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Cross-border public transport as a driver for tourism in the Alps

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Abstract

The Alpine area is object of a high environmental and social pressure caused by the tourist mobility. The modal share tends towards the private vehicle, since in most cases public transport (PT) is not competitive and does not constitute a valid alternative. This condition is due to several interrelated issues, which include connectivity, multimodality, lack of reliability in integrated tariffs and information. Furthermore, it is mostly valid at the transnational level, where orographic conditions hamper connectivity and the cooperation between transport providers is particularly complex for technical, legislative and political reasons. This paper focuses on the current condition of PT in the Alps, highlighting the issues related to the aspects previously mentioned and the implications for tourist mobility. Afterwards, the description of some virtuous initiatives that are undertaken (or are planned to be undertaken) at the transnational level shows a potential change in the mobility paradigm. This approach should be the first step of a more comprehensive strategy, aimed at defining a more appealing tourist mobility by PT for the entire Alpine arc.

Keywords: Public Transport; Alpine Area; Transnational Connectivity; Political Cooperation

1. Introduction

In the last years, European tourism has been living a constant growth of visitors (+19% between 2009 and 2014, Eurostat, 2016) and particularly of the extra-European ones (grown by 28%, Eurostat, 2016). The Alpine region confirms this trend: between 2014 and 2016, an increase of arrivals by 9.9% occurred, as well as an amount of over 95 Mio long-stay tourists and 60 Mio day-trip visitors per year has been reached (Astat, 2017a). These high numbers are concentrated in few regions (5% of all Alpine municipalities offer 46% of all available beds; Alpine Convention, 2013) and in limited periods (the average duration of holidays, now equal to 3.5 days, is constantly decreasing;

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Astat, 2017a). These spatial and temporal concentrations are sided by a high share of private vehicles (more than 84% to reach the destination and move within it, Alpine Convention, 2013). These elements result in high levels of congestion along main infrastructures, with negative consequences for local inhabitants in terms of transport externalities and even loss of attractiveness for the Alps as leisure destination. This framework makes tourist mobility a key challenge for the Alpine space.

Several criticalities of the public transport (PT) contribute to these figures, e.g. the low rail infrastructure density caused by orographic obstacles, the lack of direct connections related to the weak local demand and the low integration of tariffs and information. In response to these issues, many international strategies, such as the Transport Protocol of the Alpine Convention (henceforth AC; EU, 2007), as well as regional and local measures have worked to develop more competitive PT solutions in the Alps. These initiatives have generated some local excellences and positive results in terms of modal shift along specific routes. Nevertheless, they are only seldom part of a wider system referred to the entire Alpine region. Therefore, common Alpine transport policies, as well as integrated approaches for the Alps still need to be enforced and developed (AC, 2007; 2008).

Literature about mobility and tourism has been dealing for many years with the identification of common challenges (Le-Klähn and Hall, 2014). In particular, the environmental impact of tourism transport is a core topic (Dubois et al., 2011; Cohen et al., 2014), since transport is the first source of GHG emissions produced by tourism. In order to tackle this criticality, several contributions have discussed the need of dealing with both Origin-Destination travels and within-destination mobility (Dallen, 2007) and the necessity of establishing transnational collaborations with focus on tourism (Weidenfeld, 2013; Blasco et al. 2014). At the same time, a balance between the development of accessibility and the conservation of characteristics should be found (Høyer, 2000; Lumsdon and Owen, 2004). Tourism mobility has become a specific research field, able to influence strategies on tourism development (Scuttari et al., 2013; Job et al., 2014).

This paper contributes to this research line, discussing about the importance of cross-border connections in Alpine areas, in order to grant a more appealing PT network for tourists. Cross-border links are investigated as potential junctions among several virtuous regional lines, thus stimulating an Alpine regional network across national and regional borders. The article is structured as follows: section 2 presents the crucial components of the Alpine PT network for tourism, jointly with the open gap left for the improvement of cross-border transport. Afterwards, the problems affecting cross-border transport are discussed, with reference to selected critical areas, classified in four macro groups, i.e. *connectivity*, *multimodality*, *integrated tariffs and information* and *political cooperation* (section 3). For each theme, corresponding solutions already applied in the Alps are described (section 4). Section 5 underlines the importance of developing cross-border connections as parts of a more unified Alpine network. Finally, section 6 ends this contribution, by looking for potential extensions of this research line.

2. The main components of the Alpine PT network

Trans-Alpine corridors and regional secondary networks are the main components of the Alpine PT (respectively red and blue lines in Fig. 1). The former represent the main routes to access and cross the Alpine region. Since they also connect the main peri-Alpine urban areas, their development has been object of a relevant attention. In parallel, regional networks serve those valleys that are not crossed by trans-Alpine corridors, connecting settlements with each other and with the main Alpine nodes. Important infrastructural developments have occurred in the last 15 years for both components, in order to cover inhabitants' needs and to develop tourism mobility in a more sustainable way. At the same time, a third PT component is partially underestimated and low developed because of its challenging features: the cross-border and inter-regional connections (circled areas in Fig. 1).
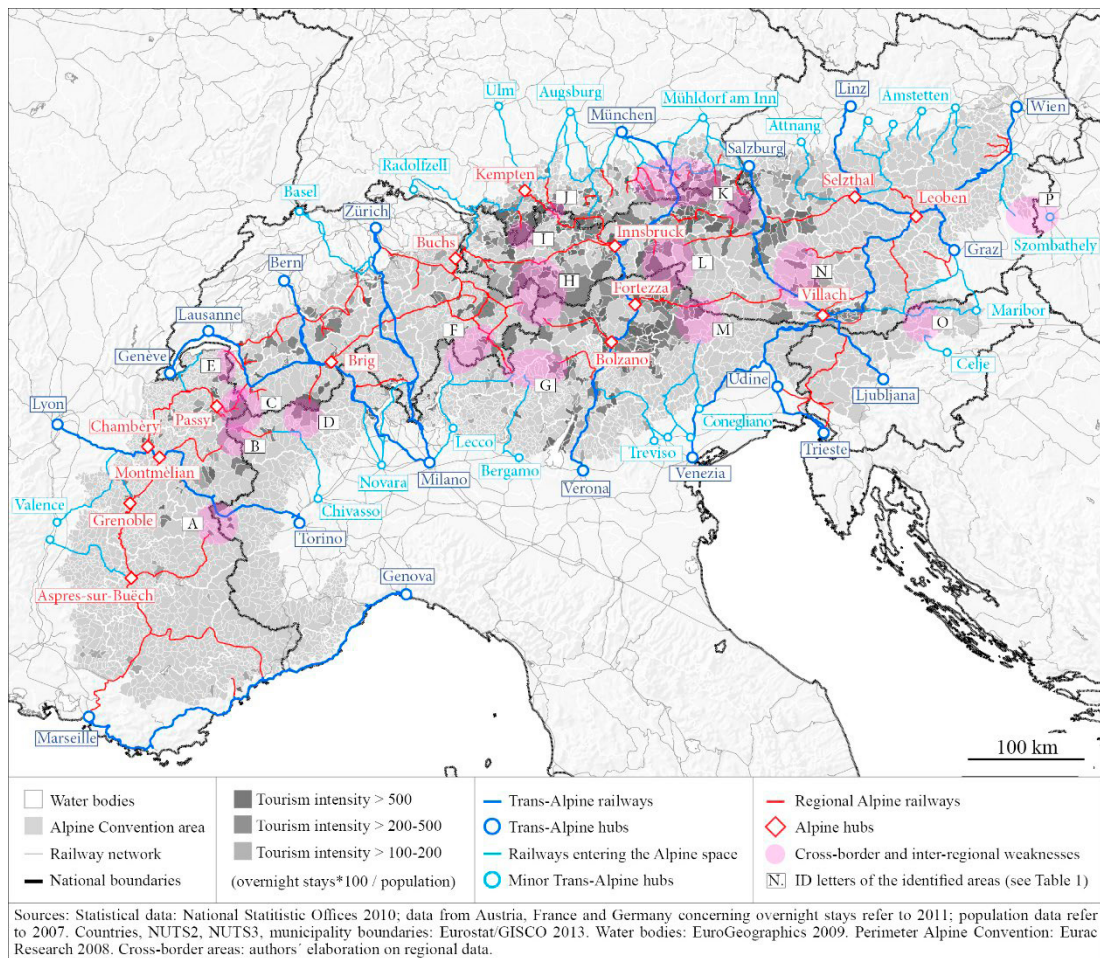
Fig. 1. Cross-border mobility in the Alpine region.

2.1. The main trans-Alpine corridors

For tourism, the main trans-Alpine corridors are crucial to shift part of the demand from road to rail. The AC has highlighted numerous measures aimed to enforce their attractiveness (EU, 2007), such as the improvement of transnational connections, the development of easily accessible information and tariffs focused on tourists' needs and the coordination of these connections with the regional networks.

Among the infrastructural investments, six new transnational high speed/high capacity railway lines are planned or under construction (Ravazzoli et al., 2017): they are the Genoa–Marseille, Milan–Lyon, Genoa–Basel, Genoa–Zurich, Verona–Munich, and Venice–Vienna. The Brenner Base Tunnel (BBT), part of the Verona-Munich corridor, is one of the most important interventions, since it is the central part of the Brenner, the trans-Alpine corridor with the highest number of passenger vehicles. Once operative, it will shorten the travel time between Fortezza (IT) and Innsbruck (AT) by about 50 minutes, allowing a higher competitiveness of PT. Thus, new relations will become possible (e.g. Zurich-Bolzano) and are expected to open new possibilities in terms of tourist accessibility.

Together with these huge investments, also other improvements are periodically performed along this line. These result from the continuous cooperation established at cross-border level between IT and AT with the EGTC Tirol-Südtirol-Trentino (CoR, 2018). Through this cooperation, currently seven daily connections per direction are guaranteed between Innsbruck (AT) and Bolzano (Connect2CE, 2018a). Furthermore, thanks to a commercial agreement between Trenitalia, Deutsche Bahn (DB) and Österreichische Bundesbahnen (ÖBB), five long-distance

connections between Munich and Verona are also provided. To implement this service, the interoperability issues related to different technical standards have been addressed by ÖBB[1], which will provide new homologated trains from 2021. Even new direct connections between Vienna and Bolzano (two daily connections per direction per day) are expected by 2020. This growth of the supply has produced a relevant increase of the travel demand: e.g. between Trento and Verona, train passengers have increased from 1.92 in 2007 to 3.48 Mio in 2015 (Legambiente, 2017).

Another interesting improvement (specifically related to tourist connections) is the extension to Trieste (IT) of the train connecting Villach (AT) and Udine (IT), part of the Tarvisio trans-Alpine corridor. This connection is tested as part of the EU project Connect2CE, (Connect2CE, 2018b). The Italian operator Ferrovie Udine Cividale (FUC) guarantees two trains per direction during weekends and festivities, providing also convoys with a carriage that hosts up to 100 bikes. This kind of initiatives is consistent with the targets set by the AC, since it promotes both the use of trains and of slow mobility once reached the destination.

2.2. The regional networks

Tourism has a strategical role also for regional connections, since these can promote a sustainable way of moving within the destination. In some cases, they can even stimulate visitors to use PT also for origin-destination (O-D) travels. The integration of these services with the main corridors is a priority, as well as the establishment of convenient tariffs and user-friendly information, able to combine PT with tourist attractions.

An example of this approach is the S-Bahn Tirol, managed by the Austrian company ÖBB and composed by six lines running in the metropolitan area of Innsbruck (ÖBB, 2018). This network has been operating since 2007, but in that year it was limited to the line S1 Kufstein-Telfs. Other five lines have been added between 2008 and 2009 and further fares have been introduced between 2013 and 2015. From the S-Bahn Tirol also two panoramic branch lines are accessible: the Pinzgauer Lokalbahn and the Zillertalbahn (Zillertalbahn zug – bus – dampf, 2018; Salzburg AG, 2018). They have a high tourist appeal, since they offer the possibility to travel with historical carriages towards the National Park Hohe Tauren and to main tourist destinations such as the famous ski-area of Kitzbühel. In the last 10 years, daily passengers of the S-Bahn Tirol have grown by 60%, passing from 40,000 to about 65,000 (mostly commuters); this data, jointly with the high frequency of the service, makes the Tyrolean S-Bahn the second most frequented PT network of Austria after the Wien S-Bahn (Tirol Unser Land, 2014), with good potentialities also for tourists.

The Swiss regional network of Grisons, managed by the railway company Rhätische Bahn (RhB, 2018), is a crucial tourist attraction, which belongs to the UNESCO World Heritage sites. The whole railway system is 384 km long, 1/3 of it runs over 1,500 m of altitude (RhB, 2018a). The Bernina and Glacier expresses are its most attractive services: the former (opened in 1973) runs through the Albula valley and the Upper Engadine, reaching the maximum altitude of 2,253 m at the Bernina Pass; the latter (opened in 1930) travels East-West between Davos and Zermatt in eight hours. About 12 Mio passengers use the RhB network every year (33,000 per day), with an increase by about 20% compared to 2000. Among total passengers, 80% travel for leisure, while 20% are commuters (RhB, 2018a).

South Tyrol is another region where the modern development of local PT has been valuable (Cavallaro and Sommacal, 2019). The flagship of this transformation is the Venosta valley railway, which reopened in 2005, after 20 years of abandon of the line. Since its reopening, the users (both inhabitants and tourists) have grown exponentially, passing from 1.0 Mio passengers in 2005 (ca 3,000 per day) to 11,100 per day in 2011 and reached more than 31,400 passengers in 2017 (Legambiente, 2017; STA, 2018). Such a high increase represents the highest registered all over Italy. This growth required in 2016 the electrification of the line, in order to increase the capacity and allow an extension of the service from the current frequency of 1 hour (plus every two hours an extra service), to a new one of 30 minutes. This experience also stimulated in 2009 the modernisation of the Pusteria valley railway. By adopting a similar approach, the line is conceived for both commuters and tourists (at the Perca station, the train is connected directly with the well-known Kronplatz sky area, about 2.5 Mio presences during the winter

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[1] The electrification system in Austria and Germany is 15 kV 16.7 Hz AC, while in Italy it is 3kV DC.

season; Astat, 2017). Also in this case, the increase of users was relevant, passing from 1.3 Mio in 2013 to more than 1.6 Mio in 2014 (+18.7%, Connect2CE, 2018a).

2.3. The cross-border and inter-regional minor connections

If the main trans-Alpine corridors and the regional networks are considered strategical for a sustainable tourism, a comparable attention is not devoted to the cross-border and inter-regional PT. Indeed, excluding some exceptions, these connections are often challenging from a technical and planning perspective. Even for this reason, they are often low developed. Furthermore, also the political and managerial issues that arise in the interfaces between different geopolitical assets are relevant limits to their enforcement. Consequently, tourists do not consider these types of connection as real options.

Taking into account the entire Alpine arc, our study has identified 16 main inter-regional and cross-border areas that could be interested by different types of developments (circled areas in Fig. 1). Some fields of intervention that typically involve the transboundary dimension, may be identified: connectivity, multimodality, info-mobility and tariff/ticketing¸ together with the strengthening of the political cooperation that grounds any intervention (Cavallaro and Dianin, 2019). In the Alps, the gap left open referred to each aspect is quite relevant. Table 1 provides readers with a general overview per each of the 16 areas identified in Fig. 1 and here reported with their ID letters.

Table 1. Cross-border and inter-regional areas of analysis in the Alpine arc.

ID	Name	Thematic challenges affecting cross-border and inter-regional connections					
		Connectivity		Multimodality		Info-mobility tariff-ticketing	Political cooperation
		Missing service	Change needed	Complex chain	Low-served surroundings	Low integration among systems across borders	Lack of cooperation at cross-border level
A	Oulx – Briancon		X	X	X	X	X
B	Pré-Saint-Didier – Bourg-Saint-Maurice	X			X		
C	Pré-Saint-Didier – Chamonix	X		X		X	
D	Gressoney and d´Ayas valleys		X		X	X	X
E	Saint Maurice – Geneva	X	X			X	
F	Chaivenna – St. Moriz		X	X	X	X	X
G	Tirano – Edolo – Mezzana		X	X		X	X
H	Malles – Zernez – Landek		X		X	X	
I	Oberstdorf – Allgäuer hochalpen		X		X		X
J	Füssen - Außerfernbahn	X			X	X	
K	Karwendel and Karwendelvorgebirge	X		X	X	X	X
L	Aurina valley – Tyrol	X		X	X	X	
M	Calalzo – Cortina – Dobbiaco		X	X		X	X
N	National Park Hohe Tauern		X	X			
O	Celje – Carinthia	X		X		X	X
P	Szombathely – Burgenland	X		X		X	X

Note: **For ID letters refer to Fig. 1.**

Even though these connections are currently low considered, working on their enhancement may represent a strategic driver for the sustainable development of tourism and mobility in the Alps. Indeed, most of these cross-border and inter-regional areas can act as links among the regional networks cited above, unifying them across borders in a wider Alpine regional system. In particular:

- An integration of regional networks across borders may promote alternative itineraries crossing the Alps (especially along the east-west routes, where several panoramic lines and Points of Interest exist), proposing alternative ways to experience the Alpine space. An example is between St. Moritz and Merano passing through the Venosta and Engadin valleys and the Swiss National Park (letter H in Fig. 1).
- An inter-regional integration may enforce those minor regional lines connecting peri-Alpine urban areas with the Alps, encouraging local inhabitants to use PT to reach their destination, thus changing their current travel behaviors. An example is between Veneto region and the Dolomites in Veneto and South Tyrol (letter M in Fig. 1).
- An enforcement of cross-border and inter-regional connections may also grant the sustainable development of those remote areas that are popular but not served by appealing PT, connecting them with the tourist nodes along regional networks. An example is the southern part of the Stelvio National Park, between Edolo and Mezzana (letter G in Fig. 1).

To understand limits and opportunities given by the cross-border and inter-regional dimension, the next two sections investigate their main issues referring to concrete samples in the Alps, as well as best practices that have reached virtuous results in addressing such issues.

3. Thematic issues of cross-border transport in the Alps

As introduced in the section 2, four main challenges hamper the development of cross-border transport: I) connectivity, II) multimodality, III) integration of tariffs and information and IV) political cooperation. The next four subsections present them in greater detail, referring to peripheral and tourist specificities and including exemplificative cases belonging to the Alpine context (Fig. 2). In most cases, the issue characterizing a line is not unique and other components need to be considered as well. Each sample is identified by a number in square brackets, which is visible also in Fig. 2.
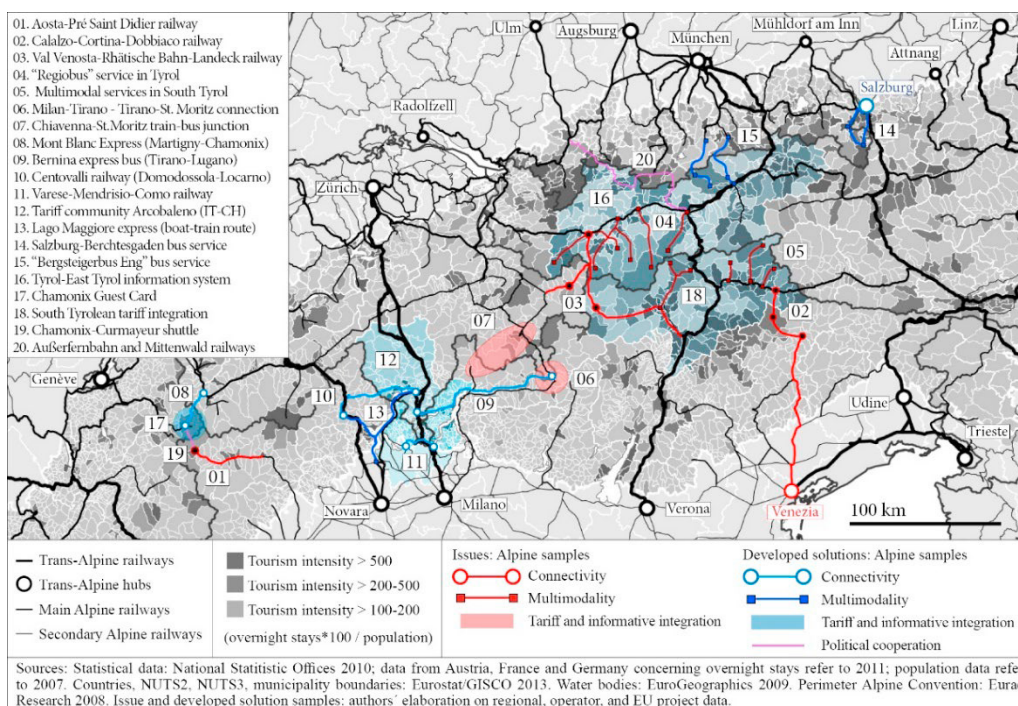

Fig. 2. Cross-border issues and solutions in the Alpine arc.

3.1. Connectivity

At peripheral and cross-border level, typical connectivity issues are the absence of rail infrastructures or services, the presence of inter-operability obstacles and the lack of harmonized timetables (Connect2CE, 2018). In the Alps, a different development of road and rail networks exacerbates this condition (since the first has significantly grown in the last century, while the second is almost stopped since 1900; AC, 2007). Moreover, orographic obstacles and disperse settlements hamper the development of efficient connections (CoR, 2016), while national policies often do not include the trans-national (or trans-regional) components as a priority. Indeed, cross-border strategies are typically focused on main passing through lines where heavy flows are concentrated, while inter-regional connections (CoR, 2006) are often minor and then addressed with specific agreements. Furthermore, several local railways closed in ´60 (e.g. Calalzo-Cortina, Gardena valley Fassa valley lines in Italy, and the Ischlerbahn in the region of Salzburg) have contributed to reducing the Alpine accessibility by PT. All these limits make alternative transport solutions more reliable than big investments, but even more challenging to propose as tourist attractions integrated in the regional supply.

In terms of connectivity, the Italian region Valle d´Aosta (at the boundary with France and Switzerland) suffers from the low density of rail infrastructures (25 km/1,000 km^2 compared to an Italian average of 55 km/1,000 km^2, Eurostat, 2015) and from the absence of cross-border trains. The line connecting Turin and Chivasso with Pré-Saint-Didier [01] is the unique railway available in the region, while tourist valleys as Lys and Valtournenche are not covered by any rail or bus service (RAVA, 2018). Furthermore, the railway does not reach the famous locality of Courmayeur (where a cross-border bus direct to Chamonix Mont-Blanc is available), leaving a gap of 3.5 km between the two services. This condition has significant consequences also on the multimodal connection currently provided between the French and the Italian sides of Mont Blanc, hampering the possible synergy between train and bus. The integration of the missing section is under discussion, despite the financial difficulties (AC-SA-PNV, 2017). Similar interventions of rail integration in bordering areas are discussed in the region of Veneto, where the hypothesis of restoring the dismissed connection Calalzo-Cortina is under evaluation. On this route, currently a multimodal bus service called "Trenobus delle Dolomiti" allows visitors to cycle in the Dolomite area and to overcome the steepest parts of the line (Dolomitibus, 2018). The restoration of the line is expected to reconnect the current terminal of Calalzo with the tourist hubs of Cortina and Dobbiaco [02], linking the cross-border line between South Tyrol and East Tyrol (STA, 2016). Between the two Italian regions involved, a protocol has been signed in 2016 for the implementation of a feasibility study, whose results were presented in March 2017. The study proposes two possible routes, both requiring an investment of almost 700 Mio Euro (Alto Adige, 2017). A similar study has regarded the potential connection between the Venosta valley line in South Tyrol and the Rhätische Bahn in Grisons and/or the Austrian hub of Landeck [03] (Rätisches Dreieck, 2006; STA, 2017). Currently, this connection is ensured by transnational buses, thanks to an agreement between the Autonomous Province of Bolzano and the Swiss operator AutoPostale.

3.2. Multimodality

In peripheral areas, multimodality can guarantee competitive PT solutions, which are able to compete with the flexibility ensured by private car (Pucher and Kurth, 1995). Due to the difficulties in transnational contexts, the development of alternative multimodal solutions is a crucial point for a sustainable development of tourism. It helps covering the last mile from the main station to the resort and offering adequate door-to-door solutions to visitors (AC, 2014). This necessity is particularly important for remote areas, usually also isolated from the main regional networks. This characteristic belongs to several border regions, where the distance from main infrastructures is relevant and where the tourism intensity is often high (AC, 2018). The South Tyrolean and Tyrolean valleys are exemplificative of this condition. In particular, the Austrian side presents critical levels of accessibility, since in most of its valleys about 30 minutes by car are necessary to reach the closest municipality with more than 5,000 inhabitants (AC, 2018).

In Tyrol, the public company VVT manages the service of extra urban buses called "Regiobus" [04], which reaches the minor valleys of the region with 29 lines (VVT, 2018). This network is mainly oriented to local population and offers numerous stops in order to serve remote settlements (VVT, 2018a, 2018b), rather than

focusing just on the main nodes of tourist interest. Even with such premises, the official site for tourism in Tirol proposes this as a prime connecting service for visitors, together with local taxis and shuttles (Tirol Austria, 2018). Nevertheless, differently from rail transport, in this case no luggage transfer is provided, as well as no tariff integration into tourist offers. Similar conditions affect several other valleys in remote locations in South Tyrol, which are very popular leisure destinations (e.g. the Passiria and Aurina valleys) [05]. As in the previous example, to reach these locations by PT, a multimodal journey is necessary (from trans-Alpine corridor, to regional rail network, to local bus service). In most cases, the connection to the specific resort destination remains uncovered. Alternative flexible solutions as taxis and rental cars are available and cited in the official South Tyrolean tourism website (Südtirol, 2018), but without integrated tariff or information systems. Conversely, the East Tyrolean system called Defmobil (managed by public authorities) offers a shared taxi service on demand, based on fix routes and timetables. It is dedicated to both citizens and tourists in order to fill the gaps left by PT (LastMile, 2017). This service is particularly important for an area such as East Tyrol, characterized by small and dispersed villages, where a traditional PT service would have been ineffective. These two neighboring areas show the different approaches that can be adopted in providing the same service.

3.3. Integration of tariffs and information

The integration of tariffs and information can grant a good coordination among multimodal services. At cross-border level, this is a complex issue, which can prevent the use of PT by travelers. These integrations are essential to promote the usage of PT among tourists, since they often have a limited knowledge of destination transport supply and the difficulty in managing non-integrated tickets represent a relevant obstacle (Pronello and Camusso, 2017). The report "Public transport accessibility of Alpine tourist resorts from major European origin regions and cities" (AC, 2008) has remarked the strategical role of these elements in order to shift part of the tourist demand towards PT and the necessity of providing tailored information specifically referred to tourist resorts. Nevertheless, the current high fragmentation and heterogeneity of information among the different Alpine regions is still a relevant obstacle.

The cross-border connection between Lombardy (IT) and Grisons (CH) shows relevant difficulties in this field. No form of integration of tariffs and information is offered between these regions, despite Canton Grisons is characterized by well-known tourist destinations, like St. Moritz and the entire Engadin valley that, every year, host ca 1.48 Mio tourists (Engadin St. Moritz, 2016). On this cross-border route, Trenord operates both the Italian connection Milano-Tirano [06] and even some connections Tirano-St. Moritz (running the same route of the Bernina express and of the Swiss regional trains). Furthermore, the timetable harmonization among these lines is guaranteed (SBB, 2018). Despite this, neither Trenord, nor Trenitalia provide integrated information on this cross-border service, as well as any integrated tariffs for tourists. This issue also affects the multimodal connection (train-bus) between Milan and St. Moritz via Chiavenna [07], jointly provided by Trenord and the Swiss bus operator AutoPostale. For both the operators, multimodal tickets across the border are not available, as well as cross-border timetable information.

3.4. Political cooperation

All the issues described above could be addressed by ad-hoc cross-border collaborations, in order to implement new services and to build synergies among the existing ones (Stoffelen et al., 2017). These lasts are essential to solve national differences in terms of legislation, data standards, technical features and tariff schemes. However, building effective collaborations between small regions is challenging, since many transport themes (e.g. rail agreements and data standards) are managed at the national level. The prior importance of these collaborations for a sustainable development of transport is acknowledged (AC, 2013) through two crucial needs: the establishment of concrete collaborations between complementary sectors even at transnational scale (e.g. tourism and transport) and the construction of common Alpine transport policies among all countries.

Even if such an extensive cooperation is difficult, the establishment of four European Groping of Territorial Cooperation (EGTCs) in the last ten years is a countertrend and valuable initiative (CoR, 2018). Among them, Euregio Senza Confini (IT-AT), Tirol-Südtirol-Trentino (IT-AT) and Parc Européen Mercantour (IT-FR) operate

based on territorial relationships. On the other hand, a bottom-up approach is also possible. The consortium "Alpine Pearls" is composed by a network of 25 localities (belonging to all Alpine countries), who apply similar tourist strategies in different places. Most of them are remote locations placed in bordering areas (e.g. between Italy and Austria, Italy and Switzerland, Italy and France, Austria and Slovenia, Austria and Germany) and are affected by issues typical of remote tourist destinations. To become an Alpine Pearl, accessibility by PT is a fundamental prerequisite: a locality has to be reachable by PT with a frequency of two hours, from 8.00 in the morning to 22.00, seven days a week; and has to ensure good connection with regional network to reach attractions and services (Alpine Pearls, 2014). However, this form of cooperation (born in 2007) is still an exception in the Alps.

4. Solutions to address cross-border challenges

The four issues described in the previous section (Connectivity, Multimodality, Integration of tariffs and information and Political cooperation) have been successfully addressed in some virtuous Alpine regions (Fig. 2). This section shows some positive experiences that have developed cross-border efficient solutions for tourist purposes. Selected cases are related to the most representative issue that they want to address, but they may include also other aspects. As in the previous section, each sample can be identified in Fig. 2 by looking at the corresponding number.

4.1. Connectivity

The Mont Blanc Express [08], connecting Martigny (CH) with Chamonix Mont-Blanc (FR), represents a positive example of cross-border rail connection, highly appealing for tourist purposes (Mont-Blanc Express, 2018). This narrow gauge track line covers a distance of 38 km in 90 minutes, including a rack section of 2.5 km with a maximum slope of 20%. The train passes through 21 tunnels, 28 bridges and viaducts, offering a panoramic route with a spectacular view on Chamonix valley and its glaciers. Moreover, the runs are performed from early morning to the evening (8.00-19.00), the timetable is on the Swiss railway company website, the service may be integrated with further PTs and the main tourist platforms regarding the Chamonix valley and the Canton Valais provide users with complete information (Canton Valais, 2018).

This cross-border connectivity is a strength also for the Bernina express bus [09], connecting Tirano and Lugano (CH) passing through Italy and the Palm Express bus, from St. Moritz to Lugano. They are proposed as integrated part of the Grand Tour of Switzerland (2018), together with the most famous rail routes of the country. This is the main commercial strength of these connections, which, even if less spectacular, works as link of a broader tour and pass-through valuable landscapes as the Como Lake (IT). The integration of information and tickets, as well as the timetable harmonization with the rail services enforce their usability.

Between Lombardy (IT) and Canton Ticino (CH), a panoramic cross-border railway lines named "Centovalli railway" [10] connects the cities of Domodossola and Locarno. The line (52 km long; 2 hours of travel time) connects the two trans-Alpine corridors of Gotthard and Simplon, and is managed by two societies (Società Subalpina di Imprese Ferroviarie and Ferrovie Autolinee Regionali Ticinesi SA), which respectively control the Italian and the Swiss sections (Centovalli Vigezzina, 2018). The line was inaugurated in 1923, with the intention to provide this isolated region with a transport service able to stimulate an economic development. Through the years, the tourist attitude of the line has grown, reaching the current 150,000 annual visitors, with daily picks of about 2,500 passengers. Even the inclusion of the line in the multimodal tour called "Lago Maggiore Express" (see below) plays a relevant role in the attractiveness of the service.

Between Lombardy and Canton Ticino, a new transnational connection has been inaugurated in January 2018. It connects Varese and Como (both in Lombardy) via Mendrisio (CH) [11]. A change to Lugano (CH) is also possible, with harmonized timetables (RFI, 2017). Rete Ferroviaria Italiana (RFI) and Swiss Federal Railways have jointly carried out the infrastructural intervention, for the Italian and Swiss sections. Thanks to this collaboration, this railway represents a suitable alternative to car for daily transboundary commuters headed to Lugano and a relevant occasion for international tourists (it is possible to reach the Malpensa Airport of Milan in about 1 hour by train from Varese). The frequency is hourly between Como and Varese via Mendrisio and every 2 hours it is extended to Malpensa. Moreover, thanks to the timetable harmonization in the triangle Varese-Como-Lugano, connections are

guaranteed with a frequency equal to thirty minutes (Tilo, 2018). Thanks to the Tariff Community Arcobaleno [12] (Trenord, 2018), the Lombardy railway operator provides integrated information and tariffs with Canton Ticino. Even if mainly oriented to commuters, the service is expected to also enlarge the regional suitability for tourists.

4.2. Multimodality

The "Lago Maggiore express" [13] (2018) is a virtuous example of a cross-border multimodal service specifically conceived for tourists. This seasonal service (active from April to October) offers a panoramic circle tour that combines three routes managed by three operators: the Centovalli railway, the cruise on the Lake Maggiore and the traditional train connection Arona-Domodossola (respectively final point of the cruise and starting point of the panoramic railway). The multimodal combination of these services allows visitors to manage the whole route in one or two days and the choice between several starting points. Moreover, integrative services including info-mobility and integrated tickets complete the proposal.

In the Salzburg-Berchtesgadener Land, the German operator Regionalverkehr Oberbayern GmbH, controlled by DB, provides the area with regular and cross-border bus services, in some cases coordinated with the main railways on both sides of the border (Salzburg Verkehr, 2018). An example is the connection between Salzburg and the tourist destination of Berchtesgaden (DE) [14], which is coordinated with the railway connection Berchtesgaden-Freilassing. The bus service is under the management of the service provider of Salzburg and integrated with the S-Bahn system of the region. Moreover, DB covers information for this service through its web page, allowing a good multimodal integration with its railway service.

Another virtuous multimodal service has been developed in the Alpenpark Karwendel. Placed in Tyrol and bordering Germany, this natural area is affected by heavy tourist flows (mainly coming from Germany), which generate a regular congestion of roads during weekends and holidays (AC, 2014). To address this condition, DB and the regional operator Bayerische Oberlandbahn (BOB) has established a seasonal bus service called "Bergsteigerbus Eng" [15] operating three times per day, which brings visitors from the last train stop in Germany to the core of the park in Tyrol. To make this service more appealing, a convenient integrated ticket merges train and bus services. The bus can store about 10 bikes and reaches Engboden, the most popular location of the area, from which numerous hiking trails start (DB, 2018).

4.3. Information and tariff integration

Thanks to the EU project AlpInfoNet (AlpinfoNet, 2015), Tyrol and East Tyrol have developed information systems [16] able to provide a framework of available PTs, with an approach specifically tailored on tourist needs (AlpinfoNet, 2014). This system generates a cooperation between the tourist interactive map of East Tyrol and the travel planner of the public company Verkehrsverbund Tirol (VVT), which organizes data coming from different transport operators. The result is a tool that provides users with information concerning the location of tourist attractions and the best ways to access them by PT. In the framework of the AlpInfoNet project, a useful transnational tool has also been adopted between Piedmont (IT) and Rhône-Alpes (FR). In this case, a web-based tool allows tourist operators to add customized widgets on their own platform, which can provide complete itineraries to reach locations, last mile solutions, interactive maps and next departure information.

In the Chamonix valley (FR), the Carte d'hôte [17] (Guest card) offers numerous advantages to visitors spending at least one night in accommodation (Vallee de Chamonix Mont-Blanc, 2017). This pass is directly given by the accommodation host and allows tourists to travel free of charge on the train lines performing internal journeys, on all bus lines and on the city center shuttles. Even the rail connection Chamonix-Martigny is included in the card, but just for the French section. For those who do not stay in a tourist accommodation, the Guest card can also be purchased at a cost of €10 per week.

Also in South Tyrol, integrated information and tariffs are a key point to encourage tourists in using PT [18]. Here three special types of tickets are available for this purpose: the MobilCard, the Museomobil Card and the Bikemobil Card (Connect2CE, 2018a). The validity can be 1, 3 or 7 days and it allows the access to the whole PT network of the region without limits, including also the cross-border bus connection with the UNESCO site of Müstair in Switzerland. Moreover, the 3 and 7 days passes combine the free access to 90 museums of the region, or

the possibility of renting a bike, with the free use of PT. This integrated approach is adopted by the region also for residents, which are allowed to access all PTs of the region and some selected cross-border connections, thanks to subscriptions based on kilometric tariffs. These examples, even if virtuous, are rarely referred to a transboundary coverage. This is a strong obstacle for tourist information and tariffs, since finding a common policy between two regions may be in contrast with the competition existing among tourist destinations. These political obstacles currently represent relevant hampers to the implementation of innovative transnational tariffs for tourists.

4.4. Political cross-border cooperation

The positive transboundary attitude of South Tyrol is significantly influenced by its participation to the EGTC Tirol-Südtirol-Trentino, which officially operates at inter-regional level since 2011 (CoR, 2018). This European form of cooperation consolidates an historical relationship between these areas and allows the development of about 25 projects every year (directly financed by the EGTC) regarding several fields, including sustainable transport. Meetings among political leaders and technical experts are frequent, in order to exchange positive practices and formulate cross-border agreements. The integration of PT and information links Trento, Bolzano and Innsbruck with Italian and Austrian train operators and it is a backbone of this cross-border relationship. A second EGTC, called "Euregio Senza Confini", establishes a cooperation between Friuli-Venezia Giulia (IT), Veneto (IT) and Carinthia (AT). Even this program puts a relevant attention on transport issues, as well as on the sustainable development of tourism taking part to the AC Working Group (ACWG) of sustainable tourism (CoR, 2018). The ongoing Interreg project (IT-AT) EMOTIONWay, proposed and led by the EGTC "Euregio Senza confini", is an example of cross-border cooperation aimed to improve tourist slow-mobility accessibility in the transboundary area between Veneto, Friuli-Venezia Giulia, South Tyrol and Carinthia in the area of oriental Alps.

Other forms of cross-border cooperation do not refer to entire regions, but rather on smaller authorities held together by common relevant elements. This is the case of the "Espace Mont-Blanc", which merges 3,500 km^2 of territories belonging to Italy, Switzerland and France (Espace Mont Blanc, 2017). Since 1991, this organization has been working on five fields: Mountain, Territory, Energy and Transport, Raising awareness and Future. The research of concrete actions for the decrease of transport GHG emissions is the core of the transport theme, together with a group of adaptation measures for climate change. Among the initiatives promoted to stimulate a sustainable mobility, the Chamonix-Courmayeur shuttle is worthy to be mentioned: it tries to solve existing difficulties in connecting Italian and French sides of the border shown in section 3.1 [19].

Finally, a virtuous cooperation regarding transport involves DB and ÖBB. They do not just collaborate to provide transnational services on the main corridors as the Brenner, but also for minor regional lines crossing the border, as the Außerfernbahn and Mittenwald railways [20] (ÖBB, 2013), where interoperability issues have been solved and therefore the national border does not constitute a technical obstacle. Both companies jointly manage the Außerfernbahn, but just DB performs the passenger service, while ÖBB takes care of the maintenance of the infrastructure along the Austrian section. For the Mittenwald line, ÖBB manages the service, offering a direct connection from Innsbruck to Garmisch-Partenkirchen (DE).

5. Findings: cross-border integration for a unified Alpine regional network

Sections 3 and 4 have shown how issues in connectivity, multimodality, tariff integration and information systems hamper the cross-border integration among PT services. Even the low density and the reduced transport demand typical of bordering regions obstacle a growth of investments in this field (Šťastná and Vaishar, 2017), thus making tourist mobility by PT complex. Nevertheless, cross-border integration would deserve an increasing attention, because it can be strategical to shift European PT networks from a local dimension (Henneberg, 2013) to a transnational one (in line with the vision of Europe as a "single transport area"). Specifically, cross-border integration may link regional Alpine systems, promoting a unified network as occasion to experience this territory with alternative itineraries. Furthermore, it can produce new accessibility for minor urban areas besides trans-Alpine corridors (AC, 2008). Fig. 3, which is a visual summary of this concept, displays this potential systemization of the Alpine network. It highlights areas where better cross-border collaborations are necessary and where missing connections occur.
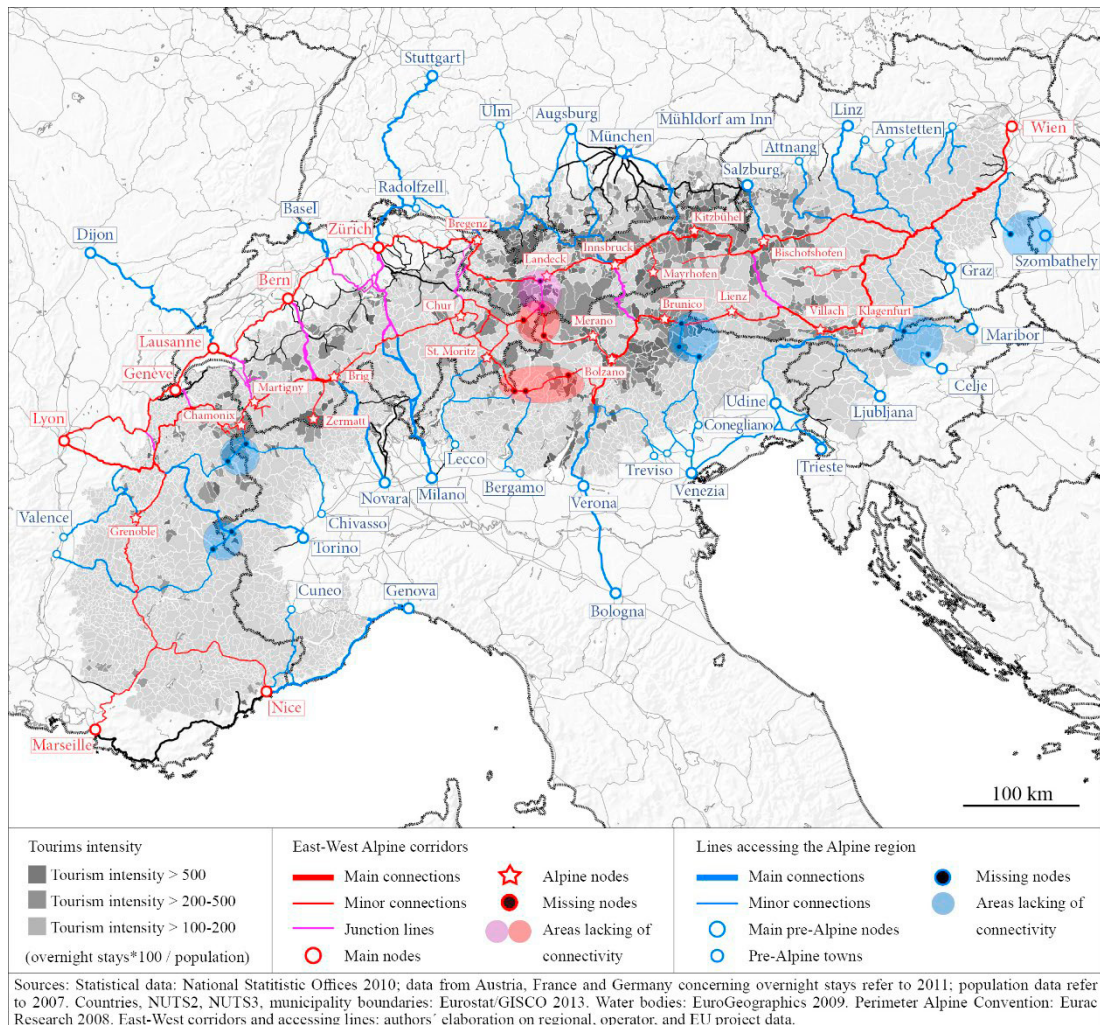
Fig. 3. A unified regional Alpine network through cross-border integration.

From this investigation, two main potentialities arise (signed in red and blue in Fig. 3):

- Improved synergies between Haute-Savoie (FR) and Canton Valais (CH); Canton Grisons (CH) and South Tyrol (IT); and between South Tyrol (IT) and East Tyrol (AT) might generate an East-West connection currently missing, passing through the whole Alpine arc and involving numerous panoramic lines (e.g. the Mont Blanc Express, the Glacier Express, the Venosta valley line and the Semmering railway). Through their systemization, new tourist itineraries might be introduced and side valleys (now reachable exclusively from trans-Alpine corridors) might find new accesses. To this aim, integration of tariffs and information, as well as service harmonization between different operators are needed. In South Tyrol, a recent stakeholder survey operated by the regional transport agency STA has highlighted the potential market reachable by improving connections with Switzerland (STA, 2017); starting from this document, the Autonomous Province of Bolzano is planning to evaluate the replacement of the existing bus service with the extension of the Venosta valley railway line (CIFI, 2016).
- Improved coordination between East-West and North-South lines might enlarge the number of urban areas with PT access to the Alpine region. For example, Italian peri-Alpine towns like Lecco, Bergamo, Brescia,

Conegliano, and Treviso may benefit from such interventions, as well as main (farer) centers like Venice, Bologna, Milan and Novara. The harmonization of East-West and North-South services is crucial, as well as an appealing integration of multimodal services along these routes. The attention reserved by Veneto and South Tyrol to the reopening of the Dolomites railway line is exemplificative in this sense. A feasibility study has calculated costs higher than M€700 to complete the line, which require regional, national and European funds (Alto Adige, 2017). From a tourist perspective, this railway would be relevant, connecting two well-known UNESCO World Heritage sites, such as Venice and Dolomites in about 2 hours (the same time required by car).

The integration of Alpine regional networks through borders can be pursued primarily by holding together available elements through policies of cooperation and secondarily by investing on the development of strategical missing connections. Concerning the former aspect (*holding together available elements*), a key point is the disclosure of tariffs and information oriented to promote this concept and experience the Alps in an alternative way. The long-lived initiative of InterRail can represent a reference. The Alpine space already covers a relevant role in the general InterRail proposal, since several panoramic lines are cited (e.g. the Bernina Express in Switzerland and the Black forest line in South Germany) and the tour "Across the Alps" is cited among the suggested destinations (including Zermatt, Chamonix, Tirano, Innsbruck and St. Moritz). However, this travel concept can be declined with a more specific context and with the integration of tourist-specific elements. To this aim, CIPRA Youth Council and CIPRA International (CIPRA, 2018) have launched the initiative called "Youth Alpine Interrail - Yoalin". This project enables 100 selected young people (between 16 and 27 years old) to travel sustainably across the Alps by means of public transport for 50 Euro for one month in summer 2018. As regards the latter component (*investing on the development of strategical missing connections*), the high costs needed to build new infrastructures in mountainous contexts (which are usually low populated) make large investments hardly feasible. At the same time, assessments on the potential benefits given by such interventions could be considered on the overall Alpine scale, rather than on national or regional basis. However, this theme should deserve a scientific deepening, in order to reach a proper insight. Beside these considerations, new technologies (as automated vehicles) can be interesting opportunities to address low demand routes with flexible services managed without staff costs. The SmartShuttle introduced in Sion (CH) is exemplificative in this sense: potentially it can offer a tailored service for small groups, avoiding waiting times, and proposing an appealing travel, suitable for tourist propose.

6. Conclusions

The systemization of regional lines into an Alpine-wide regional network is a complex concept that needs multidisciplinary studies. They include not only transport issues (e.g. demand potentials and impact of flows), but also other aspects such as analyses of tourist markets, political collaboration needs, economic evaluations on potential investments and benefits and potential environmental consequences. Along with such necessities, this contribute does not claim to give solid argumentations of the suitability of this hypothesis, but rather tries to raise the interest around it. Moreover, it is important to mention that even if the establishment of a unified Alpine PT network would require the improvement of the accessibility, this should not be conceived as a widespread phenomenon. Literature and practical experience highlight the necessity of a balance between development and preservation (Weidenfeld, 2013; AC, 2013), especially for the Alpine environment, where isolation and wilderness are perceived as intrinsic qualities. Some regions have made this aspect a core value to preserve, which fits with niche tourist practices. The Vals valley in Switzerland is a clear example of this approach. It is the secondary extension of the side valley Lumnezia in Grisons, which is accessible from the main Rhine Valley that connects Chur with Andermatt. The Vals valley is renowned as point of interest for specific attractions, as the only thermal source of the Grisons, the Adula Massif and its hiking itineraries, the mineral springs and the sky resort Dachberg that lies between 1250 and 3000 m of altitude (Switzerland, 2018). As for PT, this valley is uniquely served by a bus connection (operated by AutoPostale) that hourly goes through the valley in about one hour. This bus service meets the Rhätische Bahn in Ilanz (25 km from Chur). Other Alpine locations, as the Funes valley in South Tyrol and the Maira valley in Piedmont, are adopting similar approaches, limiting the tourist arrivals to encourage alternative forms of tourism.

In conclusion, the accessibility discussed in this paper means that PT and alternative transport modes have to become a valid alternative to car in order to reach the Alpine region. Even if tourism is a complex issue, which includes several cultural, marketing, economic and natural aspects, the product promoted by each destination cannot avoid considering PT as an attractive service offered to tourists. Along with this necessity, cross-border and inter-regional areas may offer worthy occasions to guarantee an integration of the Alpine PT network.

Acknowledgements

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