

XXV International Conference Living and Walking in Cities - New scenarios for safe mobility in urban areas (LWC 2021), 9-10 September 2021, Brescia, Italy

## Comparison between different territorial policies to support intermodality of public transport.

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### Abstract

As an important part of sustainable mobility, intermodality aims at improving the efficiency and attractiveness of a travel made by different means of transport, resulting in a seamless experience for travellers. The Inter-Connect Project was set up as a study to reduce environmental impact caused by motorised transport, thus enhancing sustainable mobility of passengers. The whole analysis developed through the creation of integrated connections among different transport modes - road, rail, and sea transport considering different factors related to sustainability such as social (quality of life, transfer safety and comfort), economic (efficiency, employment, productivity) and environmental factors (emissions, biodiversity, environmental protection). The study was realized in the ADRIAN area developing different solutions aimed to promote transport integration among partner States: Albania, Bosnia Herzegovina, Croatia, Greece, Italy, Montenegro, Serbia, Slovenia. The cooperation between the partner states led to align some goals and policies, to share knowledge, data and resources, between different institutions and organizations. To this end, the study methodology followed a bottom-up approach to ensure each entity involved was willing to cooperate, in order to overcome any legal, infrastructural, and operating barriers, and to supply the best intermodal solutions to facilitate passengers. Potential improvements introduced to promote intermodality in the eight Inter-Connect study cases were examined from a transnational, national, and regional point of view to identify their strengths and weaknesses. Each partner of the Inter-Connect Project developed their projects thus enhancing and promoting the use of intermodal transport modes for passengers.

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Peer-review under responsibility of the scientific committee of the Living and Walking in Cities

*Keywords:* InterConnect project; intermodality; stakeholders involvement; accessibility of port areas; promotion of sustainable mobility.

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## 1. Introduction

In recent years transport planning has focused on sustainable modes of transport to minimize the environmental impact of motorized transport and improve sustainable passenger mobility (Brůhová Foltýnová et al., (2020)). Sustainable mobility includes all means of transport reducing the negative impact of traffic from private vehicles: pedestrians, bicycles, scooters, buses, trains, shared vehicles and, in some cases, boats and ships (Acheampong et al. (2021); Dondi et al. (2011)). Of course, sustainable mobility is expected to combine and harmonise different factors: economic (productivity, activity, employment), social (quality of life, citizen participation) and environmental (emissions, climate change, biodiversity, environmental protection) (Banister (2008); Hickman et al., (2013)).

Intermodality is part of sustainable mobility and aims to improve the efficiency and attractiveness of a journey made by combining more than one mode of transport avoiding the use of private cars. (Kim et al. (2021)) Using and combining different means of transport in a flexible way in a single journey is crucial for a more efficient and sustainable urban transport system (Pazzini et al. (2020)). In cities and towns intermodal stations have a pivot role for the correct operation of an effective chain of intermodal transport (Yashiro and Kato, (2019); Gebhardt et al. (2016)). A reliable and adequate level of public transport should be offered, in the form of a well-organized system that integrates two or more means of transport in the same journey avoiding high waiting times and ensuring affordable prices and accessibility for all types of users (Kopylova et al. (2018)). Kim et al. (2021) have shown that the choice of users for intermodal transport varies significantly according to their socioeconomic characteristics and working environment (flexibility of working time). Oostendorp and Gebhardt (2018) conducted a study that showed how spatial distances highly influence intermodal choices. The combination of bicycle and public transport is strong in urban neighborhoods, car and public transport in decentralized neighborhoods, while combinations of different public transport in well-connected neighborhoods. In addition, the study underlines that time efficiency is an important issue for intermodal users and is among the main factors indicated for the choice of intermodal trips and in their evaluation of interchanges.

Human behaviour associates moving from one means of transport to another with waiting time, direction and distances to be covered, and therefore it is uncomfortable and represents a potential disturbance during a journey (Preisendörfer and Diekmann, (2000)). Estimating the time taken by a public transport journey is a key component since providing accurate real-time travel information about public transport instead of predetermined timetables may reduce waiting times for passengers (Ma et al., (2019); Matiur Rahman et al., (2018)). New information and communication technology make planning and using different means of transport easier and more flexible (Follmer and Scholz (2013); Lenz, (2011)). Lu et al. (2018) found out how the socio-demographic characteristics of participants and their current travel characteristics have an impact on assigning a value to the waiting time and the time spent in a vehicle.

To meet all forms of coordination -mainly in large cities- integrated tariff systems have been introduced, namely forms of contract involving different public transport operators allowing the use of different means of transport with a single ticket (Turner and Wilson (2010); Puhe (2014)). Piacenza and Carpani (2006) say that for the implementation of an integrated system it is essential to have infrastructure integration - through parking areas, stations, stops, etc.-, modal integration and tariff integration with a single ticket valid for all modes of transport.

Public transport services often fail to cover all the population of an area effectively and economically, especially those located in isolated interurban areas around a modern urban complex. (Papanikolaou et al. (2017); Wang et al. (2015)). A possible solution for these areas is the development of Demand Responsive Transport services, which may be an alternative meeting the needs of all population groups in a relatively economic and efficient way. Viergutz and Schmidt (2019) and Franco et al. (2020) have shown that forecasting demand for a DRT service and identifying the best routes to maximize the number of users served, a high level of service can be achieved by increasing accordingly the benefits of public transport services compared to transport with private car. The analysis carried out by Wang et al. (2015) shows that disabled, traveling for work or living in less densely populated areas, travel more frequently in DRT.

The aim of this work is to provide alternative solutions to enhance the use of public transport by increasing the level of service offered to users in cities. Special solutions have been sought not involving large investments and yet, offering valid options to private transport. This study provides a concrete methodology to develop a future investment plan to promote intermodality of public transport within cities.

## 2. General description

All the topics relevant to sustainable mobility and intermodality are included in the transport policies developed by the European Union. In the White Paper the EU listed concrete initiatives to build a competitive transport system, to reduce the dependence of EU on imported oil, to achieve substantially CO<sub>2</sub>-free urban mobility in major urban centers by 2030 and to reduce transport carbon emissions by 60% by 2050. Several of these actions directly refers to the promotion of rail and intermodal transport solutions with regional solutions. The EU regional strategy for the Adriatic and Ionian Region (called "EUSAIR") approved by the European Council in 2014 aims at the development of the region, with the main objective of promoting the economic and social growth of the area.

The Inter-Connect project is directly linked to the EUSAIR strategy as it pursued the promotion of sustainable transport in the ADRION area. Its specific objectives were the increased efficiency and competitiveness of public transport and the reduction of its environmental impact, the creation of integrated railway system and of synergies between transport operators, the increase in the number of passengers (both tourists and commuters) using railway and sustainable transport solutions and the support of port-rail connections. The different solutions developed to promote transport integration and improve land-sea connectivity among partner states reinforcing the economic, social and territorial cohesion of the area.

The Inter-Connect project promoted intermodality in eight regions - Igoumenitsa (GR), Regione Emilia Romagna (IT), FVG (IT), Ljubljana (SL), Zagreb (CR), Bar (ME), Durazzo (AL) and Belgrade (RS) - starting from the evaluation of potential of each single case study (effective measures, cooperation schemes, potential transferability, financing schemes for the realization of actions). The Inter-Connect project promoted rail and maritime intermodality transport working on three different project dimensions: soft measures (increasing efficiency of existing services and infrastructures without big investments), major measures (public investments for infrastructures) and administrative/governance measures. Each partner developed projects encouraging the use of railway or other intermodal solutions in their area.

The Inter-Connect project followed a bottom-up approach to verify that each partner involved could easily cooperate overcoming legal, infrastructural and operational barriers, and providing better intermodal solutions for maritime and rail passengers. Measures taken were also evaluated as for their transferability to other ADRION areas with similar characteristics. Since the ADRION area consists of coastal towns and countries (apart from Belgrade-Serbia), the main measures of the Interconnect project referred to maritime transport solutions and other possible intermodal connections - especially the railway- with the hinterland and the neighboring countries.

The Interconnect project considered and analyzed all problems and risks involved in promoting intermodality from different points of view according to the territory each town or area was located. The levels of intervention focused on local, national and transnational measures ranging from promoting and enhancing an area for its touristic attraction through good road or rail transport connections, like in Igoumenitza (Greece) or in Emilia Romagna (Italy) or sea connections like in Zagreb (Croatia), to implementing the public railway and bus network to facilitate the movement of both tourists and commuters, like in Ljubljana (Slovenia) or in Trieste (Italy); from introducing new technologies at terminals and gates, like in Tirana (Albania), to facilitating relationships and cooperation among different partners and societies to unify and optimize the interventions, like in Belgrade (Serbia), or in Bar (Montenegro).

## 3. Case studies development phases - major problems and needs

Based on international literature and data collected during the Interconnect project implementation, strategies and actions were developed considering three different levels for each area: City connectivity, referring to measures aimed at improving public connections among different urban transport hubs (bus and train stations); Regional connectivity, referring to measures aimed at improving sustainable public connection among different cities competing with private car transport (rail connections have a crucial role); Transnational connectivity, referring to connections among the main cities of the ADRION area by fast and reliable public transport solutions (rail and maritime connections have a crucial role).

From the analysis of the case studies of the Inter-Connect project, it was possible to map the major problems affecting the intermodal promotion at the different geographical scales. At city level the main problems faced were relevant to hub-to-hub connections (mainly from ports to train and bus stations) and to the increased demand for public

transport and its efficiency during peak touristic seasons. At regional level fast and reliable coast to inland sustainable connections were required and a hub-to-hub smooth connections (mainly connections from ports to train and bus stations at regional scale). At transnational level, the main problems were the lack of cross-borders train and ships services and the fact that the existing services are not competitive with car use (due to long travel times and costly fares).

In general, the main needs/challenges of the Inter-Connect case studies can be summarized in the following points:

- Integration of long-distance travel with the last urban mile;
- Integration of maritime transport with local public transport services;
- Develop innovative and effective cooperation schemes between the main stakeholders (public and private) in order to achieve seamless intermodal travel solutions.

Focusing on city connectivity, as above mentioned, stations play a very important role in promoting intermodality and problems with hub-to-hub connections were mainly due to different kinds of lacks at stations: lack of information on connections, of soft infrastructures like info boards or signals guiding tourists and passengers from one hub to another, of convenient public transport solutions like dedicated bus lines or fast public connections between two stations, of facilities like luggage deposits, and finally lack of integration of timetables among different transport services. As for high season public transport demand, the difficulties were relevant to a correct balance between offer and demand in periods with great passenger flows, as well as to possible conflicts between residents and tourists who flock buses when their number is not implemented or for lack of requested stops and territorial coverage of the public transport system often due to limited economic resources.

Significant is the case study of Trieste where the railway station and the ferry terminal are very close – only 450 m – but public transport was poor and not adequately promoted so that passengers ignored the possibility of moving fast and easily from one hub to another and this limited intermodality promotion, too.

Other examples are the case study of Igoumenista, where no regular public service was provided connecting the suburbs with the city centre and road transport was still the most effective transport solution, and that of the port of Bar where connections between the port and the railway station or the road networks to and from the hinterland were quite weak, and it was impossible to establish intermodality. Moreover, information was difficult to get for passengers and not available in foreign languages. However, the main problems found at city level seem to be related to deficiencies and weaknesses of cooperation, organization, infrastructures and promotion of public transport services (for both commuters and tourists).

The Interconnect cases of Igoumenitsa and Bar, for example, showed how poor public transport connections, inadequate infrastructure, and the lack of suitable information about possible delays may be the main reasons why private vehicles were preferred to public transport solutions. In the town of Igoumenitsa, on the contrary, there were no public transport services, except for an irregular intercity bus service connecting the surrounding villages and the suburbs to the town centre. After a careful analysis of timetables and existing public transport service lines, intermodality in Montenegro proved to have low levels of accessibility and attractiveness. Due to these obstacles, only few passengers used public transports while travelers using private vehicles were constantly increasing and private cars were the most popular transport solution. Moreover, information for users were not accessible or easy to understand since not translated in foreign languages. The information points were not clearly identified, web sites were not regularly updated, real-time information for travelers was not available, there was no online ticketing service, and it was not possible to combine tickets to use them to travel by different means of transport.

As for the study carried out in Trieste, the main problem was the connections between bus and ferry services which allow moving from one point to another around the town. Finally, the case of Albania concerned above all the improvements of the railway connections in the city of Durres. Maritime connections with the rest of the ADRION area were good thanks to the port of Durres, connecting Albania to Piran (Slovenia), Split (Croatia) and Bari (Italy) but railway connections were only with the city of Belgrade (Serbia). Therefore, the most used means of transport are cars and airplanes.

In order to collect relevant information among all the different partners in the project, it was defined a common evaluation methodology. The aim was to extrapolate common data to be used in other areas and generalized in the ADRION area. Inter-Connect case studies were compared referring to 5 different steps as summarized in Table 1.

Table 1. Inter-Connect case studies development phases' assessment methodology.

Case study phases	Case study phases	Brief description of each phase
Phase 1	Concept definition	<i>Define needs, specify scopes, study the problem(s), identification of the main project ideas, identification of the key stakeholders to be involved.</i>
Phase 2	Pre-feasibility study	<i>Identification of the best business scenario, both technically and financially, to solve the identified problems. Minor components of investment and implementation/management costs are identified in order to select the best solution to be realized.</i>
Phase 3	Feasibility study	<i>Project evaluation and approval phase.</i>
Phase 4	Project implementation	<i>Project implementation (or project execution). This is the conclusion phase, after evaluating, deciding, visioning, planning, applying for funds and finding all the financial resources for the project.</i>
Phase 5	Operation & maintenance	<i>Project operations and maintenance phases encompasses a broad spectrum of services, competencies, processes, and tools required to assure the measure will perform all the functions for which a solution/project was designed and implemented.</i>

During the Inter-Connect project the eight case studies reached different levels of development. In general, there has been a greater focus on a preliminary feasibility analysis without foreseeing its implementation during the duration of Inter-Connect. The different solutions among the various proposals for the realization of the project will be analyzed in the coming years by selecting the best idea and evaluating in a more precise way the various costs of realization, management, and investment.

#### 4. Solutions found for promotion of passenger intermodality.

The development of a sustainable model of tourist mobility requires a careful analysis of the potential use of public transport by passengers both inland and on the coast. Within the Inter-Connect project each pilot has found convenient and sustainable solutions to improve public services at a city level and encourage their use instead of private means of transport (Table 2).

Table 2. Synthesis of the key soft measures analysed and developed in the Inter-Connect case studies.

Case Study	Key soft measures analysed in the Inter-Connect case study
Igoumenitsa	<i>Bus lines; Transport hubs accessibility; Demand responsive transport (DRT).</i>
Emilia-Romagna	<i>Train timetables optimization aimed to reduce travel times; Integrated train-bus ticketing system.</i>
Trieste	<i>Improvement accessibility of port hub; Better information to tourists; Cooperation scheme for the promotion of a new cross border maritime service.</i>
Ljubljana	<i>Transport hubs accessibility; Bus lines improvement; Info-mobility; Integrated ticketing.</i>
Zagreb	<i>Train timetable; Integrated ticketing; Collaborative strategies among key stakeholders.</i>
Port of Bar	<i>New ship line; Info mobility.</i>
Durres-Tirana	<i>Real time information; Train digital solutions;</i>
Belgrade	<i>Data and transport planning; Urban public transport lines reorganization.</i>

In the town of Igoumenitsa public transport services had to be enhanced as well as walking and cycling paths to encourage people to leave private cars and use sustainable transport also at urban level. The lack of appropriate sustainable transport infrastructures and of a valid alternative to private transports also represented a great weakness

for the increase of attractiveness for tourists. Thanks to the Interconnect project, a new public transport system was implemented capable of supplying regular connections among different terminals (i.e., between the international port of Igoumenitsa and bus stations) to facilitate the visit of the town by bus to international tourists. For this purpose, local offers had to be properly advertised and a new synergic public transport system was planned with a regular line operating all year round and a DRT service during the holiday period (7 months a year).

In the Emilia-Romagna region tourism in coastal towns is widely promoted especially during the summer season. Anyway, poor connection between coastal and inland towns discouraged tourists to move toward the interior of the region. It often happened that tourists spent their holiday on the sea staying there for the whole period without moving to visit other cities of interest in the same area. An enhancement of rail services, a proper promotion of public transport at a city level and the introduction of a 3- or 7-days integrated ticket to be used for travelling around all the towns in the Romagna Region helped tourism and internal mobility of citizens. The soft measures adopted consisted in the removal of little traffic train stops and the enhancing of buses with dedicated lines from major stations.

Similar initiatives have been taken in the Slovenian case. Measures were taken to improve the use of public transport both for tourists and citizens travelling from and to Slovenian coastal towns, the urban region of Ljubljana and Joze Pucnik airport in Ljubljana. One of the aims was to provide passengers with reliable information and customer support services (i.e., information mobility app, pre-trip, and travel information, opening times of stations, additional information services, timetables, shuttle buses at railway stations). Some convenient ticketing systems valid on different public transport and shuttle buses within the area taken into exam helped to overcome problems.

In relation to the Trieste case study, the main aim was to facilitate changes between urban public transport services and the maritime passenger terminals especially for tourists leaving Trieste to Slovenian and Croatian coastal areas (i.e., provide practical and useful information or manage accessibility of the maritime terminal). In order to integrate mobility and tourist services, an integrated ferry-bus-train ticketing system was created for the summer season and a bus-train-ski one for the winter period.

Solutions for the Albanian case study focused on the development and implementation of technological solutions aimed to improve intermodal public transport thanks to an improvement of real-time information for travelers, the harmonization and integration of the time schedules of all the public transport solutions. The Albanian Ministry of Infrastructure and Energy intended to promote intermodal solutions using various information channels including the website of the Ministry of Transport, Albanian tourism fairs and sites of Albanian tourism. Integrated digital time information will help tourists and Albanians to get all useful information in real time enabling them to plan and coordinate their movements effectively and efficiently.

The Croatian pilot focused on solutions to improve information systems both for domestic population and tourists using public means of transport (real-time information, timetables, time delays or unexpected events). Moreover, the rail network is going to be enhanced giving passengers a faster and more convenient service to move between coastal and inland areas thus discouraging the use of private vehicles.

In the Montenegrin case, the pier infrastructure of the port of Bar does not meet the technical requirements to allow the docking of modern cruise and passenger ships and it is not possible to set up new ferry lines. In this case study investments had to be based on economic interests, spatial planning, local and tourist transport planning, requirements of local government and of a broad public interested in the project of promoting intermodality. Better infrastructure will create conditions for better transport connectivity which is vital for the development of the territory.

The case of Belgrade considered another solution to increase accessibility within the region. The main result of the case study was the definition of a follow-up project to reorganize transit lines in the city center to ensure better connections between railway and bus stations as well as future rail links to Belgrade Airport. The general aim was to establish the basis to create intermodal solutions for a sustainable public transport in the Belgrade metropolitan area.

At institutional level, a common experience resulting from all the eight case studies was the importance of the involvement of stakeholders, not only to have a good technical result but also to guarantee the duration of the project and the effectiveness of the actions in the long terms perspectives. Most of the stakeholders were public authorities, but private operators were also present in almost all the Inter-Connect case studies as well as citizens' associations. The case studies showed how important was to involve all the key stakeholders since the beginning of the decision-making process (pre-feasibility stage) to agree on the general vision and objectives to be reached with the different actions. Identifying the most relevant stakeholders and their specific contributions and role in reaching the project's main objectives is of primary importance not only to define the local action plans, but also to support the identification

of possible conflicts and coalitions between stakeholders and how these may affect the action plan definition process in terms of geographical coverage, policy integration and resource availability. The engagement level is assessed using the categories summarized and described in Figure 1.

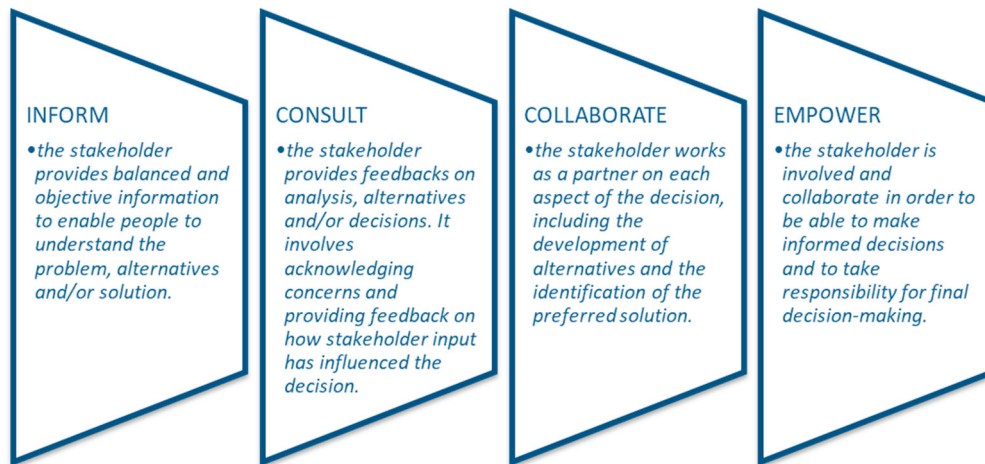


Fig. 1. The engagement level of stakeholders

In almost all cases, partners played the role of consultancy, collaboration and decision-making. This shows how great is the desire of stakeholders of being involved in preparatory and feasibility phases to choose among different alternatives and share opinions for the positive development of each project. Only in some cases including Durres, Port of Bar, Zagreb and Ljubljana partners involved in the project had to provide people with information to understand the problem, alternatives and / or the proposed solution. Finally, only in the case of Trieste the parties were involved only in the decision-making process.

## 5. Conclusion

The Inter-Connect project pursued the promotion of sustainable integrated transport and the reduction of bottlenecks in public transport infrastructures, increasing the capacity of existing transport services and promoting integrated and connected solutions across the Adriatic and Ionian Seas. This is in accordance with what shown Kim et al. (2021) who say that intermodality is the key to improve the efficiency and attractiveness of a journey made by combining different modes of public transport in a single solution and in a flexible way. The measures analyzed in the Inter-Connect project focused both on interventions related to infrastructure improvements and on soft improvements more related to operational and organizational aspects. One of the main results observed within the Inter-Connect case studies at city level is that, if pilots are considered as isolated interventions on public transport infrastructures, they cannot have a great impact on the increase in passengers (both tourists and local population). Pilots should be accompanied by synergies with the user's needs and with political and planning processes. Lu et al. (2018) also demonstrated how socio-demographic and travel characteristics have an impact on users' travel choice. For this reason, this article summarizes the main problems found, the solutions suggested and ways and means of implementation for cities of the Inter-Connect cases analyzing actions planned by each pilot and the promotion of intermodal transport. At a city level intermodal connectivity consisted in actions and strategies to improve passenger connections between different urban transport hubs (train, bus stations, ports.). Piacenza and Carpani (2006) underline the importance of infrastructure integration and internal coordination among the different intermodal means of transport for the implementation of a modal integration. However, the main problems related to intermodal passenger transport were relevant to the absence of fluid connections from hub to hub, to the difficulty in providing efficient public transport solutions during the high peck tourist season and services that are not competitive (both in terms of economic convenience and time required) with the use of car. Solutions adopted to overcome the problems did not involve high costs. They were “soft measures”

trying to enhance the existing infrastructure. One of the key points founded within the project was the involvement of stakeholders. Most of them were public authorities, but there were also private institutions, citizens' associations and private stakeholders. They were fundamental in order to reach the objectives, not only in order to have a good technical result of the project activities, but also to guarantee the duration of the project actions and their effectiveness.

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