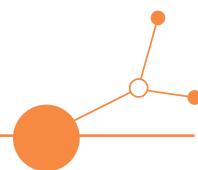


SUSTANCE

D.2.5.1. Long term sustainability guidelines for solution n. 1 (PA1) Cross-border train connection IT-SI-HR - Trieste V.O.-Divača - Pivka - Rijeka



Final
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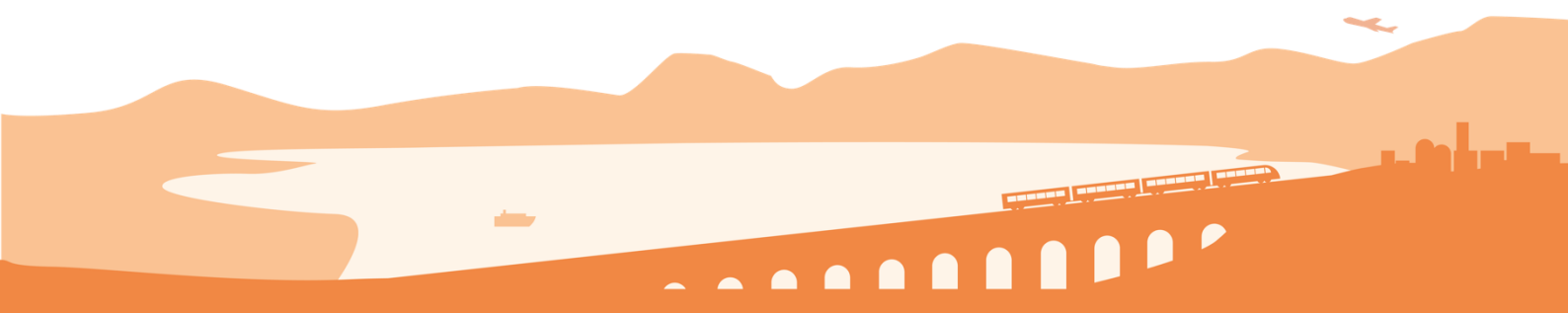




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Abbreviations

AF	Application Form
WP	Work Package
PT	Public Transport
SZPP	Slovenian railways - Passengers transport



1 Overview

This deliverable (D.2.5.1) presents the jointly developed SUSTANCE Solution based on Pilot Action 1 (PA1) as a replicable implementation model for the planning, deployment and long-term management of cross-border regional rail services. Building on the experience and evidence generated through the implementation and testing of PA1 - *Cross-border train connection IT-SI-HR: Trieste-Villa Opicina-Divača-Pivka-Rijeka* - the document defines a roadmap for the uptake, transfer and scaling-up of the solution, providing strategic, operational and governance recommendations to support its adoption in other cross-border regions. The document is elaborated by a partner SŽPP (PP8) in cooperation with PIL (PP7) and HŽPP (PP4), who jointly implemented this pilot activity under leadership of SŽPP (PP8). This document belongs to the set of 6 long-term sustainability guidelines documents (Jointly developed Solutions) that have been developed by the partners, responsible for implementing one of the 6 SUSTANCE pilot actions, in cooperation with involved project and associated partners.

The deliverable is based on:

- the knowledge and results gained from PT accessibility assessment of (Trieste) V. Opicina - Rijeka cross border route (reported in D.1.2.3),
- a feedback received from three rounds of local stakeholders consultations (reported in D.3.3.1, D.3.3.2 and D.3.3.3) and
- the experiences collected from implementation of a pilot action no. 1 (PA1) (reported in D.2.2.2 and D.2.3.3).

Key objectives of the SUSTANCE long-term sustainability guidelines are:

- Definition of the solution based on pilot action testing for long-term capitalization/replicability/exploitation strategy and
- Definition of replicability factors (in the pilot area and beyond the pilot area).

2 The Sustance solution based on Pilot SWOT analysis and adopted technical measures to overcome the main threats

Implementation of a solution followed by the introduction a new (Trieste) V. Opicina-Rijeka cross-border railway line (PA1) faced many challenges, but on the other hand revealed many possibilities for improving this service. The forthcoming SWOT analysis provides a synthetic overview of the pilot action no. 1 (PA1) implementation in terms of Strengths (S), Weaknesses (W), Opportunities (O) and Threats (T) of the new service by addressing technical advancement, financing, political cooperation and other aspects necessary for the replicability of the solution beyond the pilot area.

Table 1: SWOT analysis of pilot action No 1 (PA1): “(Trieste) V. Opicina-Rijeka cross-border train connection”

Strengths	Weaknesses
Technical advancements: • Cross-border direct passenger train connecting three regions with a new multi-system electro-motor unit, enabling a smooth and faster cross-border transport without transferring to	Technical advancements: • Only 1 pair of trains daily and consequently low utilization of for the PA1 service dedicated electro motor unit; the unit was dwelling in Rijeka from 10.00 until 18:40, out of operation.



another train or changing a train locomotive at the border.

- A new multi-system electro motor unit for PA1 train service enabled on-board bicycles transport and provided a high-level passenger service (better comfort, travel experience: WiFi...) and produced low carbon footprint.

Financing:

- Not only specific SUSTANCE ticket, but also other regular tickets valid in national, cross-border and international transport were accepted for the new SUSTANCE pilot service.
- Operating costs incurring due to the service operation on the Slovenian stretch of the pilot route are partly covered by PSO contract.

Political cooperation:

- Interest in cross-border cooperation between Slovenia and Croatia has been expressed on a national level, by signing a bilateral agreement within CONNECT2CE project, and a similar interest between Slovenia and Italian region FVG, where framework agreement on cooperation in regulation of cross-border transport between the parties, was undersigned.

Other:

- A very resounding promotional event on the launch of the train service resulted in raising public awareness on this new PA1 train.
- IT-slo-HZ areas are attractive for bicycle tourism providing good basis for a C-B train service.
- New SUSTANCE pilot train service is interesting to daily tourists and commuters as well.
- Not only the origin and destination stations, but also the stations with the surrounding areas along the pilot route attracted many tourists to visit them.

- The timetable of the new SUSTANCE railway train was not well harmonised with the timetable of other trains at Pivka intermediate station, the main transfer point along the pilot route.
- Online ticket purchase was not available, purchase was possible only over the train station counter or onboard of the train.
- Low number of bicycles stands onboard of the train
- Bicycle stands were not possible to book.
- Timetable of cross-border trains are not included in national timetable system SIMO (Slovenian national journey system).
- The unit train is not homologated for Italian national network and cannot run over the border station at Villa Opicina (I).

Financing:

- Costs of a new SUSTANCE pilot train operation in the territory of Croatia completely covered by the project and not through PSO contract.
- The price of carrying bicycles on the SUSTANCE pilot train is relatively high to encourage passengers to use this service.
- Tariff for SUSTANCE train is not favourable between all stops; some prices are comparatively higher (e.g. a combination of separate national ticket to Sežana and a ticket from Sežana to Villa Opicina is cheaper than SUSTANCE aggregated ticket).

Political cooperation:

- Extension of the line to start in Trieste and not only in V. Opicina is hindered by operational obstacles (expensive safety regulations approval) that need additional political cooperation to solve them.

Other:

- The service was not sufficiently focused on passengers originating in Rijeka.
- The service was not particularly focused on commuters.
- Seasonal bicycle tourism on trains pose some organisational and safety issue.
- Duration of pilot project operation of the SUSTANCE pilot train service is too short to allow passengers to adequately respond to a new offer.



	A survey on satisfaction of PA1 users to obtain feedback on further development (related to modification of timetables, additional services and better understanding of the structure of passengers and travel patterns) was not implemented.
Opportunities	Threats
Technical advancements: - New multi-system electro motor units have obtained permits to operate on other parts of the Croatian railway network and are fully-fledged to provide cross-border transport service also on other cross-border railway routes between Slovenia and Croatia (e.g. Ljubljana - Pula, Ljubljana - Zagreb etc.). Financing: - Extension of validity of Slovenian domestic transport ticket to the first railway station across the border would ensure financing of operational costs from the border line to the first cross-border station under Slovenian PSO contract. - Existing basis for adoption of covering of cross-border lines operating costs on Croatian railway network by Croatian PSO contract. - Incentive for revival of train cross-border lines by a specific EU program to assure long-term sustainability through long-term financial and organization support Political cooperation: - Legal basis enabling the introduction of cross-border railway public transport services PSO is provided at the EU as well as Slovenian national levels - "Interpretative guidelines concerning Regulation (EC) No 1370/2007 on public passenger transport services by rail and by road 2023/C 222/01" - International passenger transport platform was established at EU level a few years ago, bringing together ministries, carriers, travel agencies, travel organisations, etc. for the establishment of TEN-T corridors, the revival of night trains etc. This platform is also used to	Technical advancements: - New technical requirements, related to high financial inputs (for infrastructure and rolling stock), can hinder development of cross-border services. - Harmonization of international tariffs is complicated because there are different categories of discounts in tariff and ticketing systems. Financing: - Railway operators may have disparate business interests in definition of common cross-border tariff elements. Political cooperation: - Railway operators from Slovenia and Croatia and transport authorities may disagree on cross-border routes that need to be prioritised for further development. - Different or competing interests in concluding cross-border agreements between competent transport authorities (focus on transport sustainability goals, focus on transport economics goals, lack of interest due to domestic transport issues). Other: - Extensive railway upgrade works in 2024 could divert passengers from using railway service due to delays and substitutional bus service. - Infrastructure works on Pivka - Ilirska Bistrica stretch resulted in cut of PA1 operation in 2024 and 2025.



help with mutual projects on cross-border trains.

- Slovenia can leverage experience gained in a cross-border agreement with FVG (I) to negotiate similar agreements also with other neighbouring countries.

Other:

- PA1 has the potential to attract additional tourists from Rijeka to take the service for daily trips and also for commuters if the timetable was adapted to the stated target groups.
- Attract local tourist agencies and mobility providers to provide service for the passengers boarding or alighting the train service at intermediate stations in Slovenia and Croatia, e.g. promoting visiting tourist attractions around Divača, Pivka, Opatija Matulji, accessible by micromobility (rental of bicycles, scooters, electric cars) or shuttle bus service.
- Attracting additional passengers by raising public awareness of sustainable and environmentally friendly railway transport.
- PA is a “good practice” for raising connectivity also on other train cross-border services.

In addition to the SWOT analysis, it needs to be pointed out that the biggest challenge faced in implementation of the PA1 emerged at the very beginning since it was not clear if the (Trieste) V. Opicina-Rijeka (PA1) train path will be allocated due to notified infrastructure works on Pivka-Ilirska Bistrica railway stretch. By taking several efforts it was managed to postpone the works to the summer months of 2025, which in turn enabled implementation of PA1.

Weaknesses and threats identified by the SWOT analysis need to be overcome in order to further develop the solution. For this purpose, potential measures were identified in the table below.

Table 2: Possible measures to overcome identified key weaknesses and threats regarding continuation of PA1 service and implementing the solution beyond the tested area.

Key issues from the SWOT analysis		Potential measures to overcome weaknesses and threats	Expected effects
1.	Technical advancement		
1.1.	Only 1 pair of trains daily	• Introduction of 2 pairs of trains per day (considering train-set availability) • Introducing additional train during the weekends out of the summer season • Raising of frequency of trains to also support local commuter transfers	• Better utilized train unit • Better accessibility for passengers from Rijeka • Higher attraction of service for daily commuters



Key issues from the SWOT analysis		Potential measures to overcome weaknesses and threats	Expected effects
1.2.	PA1 train timetable is not harmonised with other trains on transfer points	Harmonization of timetable of the SUSTANCE pilot train service (PA1) with the trains from/to Ljubljana and Pula at the Pivka (SI) and Divača (SI) transfer points.	• Improved PT accessibility • Attract more passengers
1.3.	Insufficient ticket purchase options for the PA1 train	Enabling of online ticket purchase and/or mobile app	• To gain better response from passengers regarding the new PA1 train service
1.4.	Too few bicycles stand on board	Implementation of the reservation system to book bicycle stands	• Additional offer for cycling passengers
1.5.	Different national tariffs and ticketing systems	Harmonization of tariffs and ticketing system to ensure integrated cross-border offer	• Attract more passengers
1.6.	Technical obstacles for electric unit train operation on Italian railway network	• Adaptation of standardised ETCS system • Active involvement of PT authorities to overcome technical deviations	• Extension of the CB line from V. Opicina to Trieste
1.7.	Difficult search of PA1 timetable information	Integration of PA1 timetable to the national timetable system and sharing with other timetable platforms	• Better information on CB service for the national and cross-border passengers
2.	Financing		
2.1	Insufficient project funds	Establishment and management of the SUSTANCE pilot train connection as a European cross-border PT railway corridor, as inspired by the practice of the European railway freight corridors	• Assuring long-term sustainability of the new train connection through long-term financial and organization support
2.2	Lack of national co-financing from all countries across the pilot train line	Introduction of the cross-border PSO for the new SUSTANCE pilot train connection	• Provision of stable financial source
2.3	Different national tariffs and ticketing systems	• Harmonization of tariffs and ticketing system to ensure integrated cross-border offer • Enable use of a national ticket on a CB line to the first major town in neighbouring country, if possible, also including integration of the municipal transport ticket in the cross-border town.	• Attract more passengers
3.	Political cooperation		
3.1	Different interests of railways operators in	• Definition of priority cross-border connections on national/regional or on EU level	• Better public transport accessibility



Key issues from the SWOT analysis		Potential measures to overcome weaknesses and threats	Expected effects
	introduction of cross-border connections	• Conclusions of bilateral agreements between PT authorities and establishment of governance schemes implementing of cross-border PSO.	
4.	Other		
4.1.	Low response to the new train service	• Longer duration of PA1 (in the SUSTANCE project train operated 160 days) • Better promotion of tourist attractions along the route and cooperation with local communities and other stakeholders to develop micromobility • Targeted promotion of public transport and cycling routes integration • Revival of the formerly running circular bus line "Divača - Lipica - Škocjanske jame"	• Attract more passengers • Improve accessibility • Raise train occupancy

3 Long-term sustainability goals and strategies of the solution

Three long-term sustainability goals have been identified for the implementation of the solution based on the prospected continuation of the new cross-border railway line (Trieste) V. Opicina-Rijeka (PA1):

- Goal G1: Enhancing attractiveness and usability of a direct cross-border railway train connection based on the test service (Trieste) V. Opicina to Rijeka (PA1),
- Goal G2: Securing long-term financial viability of the direct train connection and
- Goal G3: Building institutional and political support between involved PT authorities and key stakeholders.

The table below provides possible strategies to apply for achieving the stated goals and the expected impacts if the implemented strategies.

Table 3: Proposed strategies to provide long term continuation of the solution as tested in the new cross-border railway line (Trieste) V. Opicina-Rijeka (PA1)

No.	Long-term sustainability goals	Proposed strategies for implementation of goals	Expected long-term impact
G1	Enhancing attractiveness and usability of a direct cross-border railway train based of (Trieste) V. Opicina-Rijeka connection (PA1)	• Increase daily frequency of trains during the summer season and additionally the weekend daily frequency outside the summer season • Link the new train service with the international airport in Ronchi, either by train, shuttle or bus • Harmonize timetable of a new cross-border train at key hubs (e.g. Pivka,	• Higher ridership • Attraction of recreational users such as cyclists and hikers to enhance regional tourism • More accessible cross-border PT



No.	Long-term sustainability goals	Proposed strategies for implementation of goals	Expected long-term impact
		Divača) in order to smooth transfers to other trains linking other destinations (e.g. Pula, Koper, Ljubljana) • Integrate a new cross-border train timetable into international and national timetable platforms to improve visibility of the train • Implement online/mobile app for ticket purchase and reservation of bicycle stands • Harmonize different tariffs and ticketing systems applied countries across the border • Connect the train to micromobility and other PT services (cycling, walking links, shuttle) at the stations close to tourist hotspots (e.g. Divača - Lipica - Škocjan) to improve first and last mile connectivity • Strengthen promotion (e.g. brand the service with a clear identity - visual style, storytelling, naming...) to raise awareness and usage • Targeted promotional campaign to raise awareness of Zero or low carbon train compared to other modes • Implement KPIs (passenger numbers, ticket sales, transfers, user satisfaction) to evaluate operation of the service	• Support of modal shift from car to rail • Better awareness of the new train service • Increased relevance of the PT on the route improvements for tourists and locals alike • Increased environmental awareness
G2	Securing long-term financial viability	• Introduce cross-border lines through PSO financing by all involved bordering countries • Provide dedicated EU funds for establishment of the European railway passenger cross-border corridors governance structure and initial-phase cofinancing of operation of the cross-border PSO by the new corridor governance structure • Research other alternative funding models, e.g. co-financing through partnerships with regions or municipalities and tourist service providers	• Sustainable operation of the new train service beyond project duration • Predictability of financial sources to implement a new cross-border train service and to maintain its continuity • Shared costs among bordering countries
G3	Building institutional and political support	• Institutionalize the new railway line as a European cross-border PT corridor following the example of operation of European rail freight corridors	• Coordinated governance of the implemented service • Ensured seamless travel experience



No.	Long-term sustainability goals	Proposed strategies for implementation of goals	Expected long-term impact
		• Establish cross-border stakeholder structure (e.g. trilateral working group) for development of the new railway line service and for promoting inclusion of the cross-border line in national and EU development strategies • Promote bilateral and multilateral agreements to ensure cross-border train interoperability and elimination of technical obstacles that hinder operation of multi-system vehicles across the national network borders • Encourage regular cooperation between rail operators and authorities	• Resilience of the service operation to political or funding changes • Internationally coordinated strategies on planning of development of the implemented service • More resilient and connected cross-border PT

Based on the lessons learned, in order to move from a pilot phase like tested in the new (Trieste) V. Opicina-Rijeka (PA1) cross-border railway line to a long-term operation of the service, the first step should be towards formation of cross-border advisory group, membered by relevant stakeholders, which would define conditions for viable service continuation (train frequency, schedule, tariff, financial sources...), considering also experience with PA1 implementation. The cross-border advisory group should also identify financing possibilities for long-term sustainability by considering established good practice of EU financing of European freight corridors and a Manual for rail passenger transport cross-border PSO Services¹, deployed to support establishing a cross-border PSO. A timetable of the new cross-border train service timetable should also be brought to discussion at yearly international railway timetable conferences.

The cross-border advisory group should include all competent authorities from neighbouring countries responsible for the organization and implementation of PT, as only these authorities can provide necessary support and provide stable financing for the continuation of this new cross-border train service. It is also very important to involve all railway transport operators into the planning phase of continuation of the service, as they be able to identify any possible operational risks and obstacles to the service.

The experience and knowledge gained during implementation of PA1 cannot only be used to improve the provided train (Trieste) V. Opicina-Rijeka service but can also be applied for planning and implementation of similar service in another cross-border area (provided the train unit has already obtained relevant homologation and safety certificates for the entire route).

As the Pilot demonstrated, the solution rely on new approach on technical coordination between transport operators where the Slovenian PT railway operator has already obtained the homologation and a safety certificates of multisystem electric units for operation on the Austrian and Croatian railway network and is therefore ready for implementation of additional cross-border lines crossing the stated railway networks. According to that several new direct train service can be established as proposed by the stakeholders:

- Two existing railway connections, one from Ljubljana (SI) to Zagreb (HR) and another from Ljubljana (SI) to Pula (HR), for which the new Slovenian multi-system electro unit trains have already been homologated and are therefore in operational terms ready for cross-border service.
- An existing railway connection from Metlika (SI) to Karlovac (HR) that is at the time out of operation and needs to undergo infrastructural renovation on the Croatian side to restore the crumbling

¹ Reference: Ministerial Platform International Rail Passenger Transport, 2nd Progress Report 2022, Annex 2, [Progress Report Platform International Rail Passenger Transport \(1\).pdf](#).



railway link; after the planned renovation this railway connection will be able to accommodate the already homologated Slovenian diesel motor unit train.

- A service on existing railway connections from Ljubljana (Slovenia) to Belgrade (Serbia) is considered for restoration as a direct train, due to high interest expressed among passengers and connect it with the trains running to/from cities in neighbouring countries (Austria, Germany, Italy).

Slovenia has already established connection from Maribor (SI) to Graz (A), also operated by the Slovenian electromotor unit train. Direct railway connections with the same train currently don't exist between Slovenia and Italy and Hungary, respectively. As there have been issues with technical compliance with Italian railway network there is an option for Italian railway operator to operate a direct unit train, for example FVG Crossmoby train from Trieste (I) to Ljubljana (SI). Currently there are no initiatives for a direct train service without locomotive change at the Hungarian railway network border.

The solution can be further improved to attract both tourists and daily commuters, as this rail connection tested is very competitive with individual transport. To better serve commuters needs, the new SUSTANCE direct train service should be extended to from V. Opicina (I) to Trieste (I), Venice (I) or Udine (I), but in this case technical obstacles for operation of Slovenian unit trains in Italy should be removed first.

The lesson learned from the PA1 implementation shows that most of the monitored KPI-s target values were met at the initial phases of the service operation, only the monthly number of passengers reached the targeted level only in the last month of the train's operation, which implies that it takes time for new cross-border service to fully reach its market potential. In order to further increase ridership on the cross-border line it is therefore suggested to apply the above proposed strategies when planning development and continuation of the PA1 or the establishment of a new cross border service in other areas.

The testing of the PA1 service and the need to ensure its continuation beyond the SUSTANCE project demonstrate that the solution must be relied on a strengthened cross-border coordination approach. In this context, the continuation and possible extension of PA1 could build on the "Operational Agreement between the Autonomous Region of Friuli Venezia Giulia and the Republic of Slovenia for the planning and implementation of a sustainable cross-border mobility system which was concluded in 2024 and provides provisions regarding identification of specific cross-border routes where experimental services can be implemented. Such agreements that support identification and implementation of cross-border PT services could also be signed also with a Croatian transport authority and relevant stakeholders to gain a political and operational support for continuation of a cross border service.

4 Financial indications related to the long-term sustainability of the solution

The operation of the pilot direct cross-border motor unit train service relied on a mixed financing model. Approximately 50% of the operational costs on the Slovenian section—including traction costs (train drivers), rolling stock maintenance, train staff, energy consumption, depreciation and other operating costs—were covered through the Slovenian Public Service Obligation (PSO) scheme. The remaining approximately 50% was financed through ticket revenues and co-financing provided by the SUSTANCE project. The stated sources don't provide for long-term viability of the service.

The operating costs incurred by HŽPP for the pilot train service on the Croatian section consisted of external and internal costs, which represented approximately equal shares of the total operating costs. External costs, mainly related to infrastructure access (use of passenger stations, railway tracks and electricity), accounted for approximately 50% of the total operating costs and were fully covered by the SUSTANCE project. The remaining approximately 50% consisted of internal direct costs, including personnel and train



operation activities such as cleaning and shunting, which were borne by HŽPP. Ticket revenues contributed to the financing of the service but were not sufficient to cover these internal costs, meaning that the service did not generate a profit. No Public Service Obligation (PSO) funding was used for the operation of the pilot service.

Solutions for the financial sustainability of the train service are indicated in two options:

- Option 1: extension of the PSO co-financing to all partners of the cross-border route or
- Option 2: long-term EU co-financing of cross-border railway passenger corridor services.

The first option, in line with the experience gained during this pilot action (PA1), together with the long-standing practice of project partner (PP3) GYSEV in operating regional cross-border rail services, confirms that such services are generally not financially self-sustainable through fare revenues alone and therefore require stable support through public funding. The most suitable long-term financing model is the first model that suggests the introduction of a cross-border PSO scheme, with operating costs shared among competent transport authorities according to agreed criteria such as train-kilometres, passenger demand, regional accessibility objectives, and socio-economic benefits. This approach would provide predictable funding, service continuity, and affordable fares. This financial model is based on a presumption that all stakeholders along the cross-border route, in particular PTA, pursue the same interest to rollout an efficient and passenger-tailored cross-border service. Provided all PTAs agree on implementation of the new cross-border service and the railway operators provide the operational capacity, the cross-border service can operate in line with mutual agreement of the neighbouring PTAs. This is an ideal model, which is not always the case due to external and internal reasons the PTAs in bordering countries or railway operators face.

The second option is an EU approach that requires adoption of the legislation at the EU level that would identify cross-border railway passenger corridors and provide governance and co-funding of railway passenger services on those corridors. A corridor authority overseen by the EU should be established in order to bring together the authorised national PTAs and railway service providers in order to plan, harmonise and implement the cross-border services. Such a mechanism could support service start-up phases, corridor governance structures, interoperability improvements, integrated ticketing systems, as well as rolling stock homologation and certification, which represent significant costs for railway operators. Financial flow to co-finance passenger cross-border service would be from the dedicated EU funds.

Apart from the funds needed for operation of the cross-border services railway transport operators also face with high cost imposed by homologation of technical compliance of the rolling stock to allow access to the neighbouring railway network. It is required from the EU to provide a legislative support for capping of homologation cost or to provide co-financing of rolling stock technical compliance and certification.

A complementary, mixed financing model that combines PSO compensation, ticket revenues, regional and municipal contributions, tourism-sector participation, and EU funding programs. PA1 as well as similar PA2, run by GYSEV, showed strong links between railway services and regional tourism development. Additional support may therefore be provided through destination management organizations, tourism boards, regional tourism cards, integrated sustainable mobility and tourism products

Building on GYSEV's experience, this approach recognises that cross-border rail services generate wider economic, environmental, and regional development benefits that extend beyond the transport sector itself.

5 Recommended solution governance schemes

To ensure continuation of the (Trieste) V. Opicina-Rijeka cross-border direct train service connection, it is crucial to establish a suitable organizational structure that will enable cooperation of all key stakeholders

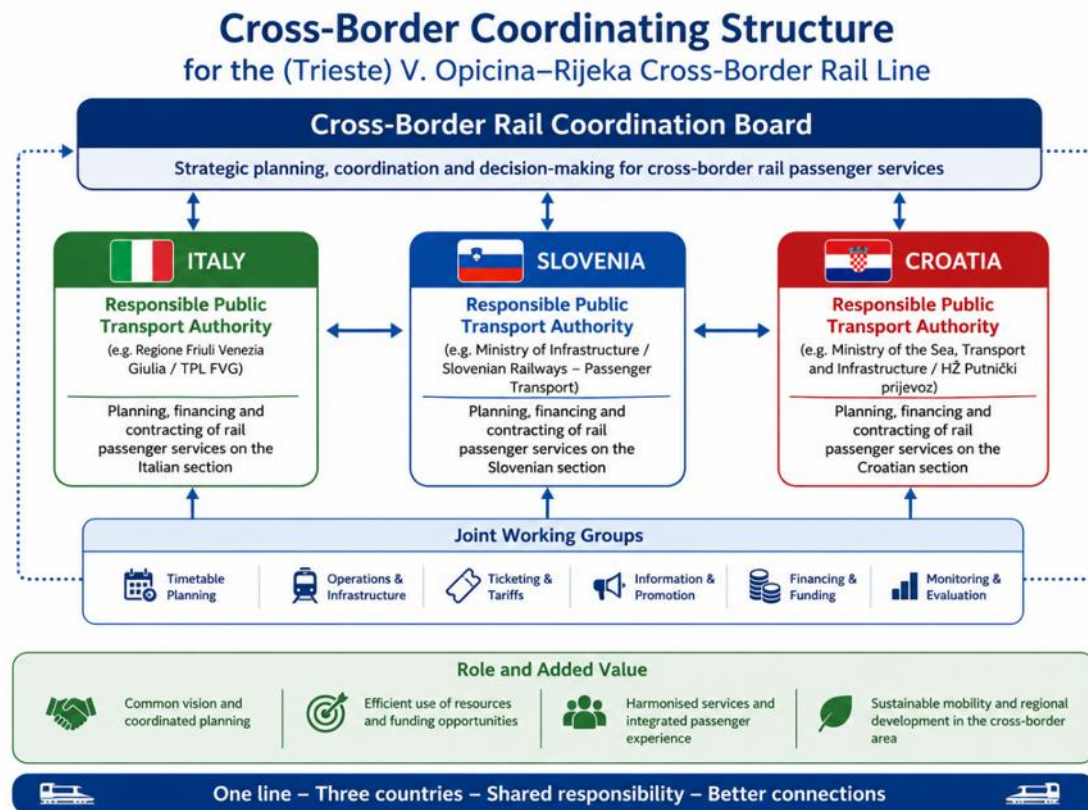


from the neighbouring countries. In line with the findings of Deliverables D.3.2.1 (Governance schemes at regional and cross-border level) and D.3.4.1 (Governance strategy), the governance framework for PA1 long-term viability should ensure a clear allocation of responsibilities among transport authorities and railway undertakings, joint planning of timetables and service levels, coordinated tariff and ticketing policies, shared monitoring of service performance through common KPIs, and stable multiannual financing commitments.

It is therefore recommended to establish a joint cross-border coordinating structure (for example Trilateral Cross-Border Railway Coordination Group), which associates responsible public passenger transport authorities from Italy, Slovenia and Croatia, railway infrastructure managers, railway undertakings, regional authorities, and tourism and mobility stakeholders, which can leverage planning and financing of the rail passenger transport on the (Trieste) V. Opicina-Rijeka cross-border line. The prime objective of this coordinating structure should be focused on definition of a direct cross-border train service operation conditions (scope of the service, frequency of trains, tariff, request for train paths, financing...) and commitment to promote this service as cross-border PSO across its entire route.

Drawing on the long-standing experience of PP3 GYSEV in operating regional cross-border passenger rail services, the governance structure should function as a permanent coordination mechanism rather than relying on ad-hoc project-based cooperation. Such an approach has proven essential for maintaining service continuity, coordinating investments and operational decisions, and ensuring long-term sustainability beyond individual project funding cycles.

Initially, this cross-border organizational structure can operate as a consortium by signing a cooperation agreement, where the associated parties define a governance structure, a decision-making process, an allocation of tasks, competences and responsibilities, a provision of resources (staff, financing...) for the implementation of the tasks and other contractual provisions for the operationalization of governance structure. Later, once cross-border PSO mechanisms have been applied for the entire route, it is recommended to formalize this cross-border cooperation structure on a higher level by formulation of a cross-border passenger corridor as a legal entity with its own governance structure and capacities to implement the activities related to management and development of the cross-border PSO. Such a structure would ensure coordinated planning and management of the service, strengthen cooperation among participating countries, and provide a stable institutional basis for the long-term development of the PA1 corridor



6 Recommendations and suggestions for the mainstreaming of the pilot lessons beyond the pilot action areas

The Solution based on PA1 is a replicable implementation model and approach for the planning, implementation and long-term management of cross-border regional rail services. Building on the experience gained through the Trieste–V. Opicina–Divača–Pivka–Rijeka (IT–SI–HR) pilot, the solution combines technical interoperability, service planning, governance arrangements, financing mechanisms and institutional cooperation into a structured methodology for establishing new sustainable cross-border passenger rail services.



It includes practical guidance for addressing technical and operational barriers, coordinating timetables, integrating ticketing systems and bicycle services, fostering the establishment of cross-border governance structures, and securing long-term financing through PSO schemes and EU support.

The solution further proposes a phased process for moving from pilot testing to the institutionalisation of cross-border rail services through bilateral and trilateral cooperation agreements and integration into regional and national mobility strategies. As such, it provides a blueprint for neighbouring border regions wishing to develop sustainable cross-border rail services adapted to their territorial and institutional context.

The recommendations presented are based on a combination of experiences gained during implementation of PA1 and the long-standing operational experience of PP3 GYSEV (PA2) in planning, financing and operating cross-border railway services between Hungary and Austria. While PA1 provided practical experience in introducing a new cross-border service linking Italy, Slovenia and Croatia, the experience of GYSEV (PA2) confirmed that many of the challenges and success factors observed during PA1 are equally relevant for mature and established cross-border railway operations.

Pilot testing of the new cross border train connection (Trieste) V. Opicina-Rijeka (PA1) represents a model for implementation of the direct cross-border motor unit train that is technically approved to run on different bordering railway networks. The unit train allows border crossing without locomotive changing at the border, which results in a shorter travel time and in turn attractive cross-border train service for the passengers. Implementation of this service is only possible if compliance with safety standards regulations for railway vehicles in all involved countries is assured through obtaining the homologations and safety certificates for operation on the railway networks crossed by the train path. A common lesson identified in both pilot actions concerns the importance of technical interoperability. Successful cross-border railway services require **interoperable rolling stock** authorized for operation in all participating countries, as well as sufficient preparation time for vehicle certification, operational planning and coordination among infrastructure managers and railway undertakings.

The rolled-out direct cross-border unit train boasts good passenger occupancy and shows potential for more frequent service. To make an **efficient timetable** where service responds to requirements of the passengers bound to either directions and a frequent service, enough motor unit trains need to be available for operation that would meet the expectations of the passengers and in turn increase occupancy. Therefore, it is recommended to plan a timetable on the basis of the prior analysis of the passenger demand.

Even if the rolling stock capacity does not allow full implementation of the timetable, make sure to optimally exploit the available motor unit trains in order not to dwell out of operation for extensive time, which was the case in Rijeka station after the morning service from (Trieste) V. Opicina to Rijeka, waiting for the evening departure service to (Trieste) V. Opicina.

Implementation of digital technology applied to support **online ticket** purchase and reservation of bicycle stands as well as online ticketing (a mobile ticket) is encouraged to attract more passengers to the train service. Further rise of service ridership is expected if provided good first/last mile transport service, i.e. connections to local mobility services (bikes, car sharing ...) at the departing and arrival stations as well as frequented intermediate stops, especially close to interesting tourist sites.

The lessons learned gained through Pilot Action 1 demonstrate that integrating bicycle transport into cross-border rail services is a key success factor for increasing the attractiveness of sustainable mobility, particularly in regions with strong tourism and recreational potential. The pilot recorded a good number of passengers, including 425 passengers travelling with bicycle, confirming the growing demand for combined rail-and-bike mobility, especially during the peak cycling season.

Future replication of the solution should therefore include sufficient onboard bicycle capacity, with the possibility of increasing the number of bicycle stands according to seasonal demand, as well as the



introduction of an online reservation system to guarantee bicycle spaces and improve operational management.

In parallel, the availability of online ticket purchasing and integrated digital booking solutions should be considered as a standard component of future cross-border rail services, facilitating access for passengers—particularly younger and digitally oriented users—and promoting seamless multimodal travel. These measures would enhance passenger satisfaction, improve service efficiency and strengthen the long-term sustainability and replicability of the SUSTANCE model in other neighbouring cross-border regions.

For planning of implementation of the new cross-border motor unit train service it is important to start activities **at least 1 year in advance** in order to harmonise the service with all relevant stakeholders and to obtain the necessary consents and official approval in time. It is crucial that the railway operators, operating any segment of the train service, are involved in service planning from the beginning.

A further common finding of both pilot actions concerns **governance**. It is important to involve political and regional institutions in order to provide political support for the implementation of a new service and its future continuation. Both pilot actions confirmed the importance of coordinated action by transport authorities, railway undertakings, infrastructure managers and regional stakeholders on both sides of the border. Political support and institutional cooperation proved equally important as technical solutions. These conclusions are fully aligned with the governance principles identified within the SUSTANCE Governance Report and Governance Strategy (Deliverables D 3.2.1. and D 3.4.1).

An affordable ticket price is very important to promote the service for the passengers; on the other hand it is also needed to at least partially recover costs of the service to make it sustainable and viable. The affordable ticket prices can be obtained, provided that cross-border trains operation is institutionally **co-financed through public service obligation (PSO)**. In case of PA1 service, approximately half of all the costs was covered by PSO contract. The PA1, and also supported by PA2, demonstrated that long-term sustainability cannot rely solely on ticket revenues. Public financing mechanisms, particularly PSO schemes, are fundamental prerequisites for service continuity, while project funding is an important instrument for testing and demonstrating new services before their integration into regular transport systems.

A good **communication campaign** to inform the public and relevant stakeholders should be provided before inception of the new train service. A well-organized launch event with major media invited can have a good impact on the public and potential users of the new service. More targeted campaigns are also advised to be run during the new train service implementation, e.g. on energy sustainability of the service, as the 100% renewable energy in case of use of PA1 train. The two pilot actions also highlighted the importance of **tourism and regional development**. In PA1, tourism demand represented a major source of potential ridership, while PA2 successfully attracted recreational travellers and cyclists in the Lake Neusiedl/Fertő area. The combined experience therefore indicates that cross-border railway services in rural and peripheral border regions should be developed as instruments supporting mobility, tourism, environmental sustainability and regional economic development simultaneously.

Finally, both PA1 and the long-standing experience of GYSEV demonstrate that cross-border railway services require a long-term perspective. Passenger demand, stakeholder support and wider socio-economic impacts develop gradually over time, making continuity of operation, stable governance arrangements and secure financing essential conditions for long-term success.

The combined experience of PA1 and the long-standing operational practice of PP3 GYSEV demonstrate that successful cross-border railway services should be viewed not merely as transport projects but **as integrated territorial development instruments**. Long-term success depends on stable financing, permanent institutional cooperation, political commitment, technical interoperability and active engagement of stakeholders from the transport, tourism and regional development sectors. This integrated approach constitutes the core transferable model recommended for replication in other European border regions.



7. Conclusion. Sustance jointly developed solution to be taken up and/or to be up-scaled

The following table refers to Sustance jointly developed solutions from joint pilot actions implemented by supported projects. In order to be counted under the indicator, the developed solution should include indications of the actions needed for it to be taken up or to be up-scaled. This indicator implies the involvement of organisations from at least two participating countries in the drafting and design process of the solution. Solutions considered for this indicator should not have as their main focus administrative or legal frameworks. Innovative solutions can be procedures, instruments or tools (including physical objects, methods, concepts, or services etc.). To lead to the desired results, solutions have to be tailored to the needs of final users, also considering the respective framework conditions. Solutions should ideally be deployed in the project lifetime and taken up by a large number of institutions.

Sustance Solution 1: Cross-border train connection	
Solution typology	Model and new integrated approach for the planning, implementation and long-term management of cross-border regional rail services
Final users/target groups	- Users traveling from Friuli Venezia region to Slovenia or Croatian Istria and vice versa - Cyclist, entering the train with their bicycles - Local tourist agencies and mobility providers, interested in promoting visits of tourist attractions around the stations especially those accessible by micromobility (rental of bicycles, scooters, electric cars) or shuttle bus service - Railway undertakings interested to implement direct cross-border service
Final user needs addressed	- Better connectivity - cross-border direct passenger train connects three regions with a new multi-system electro-motor unit, enabling a smooth and faster cross-border transport without transferring to another train or changing a train locomotive at the border. - Enabling cyclists to carry their bicycles on the train - a new multi-system electro motor unit for cross-border service 1 enabled on-board bicycles transport and provided a high-level passenger service (better comfort, travel experience: WiFi...) - Eco-friendly transport - new multi-system electro-motor unit produce low carbon footprint.
Co-design process (involved partners and country involved)	Cross-border service 1 is co-designed during the three peer review meetings with cross-border expert (see deliverable D.2.2.2.) and with collaboration with PP4-HZPP and PP3-Gysev.



	Also, feedback received from three rounds of local stakeholders consultations (reported in D.3.3.1, D.3.3.2 and D.3.3.3) was considered in co-design process of cross-border service 1.
Taken up strategy	Pilot testing of the new cross border train connection (Trieste) V. Opicina-Rijeka (PA1) represents a model for implementation of the direct cross-border service with motor unit train that is technically approved to run on different bordering railway networks. With obtaining technical permits for cross-border country similar cross-border service can be replicable with other countries. The Slovenian PT railway operator has already obtained the homologation and a safety certificates of multisystem electric units for operation on the Austrian and Croatian railway network, which allows implementation of additional cross-border lines crossing the stated railway networks. According to that new direct train service was already established, such as train connection from Ljubljana (SI) to Zagreb (HR) and another from Ljubljana (SI) to Pula (HR). Also, direct train connection from Maribor (SI) to Graz (A), operated by the Slovenian electromotor unit train has been introduced this year.
Up-scaling Strategy	The experience and knowledge gained during implementation of cross-border service 1 can also be applied for planning and implementation of similar service in another cross-border area (provided the train unit has already obtained relevant homologation and safety certificates for the entire route). Besides reaching technical standards gaining political interest is of great importance for “up-scale” strategy to extend outputs of cross-border service 1. One of the example is signing of “Operational Agreement between the Friuli Venezia Giulia region and the Republic of Slovenia for the planning and implementation of a sustainable cross-border mobility system”, which provides provisions regarding identification of specific cross-border routes where experimental services can be implemented. Such agreements that support identification and implementation of cross-border PT services could also be signed also with other cross-border transport authority and relevant stakeholders to gain a political, operational and financial support.

Disclaimer

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