the maturity model presented in D.T1.1.1 (section 3.3):

- **Priority 1 – support for multimodal routing**:
    - Walking as an eco-friendly transport mode: accommodate walking as an integrated part of any trip planning, particularly as a genuine and most common 'mode' for the first- and last- mile. This implies including "**Walking (or cycling) distance to a public transport stop**" as an output variable (score 4.7). Scenarios 2a and 5a are particularly relevant for this case (for commuting and tourism respectively).
    - Taking own vehicle onboard PT: accommodate the need to plan for the possibility to bring one's own bicycle or scooter along on various public transport legs. This implies including "**Whether taking an eco-friendly vehicle onboard is permitted**" (score 4.8) and specifying "**Additional ticket requirements**" (score 3.3) as an output variable. Scenario 1 and 6 are particularly relevant for this case (for commuting and tourism respectively), but also scenario 7 where travellers may decide to complete some legs of the Eurovelo route by public transport where possible.
- **Priority 2 – support for mode-specific and intermodal comfort:**
    - Cycling safety and comfort: accommodate the level of infrastructure quality for cycling modes in order to widen the appeal of using eco-friendly modes to other user groups. This implies including "**Type of cycling infrastructure e.g. bicycle lane (on-street, painted), bicycle track (on-street, protected), bicycle path (off-street)**" (score 3.1) as an output variable and providing an altitude profile of the route "**Avoiding ascents or total elevation**" (score 2.6). Scenarios 1, 4 and 6 are particularly relevant for this case. Additionally, this implies integrating the existing network of Eurovelo routes in OJPs, for which scenario 7 was created.
    - Comfort at public transport connections: accommodate the need to better integrate cycling with public transport at stations. This implies providing additional station information about "**Platform access facilities e.g. elevators, stairs**" as an output variable (score 3.0), relevant for scenarios 1,4 and 6, and "**Availability and characteristics of dedicated bicycle parking at end points**" (score 2.9) relevant for scenario 3.
- **Priority 3 – support for other variables which can improve the overall trip experience from a traveller perspective**
    - The remaining variables highlighted as relevant are "**Services on the route**" (score 3.1) and other information such as scenery, landmarks and points of interest (score 2.75 and 2.3). This is particularly relevant for Scenario 7 where travellers may decide to complete parts of the trip by hopping on public transport to reach the next 'interesting' Eurovelo section or landmarks.

- To consider here is also real-time information about key variables, such as delays, change of mode/platform, or limited capacity for seating and/or taking an eco-friendly vehicle onboard.

Aside from establishing the right balance between implementing desirable traveller preferences and journey planner capabilities, the issue of data availability also needs to be considered. The case of the ‘Type of cycling infrastructure’ is particularly relevant: on one hand only few journey planners support this level of detail, but European-wide regulation requires this information to be made accessible to service providers as part of National Access Points as of December 2019. Therefore, giving such Traveller preferences a higher priority would seem justified and implementable by individual OJPs, provided member states have indeed made this information available in the NAPs.

A last open item is where the ‘Accessibility’ (connected to visual or physical impairment) traveller characteristic will be handled and how: in theory this requirement could be turned ‘on’ as an input parameter or as output information in any of the scenarios, and it was indeed mentioned as an important parameter from TISPs’ perspective, but it is currently not ascribed to any specific scenario.

2.7. Eurovelo routes data

Example 7 of travel scenario assumes that bikers will follow several Eurovelo routes. Currently, none of the TISPs supports routing on Eurovelo routes. In this section, we summarize briefly our findings regarding the availability of data that describe Eurovelo routes.

OpenStreetMap contains data describing the trails and elevation profiles of Eurovelo routes[7]. Data can be visually checked on Waymarked Trail portal[8]. Information about the Eurovelo routes #7, #11 and #17 is not complete and thus further investigation is need, to confirm that the suggested origin-destination pairs are covered by available data.

[7] https://wiki.openstreetmap.org/wiki/WikiProject_Europe/EuroVelo

[8] https://cycling.waymarkedtrails.org/

Table 6: Suggested coverage of input (I) or output (O) travel preferences by travelling scenarios.

<table>
<tr><th></th><th colspan="3">Commuting use cases</th><th colspan="4">Touristic use cases</th></tr>
<tr><th>Scenarios</th><th>Scenario 1: PT + own eco-friendly mode onboard</th><th>Scenario 2: PT + eco-friendly mode at destination</th><th>Scenario 3: Parking own bicycle at first PT stop</th><th>Scenario 4: Outbound by bicycle, inbound by PT</th><th>Scenario 5: Weekend city trip</th><th>Scenario 6 : Scenic bicycle tour at destination</th><th>Scenario 7: Eurovelo tour</th></tr>
<tr><td colspan="8">Trip characteristics</td></tr>
<tr><td>Number of travellers (single or multiple) (I)</td><td>Single</td><td>Single</td><td>Single</td><td>Multiple</td><td>Multiple</td><td>Multiple</td><td>Single</td></tr>
<tr><td>Accessibility issue (physical or visual impairment) (I/O)</td><td>No</td><td>To consider in this scenario</td><td>No</td><td>No</td><td>To consider in this scenario</td><td>No</td><td>No</td></tr>
<tr><td rowspan="3">Type of eco-friendly mode (I)</td><td>Scenario 1a: Standard bicycle /e-bike</td><td>Scenario 2a: Walking</td><td rowspan="3">Examples can consider different types and sizes of bicycle, e.g. standard vs cargo bikes implicate different parking needs due to size</td><td rowspan="3">Examples can vary bicycle types (mountain, cargo, electric etc.)</td><td>Scenario 5a: Walking</td><td rowspan="3">Examples can vary bicycle types (mountain, cargo, electric etc.)</td><td rowspan="3">No</td></tr>
<tr><td>Scenario 1b: Foldable bicycle</td><td>Scenario 2b: Shared bicycle /e-bike</td><td>Scenario 5b: Shared bicycle /e-bike</td></tr>
<tr><td>Scenario 1c: e-Scooter</td><td>Scenario 2c: Shared e-scooter</td><td>Scenario 5c: Shared e-scooter</td></tr>
<tr><td>Temporal factors (season, time of the day, weekday vs weekend) (I)</td><td colspan="3">Weekdays, peak time</td><td>Weekend</td><td>Weekend</td><td>Summer, multiple days</td><td>Summer, multiple days</td></tr>
<tr><td>Urban vs rural origin <-> destination (I automatically generated by the system)</td><td colspan="3">Any <-> Urban</td><td>Urban <-> Rural</td><td>Any <-> Urban</td><td>Urban <-> Rural</td><td>Urban and rural</td></tr>
<tr><td>Number of Origin/Destination points (I)</td><td colspan="3">Two</td><td>Multiple</td><td>Two; at the destination the route should implicitly end at a bike-sharing facility, regardless of user input</td><td colspan="2">Multiple</td></tr>
</table>

Intermodal preferences (in order of most important feature)							
Whether taking an eco-friendly vehicle onboard is permitted	Yes (I); if permitted, space availability or real-time capacity is returned (O)	No	No	Yes (I); if permitted, space availability or real-time capacity is returned (O)	No	Yes (I); if permitted, space availability or real-time capacity is returned (O)	Yes (I); if permitted, space availability or real-time capacity is returned (O)
Walking or cycling distance to a public transport stop	Yes (O/I)	Yes (O/I)	Yes (O/I)	No	No	No	Yes (O)
Additional ticket requirements	Yes (O)	No	No	Yes (O)	No	Yes (O)	Yes (O)
Platform access facilities e.g. elevators, stairs	Yes (O)	No	No	Yes (O)	No	Yes (O)	Yes (O)
Availability and characteristics of dedicated bicycle parking at end points (covered, protected, etc.)	No	No	Yes (O)	No	No	No	No
Eco-friendly mode-specific preferences (in order of most important feature)							
Type of cycling infrastructure	Yes (O/I)	Yes (O/I)	Yes (O/I)	Yes (O/I)	No	Yes (O)	Yes (O/I) according to Eurovelo topology
Services on the route (bike pumps, repair-shop, or other)	No	No	No	Yes (O/I)	No	Yes (O/I)	Bike pumps (O/I) Repair services (O/I) Tourist points (O/I)
Avoiding ascents or total elevation (altitude profile of the route)	No	No	No	Altitude profile(O) for outbound	No	Altitude profile(O) at destination	Altitude profile(O)
Scenery and Point of interests (POIs) e.g. shopping, greenery, sights, landmarks etc.	No	No	No	Yes (O)	Yes (O)	Yes (O)	Yes (O)

3. Conclusions

This report extracted results from the extensive questionnaire distributed to the six OJP4Danube Travel Information Service Providers representing each country in the consortium (providing a journey planner) to produce a use case model and use case scenarios to be used as concrete trip references for the next design steps of the project. Use cases distinguish between commuting and tourist trips, which are the main defining trip characteristic both from a traveller perspective and for the traveller preferences they require to be supported by journey planners. Seven use case scenarios are defined to provide concrete trip examples to guide future work. The scenarios intend to provide a comprehensive and non-overlapping framework for categorising the different types of trip examples, and more trip examples can therefore be added to test the future capabilities of the journey planners involved and their mutual interaction. A more concrete prioritised list of traveller preferences is provided to guide OJPs in their work to align capabilities and therefore ensure some level of compatibility for multimodal cross-border trip planning providing a rich feature set (section 2.6).

The prioritised list of traveller preferences for supporting eco-friendly and intermodal trips in each use case scenario will serve as an important input to answering the next design questions:

1. Architecture: can this type of data be accommodated in the OJP format and how? For example, how can platform access information be supported? Is it supported by current interoperability standards?
2. Data availability: where is the data available? Is it covered by the EC delegated regulation timeline, and if yes, can it be accessed in a usable format? If not, where else can the data be found for each national or regional context?
3. UI specifications: assuming the data is available, and the architecture is supportive, how to best present the information to users? For example, elevation is currently handled in different ways by journey planners, is there a need to align user interfaces, and how?

Together, results of the questionnaires to TISPs are expected to inform the implementation of a cohesive journey planning tool meeting travellers needs across the Danube countries for both touristic and commuting purposes. These results include a list of traveller preferences relevant to improve the planning experience of eco-friendly trips in conjunction with public transport (in D.T1.1.1) and seven use case scenarios to exemplify these trips (in this report). The proposed use cases are realistic in the sense that they are frequently occurring in the reality and are based on local knowledge in each country. We realise that the results presented here are ambitious, multimodal and inclusive, but in practice many difficulties remain to cover all the requirements equally across OJPs.

4. Annex – Top features implementability

The questionnaires for reports D.T1.1.1 and D.T2.1.1 were useful to determine the implementation priority of potential features for integrating active mobility with public transport trips in the OJP4Danube project. Unfortunately, they were not conclusive in terms of implementability within the OJP4Danube timeframe. A second follow-up questionnaire was therefore run to zoom in on the top 8 features (3 priority 1 and 5 priority 2) and to determine in more detail the enablers and barriers to their actual implementation. The goal is this annex is to clarify which of the top features can be implemented and in the context of which use case.

In order to showcase each of the top 8 (priority 1+2) features, the goal is to ensure that a minimum of TWO TISPs are able or willing to support their implementation.

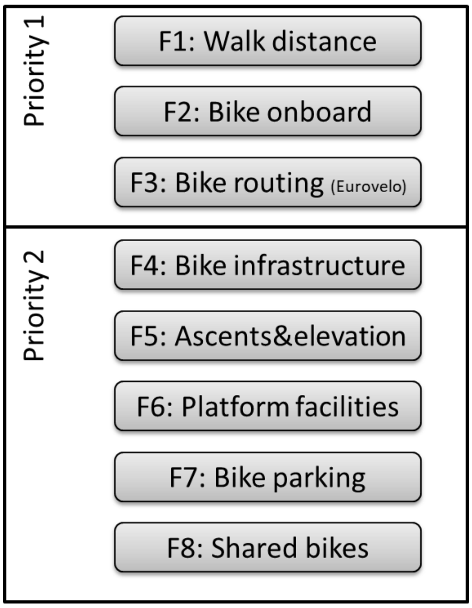

Figure 4 Summary of feature priority for implementation during OJP4Dabube lifetime

The purpose of this questionnaire was to determine to what extent a common implementation could be designed by all or most of the LJPs, so that each feature can be compatible when a cross-border trip plan is requested by users. The questionnaire investigated the services that TISPs will implement during OJP4Danube timeline that could be used to support the implementation of these features.

The table below summarises these findings. Sections 4.1 explains the approach to the questionnaire in more detail, and sections 4.2 to 4.9 provide the details for features 1 to 8 respectively, including the unaltered answers from TISPs.

Table 7: Summary of implementability questionnaire results for all 8 features

Feature	Implementability	Main interoperability challenges	Decided to showcase in OJP4Danube

			(min 2 TISPs)
Feature 1 Walking (or cycling) distance to a public transport stop	**Implemented:** It is already possible to set the maximum distance to public transport stop in both VAO (AT) <-> NCUP (SI). **Planned:** for the following pairs: VAO (AT) <-> IDSJMK (CZ) NCUP (SI) <-> TERKEPEM (HU) VAO (AT) <-> TERKEPEM (HU) TJP (RO) <-> TERKEPEM (HU) For TERKEPEM, the walking distance needs to be integrated with the public transport planner (they are currently separate). For TJP, currently only walking distance is implemented; cycling distances will be implemented.	• Design a common UI for entering maximum distance (input) and displaying routes and distances (output) • Must be possible to select a starting point other than predefined public transport stops • Walking can be easier to implement than cycling (cycling routes are needed on both public roads and designated lanes)	YES
Feature 2 Whether taking an eco-friendly vehicle onboard is permitted	**Implemented**: specifying whether a bike onboard is desired can already be tested with VAO (AT) <-> IKVC (SK). All TISPs committed to implement this feature and showcasing can take place between all possible pairs.	• In most cases the access to data from public transport service providers may be an issue • It is not clear between contexts under what conditions an eco-friendly vehicle is considered a bike or luggage (e.g. foldable bike); vehicles other than the bike might not be considered • One challenge is whether dynamic information will be supported by all TISPs (obtaining live capacities for bike onboard)	YES
Feature 3 International bicycle routing, overlapping with Eurovelo routes where possible	Most likely showcasing can take place between VAO (AT) <-> TERKEPEM (HU). NCUP (SI) will implement the feature provided routing data is available. TJP(RO) and IKVC (SK) will not implement this feature. IDSJMK (CZ) is not confirmed.	• Cross-border exchange points will need to be defined, preferably linked to EUROVelo routes • Main challenge will be to visualise the route on the map: must decide on common UI e.g. itinerary or map, and how to harmonise the check points between TISPs. • It should be possible to distinguish normal bike routes from Eurovelo routes	YES
Feature 4 Type of cycling infrastructure	Feature already implemented by TERKEPEM (HU). VAO (AT) and/or IDSJMK (CZ) may be willing to showcase the feature if data is available. This feature depends on who implements Feature 1 for cycling (i.e. calculating cycling distances requires knowledge about cycle routes).	• Need to implement in the OJP4 profile the additional variable for type of cycling infrastructure. • Typology of bike infrastructure needs to be harmonised (lane, track, route, path etc.). • UI design should include traveller preferences (e.g. safe paths) and a way to distinguish different types of infrastructure on a map • Goal should be to allow future implementation without having to redesign OJP4 profiles.	TBD; one additional willing TISP required

Feature 5 Avoiding ascents or total elevation	One of the VAO OJP supports elevation (Tyrol), which could then be showcased together with TERKEPEM. Like Feature 4, this is also an addition to the Bike routing and distances of Feature 1.	• Elevation data is needed but should be available everywhere • At minimum this should be implemented as a variable in the OJP4 profile; but there's a need to harmonise (e.g. reuse TERKEPEM's elevation profiles)	TBD; one additional willing TISP required
Feature 6 Platform access facilities e.g. elevators, stairs	The main barrier for implementation here is the availability of data, which in many cases is in servers operated by platform operators (which are distinct from publc transport operators)	• Data should be available but currently none of the TISPs have access to it • This could be at minimum added as OJP4 profile attributes to stations to allow for future implementation • Need to design public transport stop and station features that should be included (aside from elevators and stairs e.g. leveled platforms) • Feature 6 does not require Feature 1 (bike routing)	TBD but unlikely; two willing TISPs are required
Feature 7 Availability and characteristics of dedicated bicycle parking at end points	This feature is similar to Feature 6 (in terms of public transport stop/station information), and is possible to implement mostly in connection with Feature 8 (the availability of ride-sharing services). VAO (AT) supports bike&ride as a mode; all other TISPs are interested but lack data.	• OJP4 should support 'bike&ride' as a mode; a common design for supporting this in the future should be done • This is a simple feature requiring only information about availability of bike parking at stations; but it requires bike routing (Feature 1)	TBD; one additional willing TISP required
Feature 8 Integration of shared eco-friendly modes systems (bike-sharing, e-scooter sharing)	This feature is similar to Feature 7 and is already supported by VAO (AT) and data is available for NCUP (SI) in Ljubljana. IKVC (SK) already have experience with a previous related service which we can learn from.	• OJP4 should support 'bikesharing' as a mode; a common design for supporting this in the future should be done	TBD; one additional willing TISP required

In conclusion, all 8 features and the variables they require for implementation should be supported by OJP4 profiles in order to support future implementation. The next step is to determine whether new additions to the OJP standard need to be made to support all 8 features: required variables should be added to the standard in a harmonised way where necessary.

All top 3 'priority 1' features are confirmed to be showcased within the OJP4Danube project: this includes both data harmonisation and UI implementation on minimum two TISPs. In principle when evaluating implementability the geographical adjacency of local journey planners was considered and the proposed use cases in this report can easily be adjusted to showcase these features.

The remaining 5 'priority 2' features cannot be committed at this stage: showcasing each of them will require at least one or more TISPs to commit implementation to do so. We recommend at minimum that all 5 features be supported in OJP4 profiles.

One main obstacle reoccuring for many of these features is data availability, which will need to be handled case by case. There will be some work needed to select the input and output variables for each feature and to design a common preferred UI for implementation.

4.1. Questionnaire design

Questions 1 to 3 explored the ambition for implementation for the top 3 features; question 4 explored the implementation vision in terms of input, output, UI, data and API; questions 5 to 6 explored the challenges that TISPs may face for implementation; and question 8 explored shortly the feasibility for implementation of the remaining five priority 2 features.

The questions were:

1. What is the current level of support for this feature in your LJP? Please describe it from a LJP user perspective
2. What is the minimum achievable support for this feature in your LJP, as it could be utilized by the OJP4Danube project? Please describe it from a LJP user perspective
3. What is the ideal achievable support for this feature in your LJP, as it could be utilized by the OJP4Danube project? Please describe it from a LJP user perspective
4. How do you envision the implementation/extension of each feature in your OJP in practice within the scope of OJP4Danube project? (in terms of input data, output data, user interface, data sources, and APIs)
5. What challenges do you foresee in having this feature implemented in your OJP?
6. What can the OJP4Danube consortium do to support you in the implementation of this feature?
7. About the remaining Priority 2 features, what is your assessment of their implementability for your LJP?

4.2. Feature 1 Walking (or cycling) distance to a public transport stop

This feature includes input information concerning the possibility to set a maximum walking (or cycling) distance for the first and last mile of the trip; as output it concerns a provision of the routing information (for walking or cycling modes) from the initial/(final) point of the trip to the first /(from the last) public transport stop.

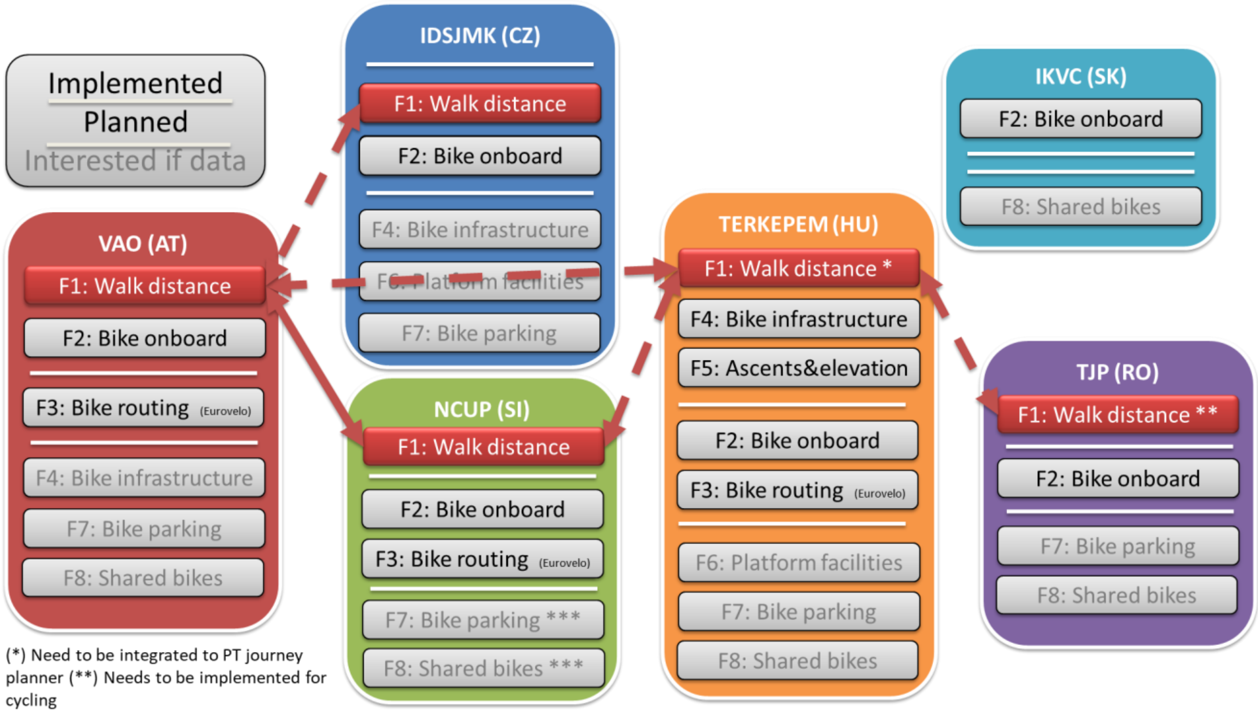

Figure 5: Summary of TISP pairs for showcasing Feature 1 (hard line: feature already implemented, can be tested now; dotted line: feature planned for implementation)

4.2.1. Ambitions

Table 8 Ambitions for Feature 1 Walking (or cycling) distance to a public transport stop

TISP	Q1. Current level of support for this feature	Q2. Minimum achievable support for this feature	Q3. Ideal achievable support for this feature
VAO (AT)	Walking or cycling can be activated as first mile and last mile in the routing. The maximum and minimum distance to the next public transport stop can be set.	Distance to walking/cycling as user input for route calculation (activating a fist and last mile calculation) -> input parameter in OJP (needs to be checked if supported by OJP profile).	Allowing a first and last mile with walking or cycling
IDSJMK (CZ)	None	Under OJP4 we are going to add walking from address to stop and possibly going by bike /scooter.	Walking and cycling / scootering from address to the nearest / most suitable stop.
TERKEPEM (HU)	As output information, the public transport routing provides the user with the walking distance to / from / between public transport stops. Also, the user has the option to specify the maximum walking distance per trip leg.	The minimal support would be the current support provided by our planner.	The public transport planner provides the user with the input option to specify the walking and / or cycling distance per trip leg and the planner plans the route accordingly and the public transport planner is fully

			integrated with the bicycle planner.
TJP (RO)	Walking distance and walking routing are available. No cycling options yet.	We are confident that cycling support will be added.	Full cycling support on public roads and/or designated lanes.
IKVC (SK)	No.	No.	Not planned.
NCUP (SI)	Walking or cycling can be activated as first mile in the JP. The maximum distance to the next public transport stop can be set (from 100 m to 5000 m).	Walking or cycling can be activated as first mile in the JP. The maximum distance to the next public transport stop can be set (from 100 m to 5000 m).	LJP front end allows users to select PT routes with walking or cycling for the first and last mile.

4.2.2. Implementation

Table 9: Implementation details of Feature 1 Walking (or cycling) distance to a public transport stop

TISP	Input data	Output data	User interface	Data sources	API
VAO (AT)	Input parameter (max and min distance to PT station)	Per Trip leg -> output of distance of leg (usually a standard value in routers). Output of polyline will probably be required for end user application (needs to be checked how OJP is handling this, if polyline is included it is ok)	VAO is focusing on the API, not on the display/front-end	Current road network with attributes related to usage with mode “bike”	Standard case of OJP Trip request – probably enlarged with an individual transport route for the first and last mile Leg: Bike or walk Leg: PT Leg Bike or walk Needs to have routing engines in place that can handle PT routing AND individual transport routing.
IDSJMK (CZ)	Maximum distance / walking time	Full routing on the map	Routes on local road network	There are two possible sources – we are discussing which one we use.	We consider to implement a special API proposed by OJP4.
TERKEPEM (HU)	Maximum distance as input per trip leg Cycling as an option (the user specifies whether they want to go by bike to / from / between public transport stops)	Walking / cycling distance per trip leg Full walking / cycling route geometry	Display routes on local road network Full schedule information for the complete trip chain	Complete road network, including footpaths, bicycle routes and lanes, explicitly designated, marked as such	Linking Danube Public Transport Open API is implemented
TJP (RO)	Maximum distance as input.	Full routing view on map.	Display routes on local road network.	In Timisoara the local cycling routes are not continuous. It is not clear yet what is the best approach to combine the dedicated	We already have support for this type of data exchange in the previous OJP profile. The support has to be extended

				cycling routes with the road network.	for the cycling mode of transport.
IKVC (SK)	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
NCUP (SI)	Criteria value for max walking or cycling (in meters) where users select max distance to PT station (from 100 m to 5000 m).	LJP shows users estimated distance (meters) and time (minutes) for the trip leg as part of the journey plan with a full and graphically distinguished routing view on a map.	LJP AtoB presents output data graphically through its user interface.	Separate cycling routes are available in another project but are not integrated in national IJPP from where AtoB sources its data. We will investigate the possibility to integrate the data separately in the project OJP4Danube.	Use of OJP Trip request with the individual mode set to walking or cycling for the first and last mile.

4.2.3. Challenges

Table 10: Highlighted challenges for implementing Feature 1 Walking (or cycling) distance to a public transport stop

TISP	Q5. Foreseen challenges for implementation	Q6. Expected OJP4Danube support
VAO (AT)	To include that in the current OJP API Version in LinkingAlps.	Analyses the LinkingAlps OJP profile if this parameter is supported.
IDSJMK (CZ)	The insufficient capacities of possible data suppliers.	Unfortunately we do not see any possibility how the consortium could help us.
TERKEPEM (HU)	No specific challenge foreseen.	-
TJP (RO)	The time frame is short for the LJP extension.	The extended OJP profile has to be defined as soon as possible.
IKVC (SK)	Not applicable.	Not applicable.
NCUP (SI)	The feature first mile is implemented; the last mile must be implemented.	Project consortium can give us support with their good practises.

4.3. Feature 2 Whether taking an eco-friendly vehicle onboard is permitted

Of particular interest are bicycles on trains, but this feature also includes the possibility to take other types of eco-friendly vehicles as carry-ons and the possibility to obtain real-time information on carry-on capacities in public transport.

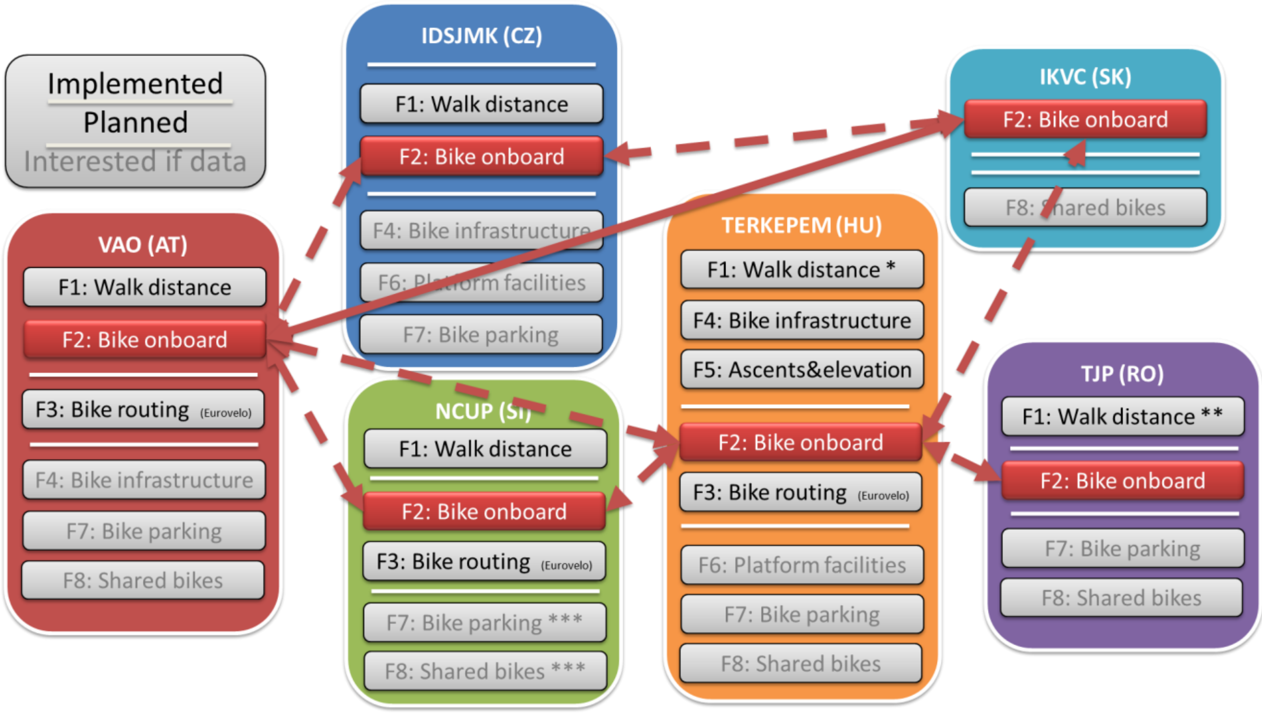

Figure 6: Summary of TISP pairs for showcasing Feature 2 (hard line: feature already implemented, can be tested now; dotted line: feature planned for implementation)

4.3.1. Ambitions

Table 11: Ambitions for Feature 2 Whether taking an eco-friendly vehicle onboard is permitted

TISP	Q1. Current level of support for this feature	Q2. Minimum achievable support for this feature	Q3. Ideal achievable support for this feature
VAO (AT)	It is possible to filter the public transport connections for modes that allow bike carriage.	**Input parameter "bike carriage"** as input for the route calculation. It supported by OJP profile.	Allowing a first and last mile with walking or cycling
IDSJMK (CZ)	In trains and in Brno city public transport always (bikes, e-scooters), in regional buses always e-scooters, **bikes only in specialized connections**.	Under OJP4 we are going to support the information on allowing transportation of bikes.	Full information and journey planner for travelling with bikes and scooters.
TERKEPEM (HU)	This information is not implemented in the planner at this point mainly because the transport service providers do not provide such information.	The public transport planner provides information (as output) on **eco-friendly vehicle onboard being permitted / not permitted / no info available**, for all the public transport route segments planned when data available. We consider this as a "safe" minimum because we experience at this point that data on this are	The public transport planner provides the input option possibility for the user to specify that they prefer eco-friendly vehicle onboard permitted routes, also **specifying whether the eco-friendly vehicle is a**

		insufficient (not provided by transport service providers) and the lack of proper data might cause unsatisfying experience for the user when trying to plan with this requirement specified as input (the planner might give back negative results repeatedly – “no such routes available”). For the full implementation of this feature, the following need to be done: • proper input data needs to be received from transport service providers on this subject • the feature needs to be implemented both as input option for the user when initiating the route planning and output information in the route, relatively minor development required	**full size** bicycle or a compact vehicle (e.g. folding bike, scooter), the public transport route planner tries to plan such routes, but also gives back as results the other possible routes as second choice category, specifying for each segment planned the information (as output) on eco-friendly vehicle onboard being permitted / not permitted / no info available (to avoid repeated negative results because of lack of data).
TJP (RO)	No support.	The feature can be added to the LJP, but it is **unclear if any public transport providers have this option**. We are still waiting for several reports on this problem.	Please see Q2.
IKVC (SK)	Yes.	Current state: We provide passengers with the information of taking eco-friendly vehicles (bikes) is possible in a specific train and the information, if there is still available capacity for eco-friendly vehicles, or the available capacity will be reached soon.	We plan to enhance the feature with the **information on a number of available places for eco-friendly vehicles in a specific train** and possibly linking it with OJP.
NCUP (SI)	This feature can be implemented when data will be available in the national IJPP database.	This feature can be implemented **when data will be available in the national IJPP database**.	LJP front end allows users to select “bike carriage” to filter out PT routes with this criteria.

4.3.2. Implementation

Table 12: Implementation details of Feature 2 Whether taking an eco-friendly vehicle onboard is permitted

TISP	Input data	Output data	User interface	Data sources	API
VAO (AT)	It is possible to filter the public transport connections for modes that allow bike carriage.->User can set “bike carriage” as option for PT routing	The output of the request is: The route provides ONLY routes that allow bike carriage for the requested time and date	Same as in D.T1.1.1. Probably connected with notes on bike carriage condition on the vehicle if available (?)	PT database needs to have the information if bike carriage is allowed on the specific trip.	With PT request with condition/parameter “bike carriage” as filter
IDSJMK (CZ)	Indication that the user wants to bring a carry-on eco-friendly vehicle	Permitted Y/N. We do not have information on available space. Usually there is enough space for bikes or scooters.	Permission of transportation.	Yes, data are available.	We consider to implement a special API proposed by OJP4.

TERKEPEM (HU)	• Option that eco-friendly vehicle onboard permitted routes preferred • Type of the eco-friendly vehicle (full size bicycle or a compact vehicle - e.g. folding bike, scooter)	• Routes, where the eco-friendly vehicle onboard transportation permitted • Second choice routes, specifying for each segment planned the information on eco-friendly vehicle onboard being permitted / not permitted / no info available	• Routes, where the eco-friendly vehicle onboard transportation permitted • Second choice routes, specifying for each segment planned the information on eco-friendly vehicle onboard being permitted / not permitted / no info available • Full schedule information for the complete trip chain	At this point, data are insufficient on this subject (transport service providers do not provide proper information), we are investigating the data source possibilities.	Linking Danube Public Transport Open API is implemented
TJP (RO)	Indication that the user wants to bring a carry-on eco-friendly vehicle on board.	The maximum data available will be the information if carry-on is permitted or not. **Real time data like space availability cannot be obtained**.	Show availability	Static data collected from the public transport providers.	To be decided in the extended OJP profile schema.
IKVC (SK)	• Indication that the user can bring a carry-on an eco-friendly vehicle on a specific train • Number of available places in a specific train • Information about the possibility to order the reservation ticket for eco-friendly vehicle	• permitted yes/no; • space available yes/no;	• **show availability and capacities**	The data come from iKVC – customer portal of ZSSK.	As in the Linking Danube project.
NCUP (SI)	In the AtoB user interface additional input selection criteria for ”bike carriage” must be implemented.	The OJP Trip request response must return a journey plan where each PT Trip leg supports the “bike carriage” option. Optionally, PT trip legs without “bike carriage” option are replaced with other modes by the system to avoid empty result set.	Journey plan annotated with the “bike carriage” availability.	The national IJPP database currently does not support the “bike carriage” attributes. If the IJPP database is updated, we can use the data within the project.	“Bike carriage” parameter is part of the Trip request data structure as a boolean value.

4.3.3. Challenges

Table 13: Highlighted challenges for implementing Feature 2 Whether taking an eco-friendly vehicle onboard is permitted

TISP	Q5. Foreseen challenges for implementation	Q6. Expected OJP4Danube support
VAO (AT)	**It is only limited to by bike carriage, other vehicles are not in the data**. It should be possible to request the ebdpoints for trips that allow bike carriage with a parameter in the trip request.	Analyses the LinkingAlps OJP profile if this parameter is supported; BikeCarriage should be in the profile.
IDSJMK (CZ)	The insufficient capacities of possible journey planner suppliers.	Unfortunately we do not see any possibility how the consortium could help us.
TERKEPEM (HU)	Insufficient input data provided by transport service providers on this.	-
TJP (RO)	As mentioned above, there is **high possibility that no public transport providers have this option**.	The extended OJP profile has to be defined as soon as possible.
IKVC (SK)	Information system provider feedback to requests is too slow, hence there is a risk that Feature 2 will not be implemented in the frame of the OJP4Danube project.	No support is expected.
NCUP (SI)	**Data must be obtained**.	Project consortium can give us support with their good practises.

4.4. Feature 3 International bicycle routing, overlapping with Eurovelo routes where possible

Routing should be at minimum possible up to the national border. Eurovelo routes are useful to define exchange points (for more information about Eurovelo routes please refer to https://en.eurovelo.com/; for more information about available data on Eurovelo routes please refer to section 2.7).

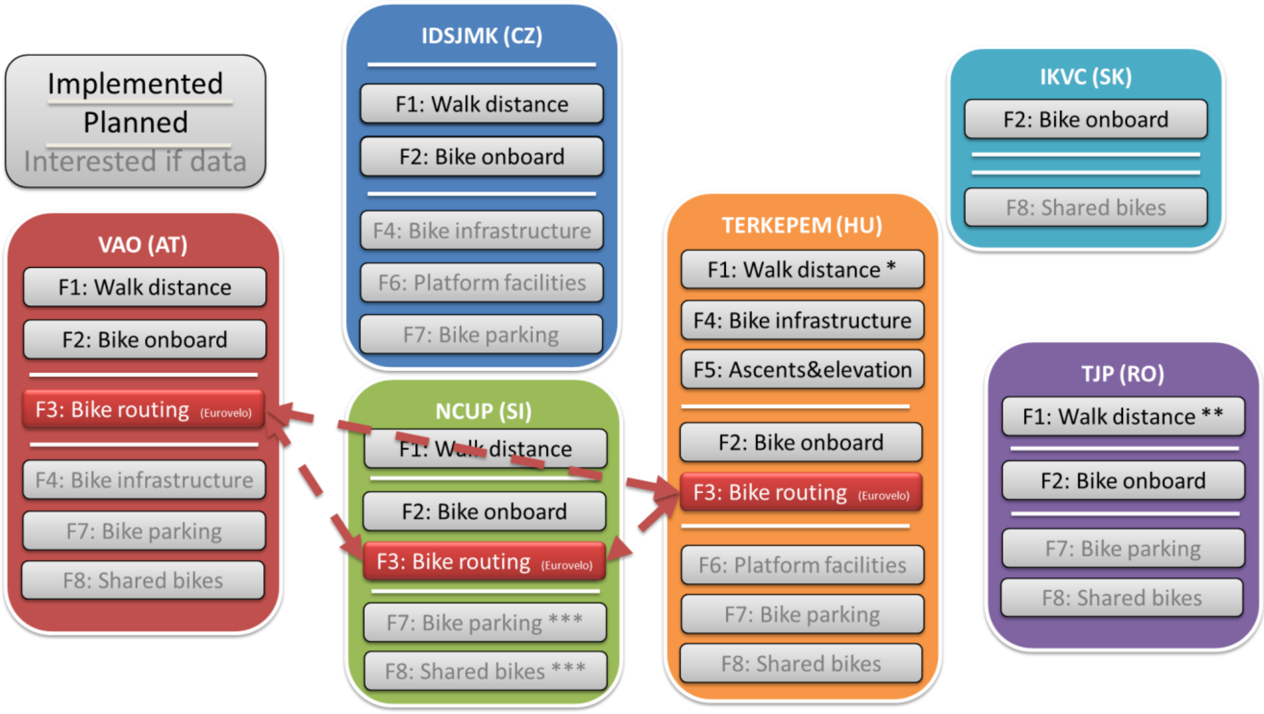

Figure 7: Summary of TISP pairs for showcasing Feature 3

4.4.1. Ambitions

Table 14: Ambitions for Feature 3 International bicycle routing, overlapping with Eurovelo routes where possible

TISP	Q1. Current level of support for this feature	Q2. Minimum achievable support for this feature	Q3. Ideal achievable support for this feature
VAO (AT)	Individual transport routes (with particular settings for the mode BIKE) can be calculated Austrian-wide, however not on pre-defined touristic routes, like EUROVELO.	Eurovelo are not included in the graph. Explicit routing on pre-fined Eurovelo will not be supported. Usual “bike routing” can be supported. Is supported by OJP Profile with “private Mode”.	Some view test cases will be supported to demonstrate feasibility of OJP for individual transport. We want to have test cases, because we do not have comprehensive EP maintenance processes yet in place for EP not being stations.
IDSJMK (CZ)	None.	Not confirmed at the moment, for testing purposes only.	We wish to have such information.
TERKEPEM (HU)	Eurovelo routes are not included in our planner at this point, the planner does not provide any information on this.	Eurovelo routes integrated in the database as a specific cycling network and managed by the bicycle route planner as such (specified as output information for the route segments planned).	The same as described for the minimal support.
TJP (RO)	No support.	No support.	No support.
IKVC (SK)	No.	No.	Not planned.

NCUP (SI)	This feature will be available as soon as EUROVELO data is available in the national IJPP database.	This feature can be implemented when EUROVELO data is available in the national IJPP database.	EP for interchange between international bicycle routes and EUROVELO routes must be defined and maintained.

4.4.2. Implementation

Table 15: Implementation details of Feature 3 International bicycle routing, overlapping with Eurovelo routes where possible

TISP	Input data	Output data	User interface	Data sources	API
VAO (AT)	Just normal “bike routes , we **cannot strictly limit to EuroVelo**. We **need to choose proper exchange points**.	See D.T1.1.1	VAO is focusing on the API, not on the display/front-end, Display is task of the end user application We can provide the Co2 savings compare to car usage. We can (probably) provide altitude meters done on the route	No EuroVelo routes mapped in VAO	**Trip request with “individual mode” BIKE**
IDSJMK (CZ)	No, there are not big differences between EV or other routes. No need to prioritise.	Routing on the map.	Display applicable velo routes and connections to PT	Yes, EV routes shall be included as the backbone of the cyklo-network.	we consider to implement a special API proposed by OJP4.
TERKEPEM (HU)	No specific input	Information for the route segments planned with Eurovelo routes differentiated Full route geometry, Eurovelo routes highlighted	Information for the route segments planned with Eurovelo routes differentiated **Full route geometry**, Eurovelo routes highlighted	Hungarian Eurovelo maintainer sources	Linking Danube Public Transport Open API is implemented
TJP (RO)	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
IKVC (SK)	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
NCUP (SI)	EP for interchange between international bicycle routes and EUROVELO routes must be defined and maintained.	**Graphically distinguished display of EUROVELO routes on a map**.	Display applicable velo routes and connections to PT.	**No EuroVelo routes mapped in the national IJPP**.	Trip request with “individual mode” BIKE.

4.4.3. Challenges

Table 16: Highlighted challenges for implementing Feature 3 International bicycle routing, overlapping with Eurovelo routes where possible

TISP	Q5. Foreseen challenges for implementation	Q6. Expected OJP4Danube support
VAO (AT)	The effort will be to overlap the transport network with Eurovelo routes.	Check the VAO network against Eurovelo routes and identify the relevant roads where exchange points should be set.
IDSJMK (CZ)	The insufficient capacities of possible data suppliers.	Unfortunately we do not see any possibility how the consortium could help us.
TERKEPEM (HU)	No specific challenge foreseen.	**Official international Eurovelo track geometry**, if available, would be useful.
TJP (RO)	Not applicable.	Not applicable.
IKVC (SK)	Not applicable.	Not applicable.
NCUP (SI)	**Data must be obtained**.	Project consortium can give us support with their good practises.

4.5. Feature 4 Type of cycling infrastructure

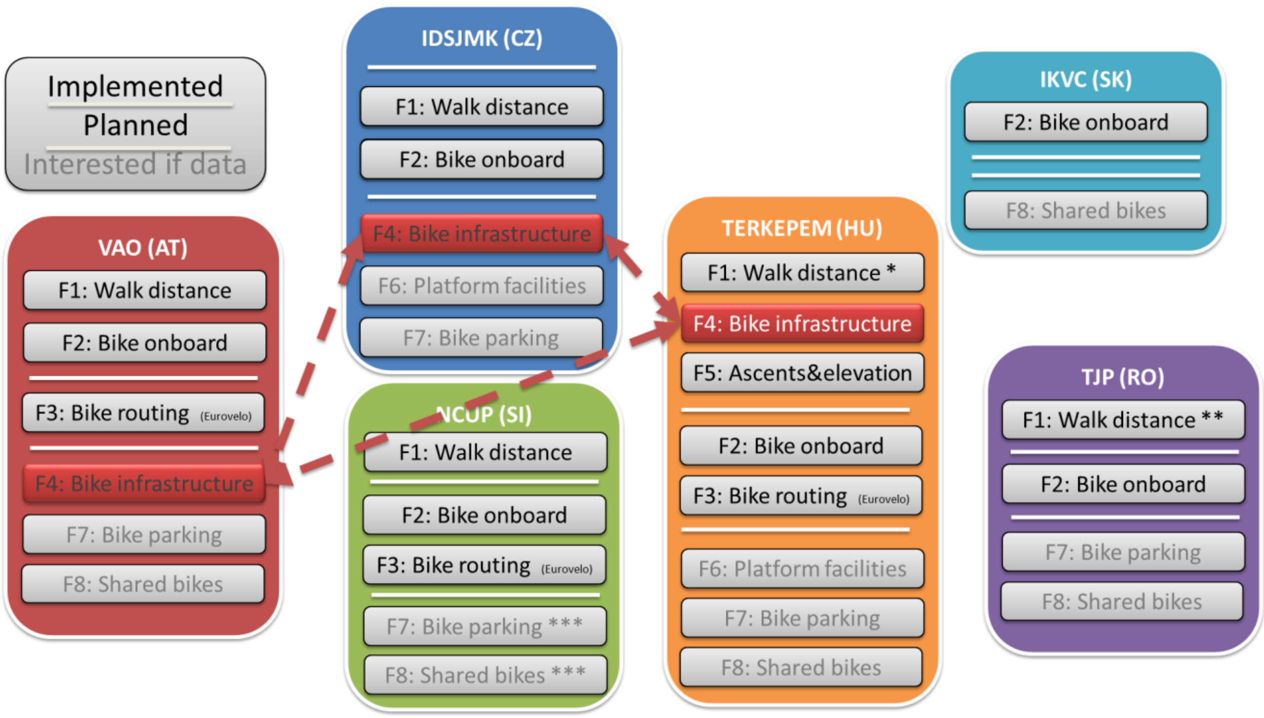

Figure 8: Summary of TISP pairs for showcasing Feature 4

Table 17: Implementability assessment for Feature 4 Type of cycling infrastructure

TISP	Q7. Implementability
VAO (AT)	Difficult
IDSJMK (CZ)	Interesting, but lack of data
TERKEPEM (HU)	Already implemented
TJP (RO)	Not implementable.
IKVC (SK)	No.
NCUP (SI)	Cycling infrastructure data will not be available in the project.

4.6. Feature 5 Avoiding ascents or total elevation

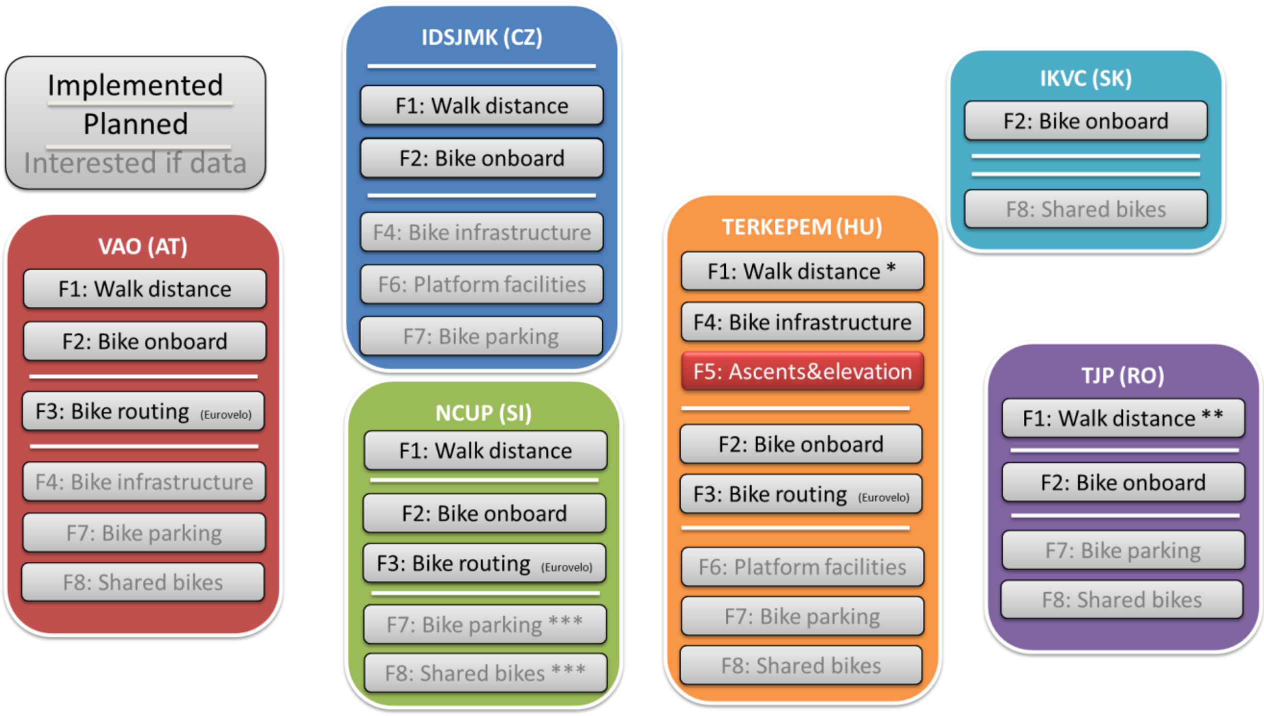

Figure 9: Summary of TISP pairs for showcasing Feature 5

Table 18: Implementability assessment for Feature 5 Avoiding ascents or total elevation

TISP	Q7. Implementability
VAO (AT)	n/a
IDSJMK (CZ)	In our area it is not very important

TERKEPEM (HU)	At this point, 3 different profiles differentiated by maximum ascent are managed by the planner and provided to the user as output, also full elevation profiles for each route are provided. The feature can be easily implemented as input option for the user to specify before planning the maximum ascent preferred.
TJP (RO)	Not implementable.
IKVC (SK)	No.
NCUP (SI)	It needs to be checked if data exists at national level.

4.7. Feature 6 Platform access facilities e.g. elevators, stairs

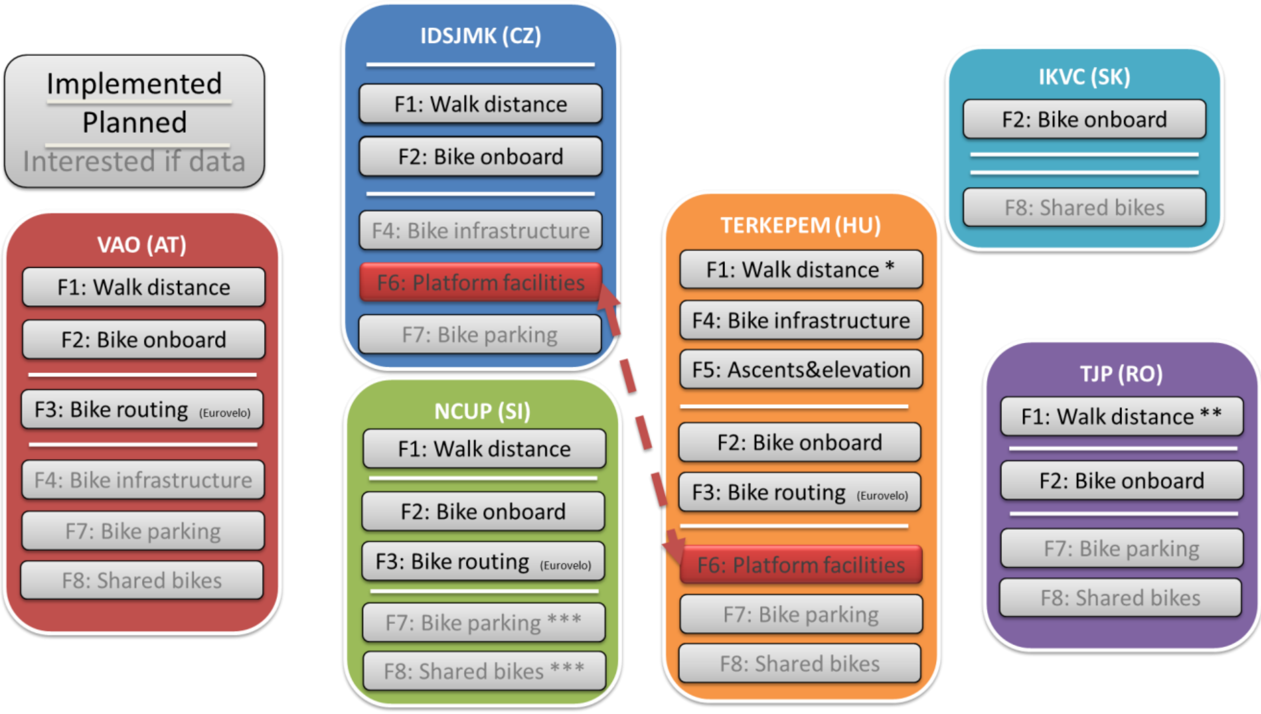

Figure 10: Summary of TISP pairs for showcasing Feature 6

Table 19: Implementability assessment for Feature 6 Platform access facilities e.g. elevators, stairs

TISP	Q7. Implementability
VAO (AT)	n/a
IDSJMK (CZ)	Important, but very few data
TERKEPEM (HU)	There are no data available on these. In case proper data becomes available, the features to provide the information to the user, also to include these as input options, could be implemented relatively easily.

TJP (RO)	Not implementable.
IKVC (SK)	No.
NCUP (SI)	It needs to be checked if data exists at national level.

4.8. Feature 7 Availability and characteristics of dedicated bicycle parking at end points

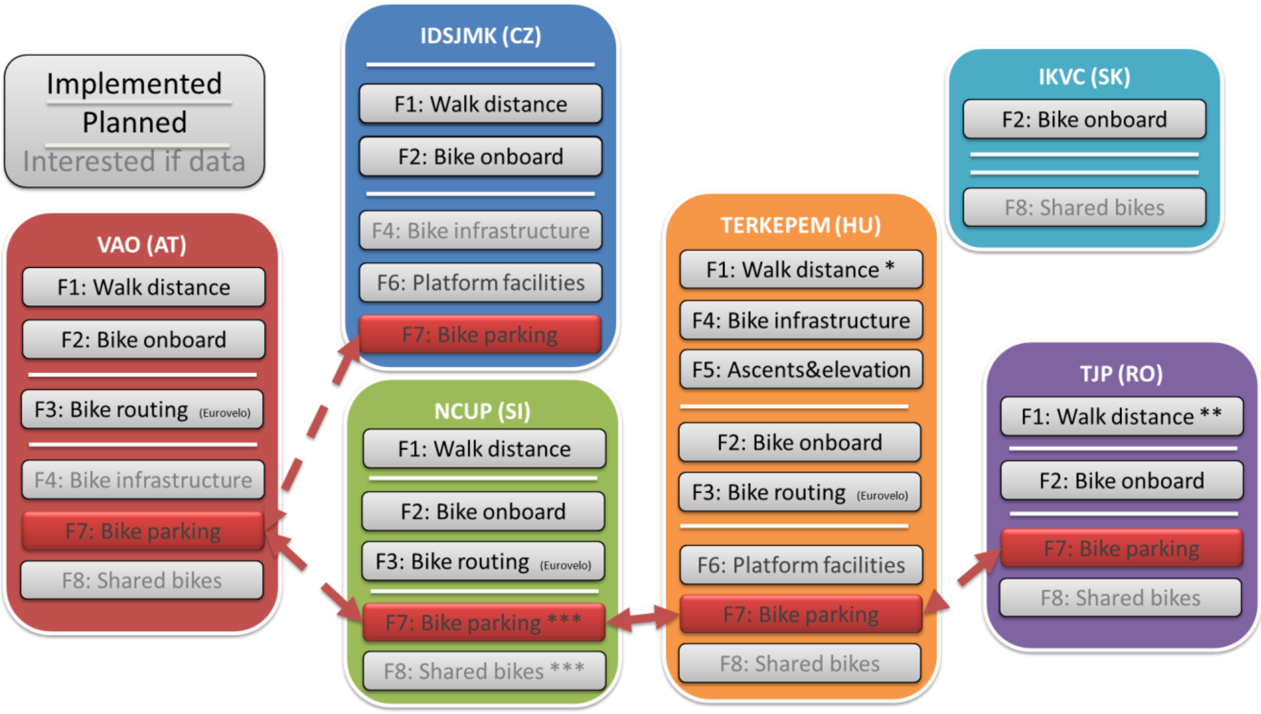

Figure 11: Summary of TISP pairs for showcasing Feature 7

Table 20: Implementability assessment for Feature 7 Availability and characteristics of dedicated bicycle parking at end points

TISP	Q7. Implementability
VAO (AT)	**Bike&Ride is available as mode in VAO but only in the areas where the service exists**. Our routes calculates a combined route of Biking_PT_biking. The OJP interface needs to support this as mode.
IDSJMK (CZ)	Important, but very few data
TERKEPEM (HU)	There are no data available on these. In case proper data becomes available, the features to provide the information to the user, also to include these as input options, could be implemented relatively easily.
TJP (RO)	Still in assessment.

IKVC (SK)	Not in a near future (The railway stations are under responsibility of The Railways of the Slovak Republic -ZSR, which is a separate company. The information systems of ZSSK and ZSR are not interconnected).
NCUP (SI)	**The data is available for the Ljubljana Bicikelj bike sharing system only**.

4.9. Feature 8 Integration of shared eco-friendly modes systems (bike-sharing, e-scooter sharing)

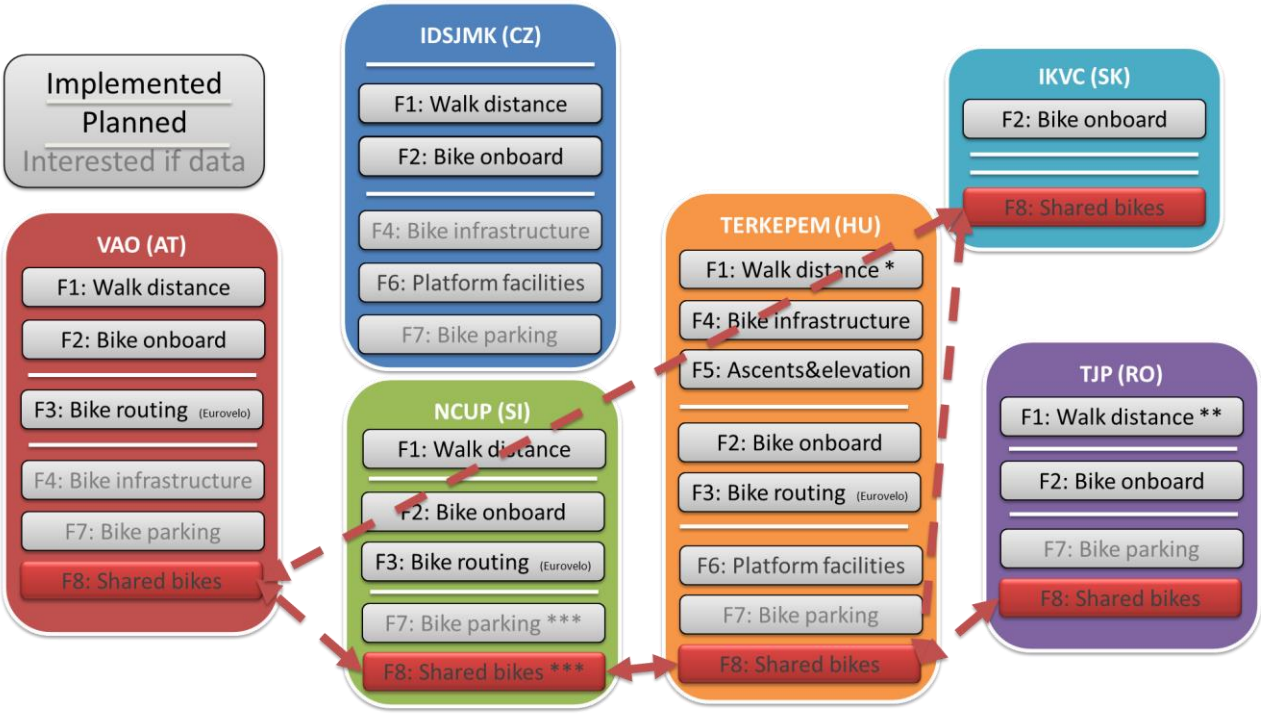

Figure 12: Summary of TISP pairs for showcasing Feature 8

Table 21: Implementability assessment for Feature 8 Integration of shared eco-friendly modes systems (bike-sharing, e-scooter sharing)

TISP	Q7. Implementability
VAO (AT)	Bikesharing is available as mode in VAO but only for very particular areas. The OJP interface needs to support this as mode.
IDSJMK (CZ)	Interesting for the future, not the issue for majority at the moment.
TERKEPEM (HU)	Implementation depends on transport service providers concerned. Negotiations in progress with providers.
TJP (RO)	Still in assessment.
IKVC (SK)	Additional information on Bike sharing service.

	This service was provided in the past through ANTIK Telekom s.r.o. as a SmartCityBike service for renting a bicycle directly on the train. The ordering procedure was as follows: • Passenger downloaded the Antik City Bike app; • Passengers approved General terms of condition, the contract, the tariff and paid a deposit of 100 EUR a bank card. Paying the deposit activated the account, and at the same time the credit in the minimum amount of 10 EUR had been paid; • Passenger selected the train number and saw the number of available SmartCityBikes in that train; • Passenger came to a dedicated place int the train, and the train staff checked his / her identity card, registration and the provided data; • Passenger scanned a QR code, signed a contract, activated a subscription and took a SmartCityBike; • To return SmatCityBik, the passenger got on the train with the train staff who ended the rental by reading the QR code; • The total rental price was deducted from the card of the passenger. ZSSK stopped the service mainly due to: • Complicated logistics; • Customers were not willing to lock the deposit, which was high (100 EUR). ZSSK is currently negotiating a similar service with the same company without having to rent thebicycles placed directly in the trains. • ZSSK is discussing with ŽSR (Railway of the Slovak Republic), which operates the railway stations, in which ANTIK is interested in building sockets for charging electric bicycles (pilots are scheduled in the city of Košice, Snina and Bratislava - Petržalka); • ZSSK will be selling the ANTIK vouchers for shared bicycles; • Passenger will buy the ANTIK voucher for a specific time period together with the ZSSK travel ticket; • ZSSK will receive a commission for purchase intermediation; • The form of vouchers was chosen because most of the shared services (provided by Antik, Bolt, and others) use the principle of promo codes and vouchers in the mobile applications; • No modification in the app development provision of API is possible from the ANTIK side.
NCUP (SI)	The data is available for the Ljubljana Bicikelj bike sharing system only.