D.T 1.4.2 REGIONAL ACTION PLAN

04.2020

Table of Contents

LIST OF FIGURES

LIST OF TABLES

Abbreviation	Full definition
AR	Augmented Reality
ATTAC	Attractive Urban Public Transport for Accessible Cities (project)
BreBeMi	Motorway Brescia – Bergamo - Milano
CNC	Core Network Corridor
D.M.	Decreto Ministeriale (Ministry Decree)
ENAC	Ente Nazionale per l'Aviazione Civile (Civil Aviation National Authority)
FMN	Ferrovie Nord Milano
IRER	Istituto Regionale di Ricerca (Regional Research Institute of Lombardy)
ISTAT	Istituto Nazionale di Statistica
ITS	Intelligent Transport System
LAirA	Landside Airports Accessibility (project)
MaaS	Mobility as a Service
MIT	Ministero delle Infrastrutture e dei Trasporti (Italian Ministry of Infrastructures and Transport)
PRMT	Programma Regionale della Mobilità e dei Trasporti (Transport and Mobility Regional Programme)
RFI	Rete Ferroviaria Italiana (Italian railway infrastructure manager)
SACBO	Società per l'Aeroporto Civile di Bergamo - Orio al Serio
SEA	Società Esercizi Aeroportuali
SUMP	Sustainable Urban Mobility Plan
SWOT	(Analysis of) Strengths, Weaknesses, Opportunities and Threats
TEN-T	Trans European Network-Transport
TPL	Trasporto Pubblico Locale (Local Public Transport)
UIC	Union internationale des chemins de fer

1. Background

The SubNodes project plans to better connect the hinterland of primary TEN-T hubs via secondary transport hubs, so-called sub-nodes. Sub-nodes will act as anchor points for hinterland accessibility and development. The SubNodes project therefore tackles weak intermodal integration of peri-urban hinterland regions to primary TEN-T hubs like the core airports of Malpensa, Linate and Bergamo. Suitable medium-sized cities in these areas shall be developed into attractive intermodal secondary hubs, which better connect the hinterland to the TEN-T rail network. In this context, this paper looks at the SubNodes of Bergamo, Brescia, Como and Varese.

1.1. Cause and Objective

Cause: Hinterland accessibility and regional development

Over the past decades substantial investments into the TEN-T railway network have been realised all across Central Europe. The extension of rail tracks has altered the existing network, resulting in new framework conditions for regional public transport systems. The itinerary and routing of the entire secondary passenger transport system therefore calls for reorganisation – because:

- Public sector actors responsible for the coordination of regional public passenger transport in Central Europe face the common challenge to adapt the regional transport system to the changed infrastructural conditions caused by the upgrade of the TEN-T infrastructure.
- In wide parts of Europe, the intermodal connections between TEN-T hubs and the adjacent peri-urban areas are rather poorly developed. Therefore, in Central Europe still is the need to further develop the secondary public transport network and better connect it with the national and transnational network.
- In many cases, weak intermodal integration between bus and rail characterises the connections to TEN-T hubs especially in the peri-urban hinterland.

In the interaction between urban areas and their hinterland, a need is expected to realise intermodal connections to long-distance transport infrastructure, like high-speed rail, and support sustainable transport modes in a complex environment. According to their needs, intermediate and even rural areas shall be provided with appropriate framework conditions for developing sustainable passenger mobility.

These are important aspects to consider taking into account that the Lombardy Region is characterised by a high per capita income and a substantial level of development of business and industrial activities. These factors lead to a high motorisation rate and high propensity to travel by private car. Nevertheless, considering that the territory of Lombardy is crossed by three TEN-T Core Network Corridors, providing sound and reliable intermodal connections between peri-urban hinterland, the SubNodes and the concerned airports, it would be beneficial to encourage diversion to collective and sustainable transport modes.

Objective: Turning small and medium-sized cities into attractive intermodal transport hubs

SubNodes will enhance the accessibility of peri-urban regions by linking them to the TEN-T nodes via mid-size cities as transport junctions between TEN-nodes and their hinterland. To move towards this aim, the SubNodes project is going to achieve three specific objectives:

- *Establishing intermodal secondary hubs in the hinterland to TEN-T nodes:* Selected medium sized cities shall be upgraded to intermodal nodes, linking intra-regional transport (mostly buses, but also other modes) to the national and TEN-T network.
- *Making intermodal travelling more attractive to canvass new passengers:* Improved connectivity will only succeed if the potential travellers in the region become real passengers of public transport. This will just happen when the general public regards intermodal travelling as attractive and advantageous.
- *Making transport planners and transport plans better respond to passenger needs:* SubNodes targets to enhance the capacity of public transport planners for improving intermodal passenger transport in the peri-urban TEN-T hinterland. This means on the one hand better coordination with a variety of other actors and stakeholders (e.g. from neighbouring regions or adjacent transport associations), on the other hand to gain more experience and knowledge on a scope of transport that is by far less in focus of public and scientific attention than e.g. inner-urban or inter-city transport.

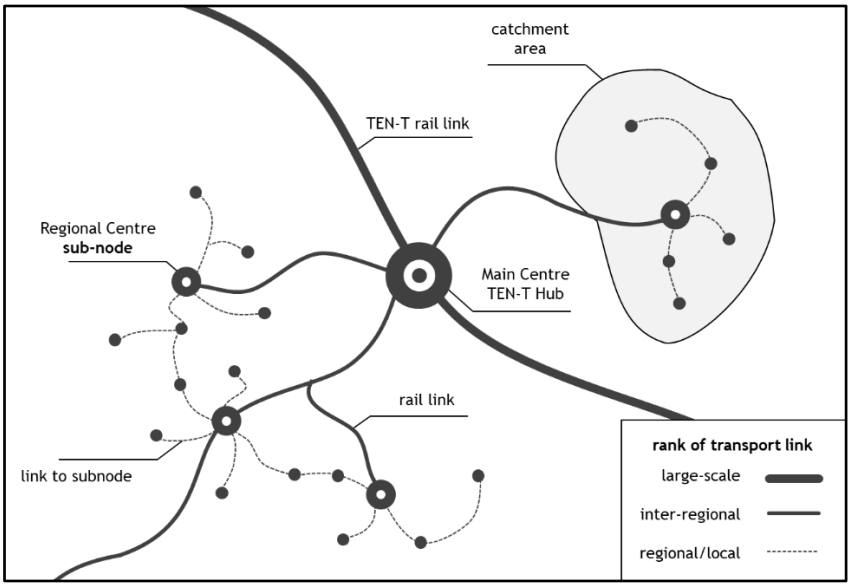
In this respect, the Action Plan should be a means to enhance public planning capacities in order to move towards improved policies on regional public passenger transport with the ultimate goal of changing mobility patterns by providing efficient, coordinated services linking all public transport systems. Building on this, the Action Plan provides specific approaches for future revisions of the respective regional transport plan, namely the Programma Regionale Mobilità e Trasporti (PRMT, henceforth) (Regione Lombardia, 2016).

The suggested actions have been analysed and verified in the light of the current status of the regional public transport system, the SubNodes strategy, the results of the pilot actions and the regional SWOT-analysis. On the basis of the current situation, expected options for intervention and action are given.

1.2. Conceptual basis: SubNodes Strategy

Within the SubNodes project, essential characteristics for small and medium-sized cities to qualify as SubNodes were identified. In general, a sub-node has to be understood as one element in a hierarchical transport network (see Figure 1). It is the access point to the long-distance transport infrastructure. The hierarchical transport network, therefore, is defined as a system of connections, which includes different types of public transport services (local public transport to high-speed rail) and interchange nodes which make the transfer between the different services possible. Coordinated private transport, public transport and alternative transport services including the transfer options constitute the intermodal transport system within a wider network of cities and their hinterland.

Figure 1: SubNodes within a hierarchical transport network



Given the hierarchical transport network, a sub-node has to show the following minimum characteristics.

Node-related criteria	Transport related criteria
is a regional administrative centre	is not part of the TEN-T core network
offers working / shopping opportunities	is directly linked via public transport to a TEN-T-hub
has a minimum size	has sufficient distance from the main-node (30 - 60 min)
has its own catchment area	is a node of an existing public transport-network
features the political will to be a sub-node	

These minimum characteristics serve as criteria to identify all SubNodes within the Lombardy region (see chapter 2.1).

In order for the hierarchical transport network (including the TEN-T node, the SubNode and its catchment area) to work, five quality factors were identified:

1. Ticketing and pricing systems have to be developed according to the different target groups, like commuters, leisure travellers and tourists or occasional passengers.
2. A regional transport association is able to combine different transport services under one roof, with one unique ticketing system and a transport network beyond the administrative borders of the regions. A regional transport association helps people to understand the all too often fragmented chain from origin to destination as one connection without further hassle about ticketing or schedule issues at system boundaries. Transport associations are able to manage and schedule interchange possibilities from bus to train and other modes of transport across transport operators – they are therefore a key element in organising intermodal transport hubs.
3. The local transport network and service must not only meet needs of the users according to their mobility patterns and commuter flows – this is a demand-driven approach to public transport planning. Public passenger transport could also be improved, when the network design is subject to a supply-directed approach. This implies that a public transport service not only responds to a

certain demand but also makes more competitive offers by improving the connectivity of the network by either establishing new or improving existing connections.

4. The definition of intermodal transport includes more than just an intersection of bus and rail service. Particularly in rural areas – where the distances between bus or rail stops are widely spaced in contrast to urban areas – the access way to a stop could be comparatively long. Long access ways to bus or rail stops are considered as one of the key elements that prevent people to use public transport by an otherwise relatively good service. Simply improving the service by increasing the frequency or adjusting the ticketing system, might not necessarily achieve the desired effect to increase the number of passengers. In an intermodal transport chain, passengers can use their bikes to cover the distance between their home and a bus stop. And if a carriage of bicycles even along short journeys is possible, the passengers are more flexible at the destination in terms of their mobility. Therefore, intermodal public transport considers possibilities that cycling offers in either upgrading bus stops with sufficient bicycle parking facility or the carriage of bicycles in buses or trains.

5. With the rise of instant information and mobile communication technology, the expectations of passengers to get informed during disruptions or along a journey are significantly higher as in the decades before smartphones have become widely spread. Pre-journey, as well as on-journey real time information, is standard by now for long-distance public transport and in most major cities with a complex transport system. Therefore, passengers do not only appreciate additional information before or during their journey, but they also expect comprehensive information especially during disruptions or delays. Along with an intermodal transport chain with interchanges between local and long-distance transport services, real-time information and information about journey alternatives with a clear focus on passengers' needs could significantly improve the service and achieve customer satisfaction.

Based on these five quality factors or respectively prerequisites for successful hierarchical public transport networks, the identified regional SubNodes and the regional transport network is being assessed (see chapter 2.2). This assessment lays ground for the regional SWOT analysis (see chapter 2.3).

2. Status quo

This chapter presents the status quo of the regional SubNodes and they are analysed with respect to a number of relevant characteristics.

Section 2.1 introduced to the Subnodes illustrating the main socio-economic characteristics and indicators, providing figures for both SubNodes and respective catchment areas. Section 2.2 presents a brief overview of the transport context which is developed taking into account the infrastructure endowment, the demand of mobility, the supply of collective transport services. This section is complemented by the description of airports' passenger demand and characteristics of the users according to past surveys carried out. The final section 2.3 presents the SWOT analysis conducted on the basis of the previous data and information and conducted to inform the following chapter of the action plan on the regional strategy.

2.1. Identification of regional subnodes

The population of Lombardy consists of around 10 million inhabitants and generates an overall income of € 164 billion. As part of the regional socio-economic context, the SubNodes and respective catchment areas are important urban agglomerations, if one excludes the metropolitan area of Milano.

The total population of the concerned areas consists of around 1.6 million inhabitants, of which nearly 0.5 million are residents in the SubNodes and 1.1 million live in the catchment areas. All in all, Brescia gathers the largest population (i.e., 0.61 million), followed by Bergamo (i.e., 0.42 million), Como (i.e., 0.29 million) and Varese (i.e., 0.25 million). As far as the total income is concerned, the four SubNodes generate 14.8% of the total at regional level. As noted for the population, Brescia generates the highest income share (i.e., 5.6%), followed by Bergamo (i.e., 4.2%), Como (i.e., 2.7%) and Varese (i.e., 2.3%).

Interestingly, the income per capita is found higher than the regional average for all SubNodes and lower for the catchment areas. Bergamo shows the highest per capita income for both SubNode and catchment area. For all SubNodes, the observed unemployment rate in 2018 is found lower with respect to the same data in 2016 and the largest reductions are found for Bergamo and Varese.

Finally, the largest share of the production is generated by service-related activities. This holds true for all the SubNodes, although one can observe that the share of the services is higher for Como and Varese, but in any case, below the regional average (i.e., 61% and 62% respectively, against 65%). The industrial sector is more important for the SubNodes of Bergamo and Brescia and found relatively higher compared to the regional average (i.e., 43% and 41% respectively, against 33%).

The figures discussed throughout the paragraphs above are gathered in Table 1.

Table 1: Socio-economic context

Indicator	SubNode				Lombardy
	Bergamo	Brescia	Como	Varese	
SubNode inhabitants	119,381	196,480	84,495	80,799	10,008,349
Catchment area inhabitants	296,743	416,284	203,402	174,013	10,008,349
SubNode total income [million €]	2,373	3,262	1,391	1,407	164,344
Catchment area total income [million €]	4,573	5,900	3,085	2,320	164,344
SubNode income per-capita [€]	19,873	16,468	16,600	17,413	16,420
Catchment area income per capita [€]	15,411	14,152	15,244	13,500	16,420
Unemployment rate (2016)	8.60%	5.30%	7.40%	8.20%	7.40%
Unemployment rate (2018)	5.20%	4.90%	7.30%	5.90%	6.00%
Share of productive sectors (2011)					
Industry	43%	41%	37%	37%	33%
Agriculture	2%	3%	2%	1%	2%
Services	55%	56%	61%	62%	65%

Source: Elaboration of the authors on data of ISTAT (2011, 2016 and 2018)

2.2. Assessment of regional subnodes and regional transport network

2.2.1. Infrastructures endowment

The territory of the Lombardy Region is crossed by three Core Network Corridors (CNC) identified by the Regulation (EU) No 1315/2013 as part of the trans-European transport network (TEN-T). They are the Rhine-Alpine corridor, the Scandinavian-Mediterranean corridor and Mediterranean corridor (European Commission, 2013).

While the Rhine-Alpine corridor crosses the Lombardy Region from south to north passing through the SubNodes of Como and Varese, the alignment of the Mediterranean corridor runs from east to west and intersects the SubNodes of Bergamo and Brescia. For the Scandinavian-Mediterranean corridor there is no particular relevance for the SubNodes, because its alignment extends on the eastern side of the Region. In the TEN-T transport context, Malpensa, Linate and Orio al Serio are Core airports of the urban node of Milano[1] and this definition implies that they are of the highest strategic importance for achieving the objectives of the TEN-T policy.

With respect to infrastructures endowment, the length of the road network of SubNodes' provinces consist of around 40% of the total for each category (i.e., motorway, main and secondary) (see Table 2). Interestingly, for both road and rail infrastructures, the SubNode of Brescia owns the highest shares for all road categories, railway line and number of rail stations.

[1] See Annex II of Regulation (EU) No 1315/2013.

Table 2: Transport context – Infrastructures endowment

Indicator	SubNode				Lombardy
	Bergamo	Brescia	Como	Varese	
Length of the motorway network [km]	58	129	35	62	723
Length of the main road network [km]	1	1.831	663	850	11,675
Length of the secondary road network [km]	1,793	3,553	1,104	1,337	20,186
Length of the railway lines [km]	116	242	102	207	1,920
Stations	20	56	39	49	428

Source: Elaboration of the authors on data of Regione Lombardia[2] and ISTAT (2018)

2.2.2. Private mobility

The descriptive indicators gathered in Table 3 present users' propensity to private mobility. Overall, the SubNodes and the catchment areas gather around 1 million of private cars. The largest share is found for Brescia (i.e., 38.1%), followed by Bergamo (i.e., 25.5%), Como (i.e., 19.3%) and Varese (i.e., 17.1%). The motorisation rate of both SubNodes and catchment areas of Bergamo and Brescia is found in line with the average at regional level (i.e., 0.61). The catchment areas of Como and Varese show the highest values (i.e., 0.67 and 0.68, respectively).

Table 3: Transport context – Private mobility

Indicator	SubNode				Lombardy
	Bergamo	Brescia	Como	Varese	
SubNode number of cars	73,309	120,310	52,722	52,451	6,145,609
Catchment area number of cars	182,432	260,883	140,473	118,975	6,145,609
SubNode motorisation rate [cars/inhab.]	0.61	0.61	0.63	0.65	0.61
Catchment area motorisation rate [cars/inhab.]	0.61	0.63	0.67	0.68	0.61

Source: Elaboration of the authors on data of Autoritratto ACI (2018)[3] and ISTAT (2018)

In general, the demand of mobility is relatively high being the number of trips between 0.74 and 0.93 (for an average working day, in 2016). Not surprisingly, the direction of the trips is quite unbalanced. The SubNodes act more as attractive nodes for the catchment areas, because 18-22% of the trips generated from the catchment areas are bounded for the SubNodes. In the opposite direction, 12-14% of the trips originated from the SubNode are bounded for the catchment areas, with the exception of Varese, where the share is the lowest observed and equal to 8% (see Table 4).

[2] Available at geoportale.regione.lombardia.it/ page "Infrastrutture in Lombardia". See www.regione.lombardia.it

[3] See http://www.aci.it/laci/studi-e-ricerche/dati-e-statistiche/autoritratto/autoritratto-2018.html

Table 4: Demand of mobility by SubNode

Indicator	SubNode			
	Bergamo	Brescia	Como	Varese
Average number of trips of the catchment area	0.89	0.92	0.74	0.93
Trips generated by the catchment area	263,230	384,527	149,776	161,391
Trips generated by the catchment area and bounded for the SubNode	47,583	86,061	33,117	30,639
Share of trips generated by the catchment area and bounded for the SubNode	18%	22%	22%	19%
Trips generated by the SubNode	120,201	187,173	78,288	90,743
Trips generated by the SubNode and bounded for the catchment area	16,711	26,815	10,441	7,391
Share of the trips generated by the SubNode and bounded for the catchment area	12%	14%	13%	8%

Source: Elaborations of the authors based on data of Lombardy Origin-Destination matrix (2014) and ISTAT (2016)

2.2.3. Collective transport services

Road transport

The bulk of road collective services is operated by coaches linking the Central station of Milano to Malpensa, Linate and Orio al Serio.

For Malpensa, three companies operate 148 runs daily from Milano Central station. The services are operated by each company every 20 minutes during day time and every 30 minutes during evening and night time, which means that one run is operated approximately every 7 minutes on average[4].

Other services are operated from Fiera di Milano and Rho according to scheduled events at fair premises. Two companies operate these services, providing hourly runs bounded for Fiera di Milano in the morning and likewise for Malpensa in the afternoon, until 7:30 pm. Direct links are operated between Malpensa and (i) Linate with 5 runs daily and (ii) Orio al Serio with 7 runs daily during week days (with stops in Monza and Bergamo).

For Orio al Serio, 3 companies operate 149 runs on a daily basis from Milano Central station. Eventually, for Linate, other two services are operated from the Central station, with stops at Dateo and Lambrate railway stations (every 30 minutes between 5:30 am and 11:30 pm).

As regards urban bus lines, the services are operated between the city centre of Milano and Linate and between Bergamo central station and Orio al Serio, respectively. For Milano, the bus line 73 operates between the terminus close to Duomo square and Linate around every 10 minutes (from 5:00 am to midnight)[5]. For Bergamo, the bus line 1 “Airport bus” operates 60 runs daily.

The programmes of the concerned basin transport authorities can provide some additional information on collective road services.

[4] Assuming a capacity of 55 seats per coach and that the services are operated every day of the year, the total capacity of the services provided is equal to 2.98 million seats per year.

[5] A number of runs also extend the service to San Felicino in Peschiera Borromeo.

The programme of the basin authority of Brescia (Agenzia del TPL di Brescia, 2018) reports that since 2016 the services of regional competence are limited between Brescia and Orio al Serio[6]. Furthermore, the line between Sesto San Giovanni and Ponte di Legno/Passo del Tonale, with transit at Orio al Serio, is operated twice daily and three runs are on Friday. The programme also envisages the possibility to move its terminus at the airport and that the extension to Sesto San Giovanni could be operated in form of concession granted to a private operator, but without public contribution.

The basin authority of Como, Lecco and Varese reports two lines for Malpensa, namely Gallarate - Malpensa - Calselnovate and Somma Lombardo - Maddalena - Casenuove - Malpensa - Castelnovate[7] (Agenzia del Trasporto Pubblico Locale Como Lecco Varese, 2018).

Other services are operated from Como and Varese. One major low-cost coach operator links Como and Malpensa (once per day and four days per week)[8] and one shuttle line links Varese and Malpensa (twice a day)[9].

Passenger demand concentrates on coach services between Milano Central station and Malpensa and Orio al Serio. For the years from 2014 to 2018, the observed volume shows a relatively constant pace of growth, from 2.0 to 2.8 million passengers for the services connecting both the airports. The observed volume is found higher for Orio al Serio, for four out of five years for which the information is available. Likewise, the estimated load factor is found higher for the services operated to Orio al Serio. Table 5 summarises the observed volumes of passengers and Figure 2 presents the estimated load factor.

The demand of collective services by coach between the SubNodes and Malpensa and Orio al Serio (i.e., Orio al Serio - Brescia and Bergamo - Orio al Serio - Malpensa) has been growing over the past years, but it is also found substantially smaller compared to that of the services operated from Milano. The service between Orio al Serio and Brescia is relatively unchanged. Interestingly, the line operated between Orio al Serio and Malpensa has been growing and nearly doubled the number of passengers between 2014 and 2018. Although increasing, the estimated load factor is found low, or very low. There is not information available for the service operated between Brescia and Malpensa[10].

Table 5: Observed volume of passengers of coach services

Service	2014	2015	2016	2017	2018
Milano Centrale - Malpensa	1.968.491	2.150.379	2.266.796	2.520.034	2.768.834
Milano Centrale - Orio al Serio	1.841.071	2.423.549	2.521.598	2.896.932	2.819.820
Orio al Serio - Brescia	80.676	87.653	87.814	82.189	91.923
Bergamo - Orio - Malpensa	34.824	41.674	42.016	46.272	60.393

Source: Elaboration of the authors on data of Regione Lombardia

[6] According to timetable of the operator 11 daily pairs are operated (journey time 1 hour, but not regularly scheduled, between 4:30 am and 10:30 pm and intermediate stop at Franciacorta outlet upon request). See www.autostradale.it.

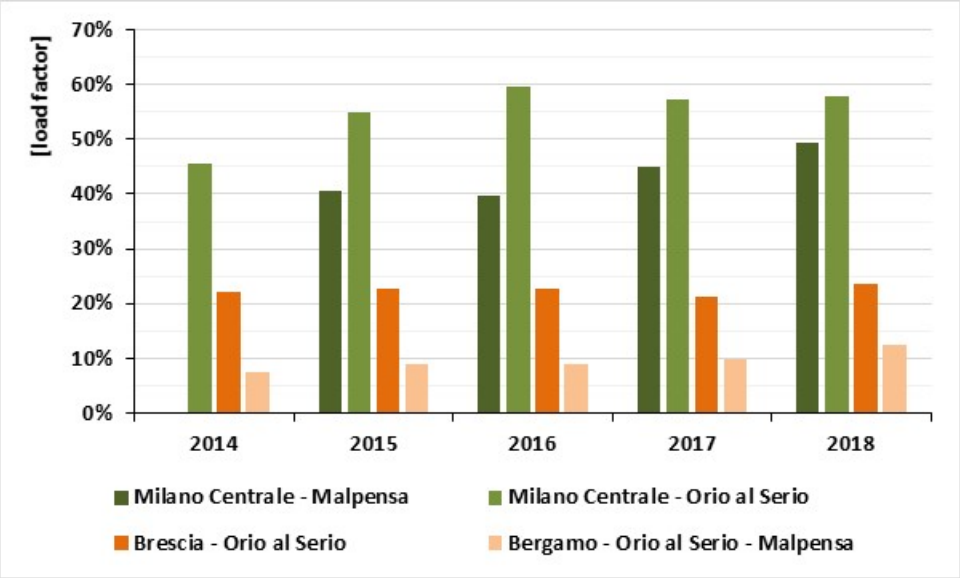
[7] The lines are classified as tertiary type, namely having an optimal frequency of less than one service per hour. Scheduled travel time are between 19 and 25 and between 10 and 15 minutes, respectively.

[8] On Monday, Thursday, Saturday and Sunday. Travel time 55 minutes.

[9] The shuttle must be booked at least 2 days in advance. Travel time 30 and 40 minutes for Terminal 1 and Terminal 2, respectively.

[10] For this service 4 shuttle runs per day are operated. From Monday to Friday, the shuttle must be booked at least 2 days in advance. On Sunday and holidays, a price quotation for the service is provided upon request. Travel time 1 hour and 35 minutes.

Figure 2: Estimated load factor of passenger coach services



Source: Elaboration of the authors on data of Regione Lombardia

Rail transport

Rail services "Malpensa Express" are operated from Milano Central station and Cadorna FNM station. The service from Cadorna FNM station operates 78 daily pairs between 4:20am and 00:20am and with a scheduled journey time of 43 minutes. The service from the Central station operates 68 daily pairs between 5:25am and 23:25pm and with a scheduled journey time of 57 minutes.

In addition, the suburban rail service S50 links Malpensa with Varese and Mendrisio (every 2 hours) and it is also possible to reach Como (with one change in Mendrisio station) with line S40[11]. It is also worth reminding that from Como Lago station Malpensa can be currently reached with one change in Saronno[12].

Orio al Serio is not yet connected with the railway network[13]. However, the regional rail services from Milano Central station allow to reach Bergamo Central station every 30 minutes, either with a direct service or with one change in Treviglio.

2.2.4. Airports passenger demand and characteristics

The airports passenger volumes and trends are shown in Figure 3. They are based on (i) the annual statistics of Assoeroporti for the period from 2009 to 2018 and (ii) the forecasts provided by the Italian national airports plan until 2030 (MIT and ENAC, 2012).

- For Malpensa the trend of passengers is found positive for the period 2009-2018, although rather fluctuating through time. The available data for 2018 indicates around 25 million passengers, which is relatively in line with the future evolution envisaged by the national airports plan.

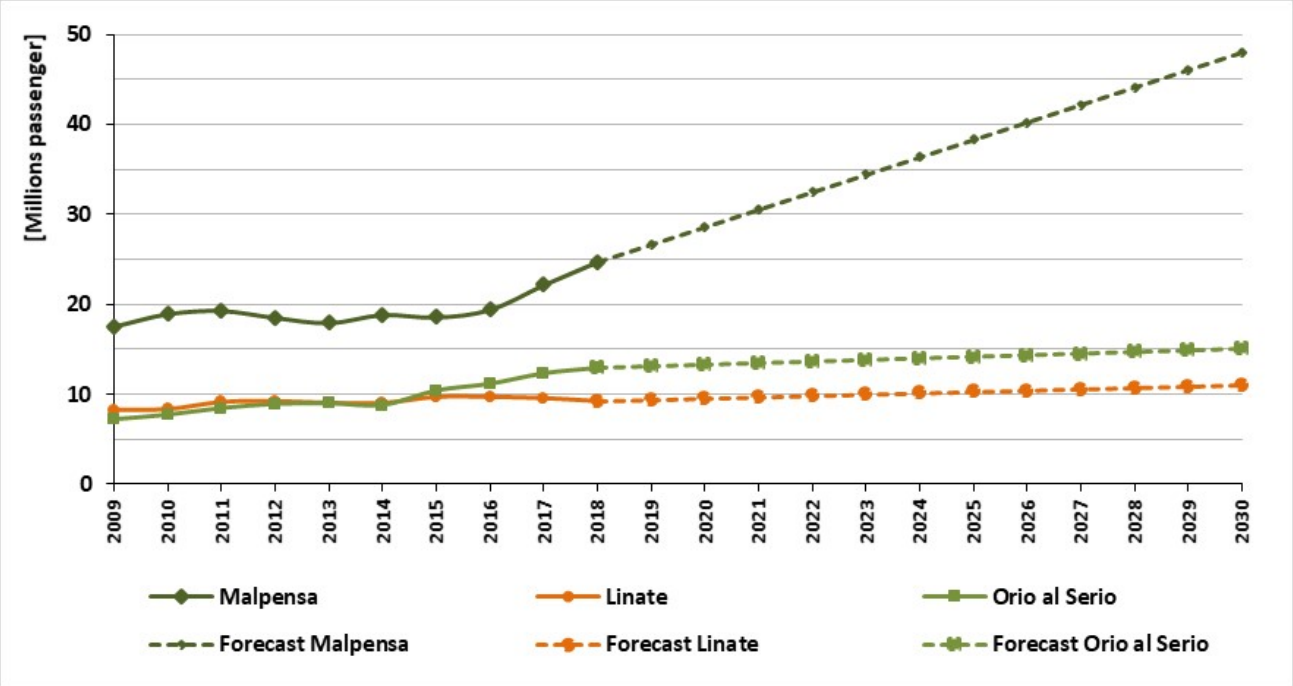
[11] Journey times to Malpensa Terminal 1 are 41 minutes from Varese, 68 minutes from Mendrisio and 91 minutes from Como, respectively.

[12] For this combination of services (i.e., Regional and Malpensa Express) the journey time is 78 minutes.

[13] In this respect, see also chapter 3 of the document.

- For Linate the demand has been reducing since 2015 and the forecasts are more conservative. This situation should be read in the light of the limitations in enforce by law to the actual number of movements and destinations served[14].
- For Orio al Serio the trend shows a stable increase for the period considered and the observed volume of passengers is in line with the forecasts of the national airports plan.

Figure 3: Observed and future volumes and trends of the air passengers by airport



Source: Elaboration of the authors based on data of Assoaeroporti[15] and MIT and ENAC (2012)

SubNodes air transport demand and characteristics – Malpensa and Linate

An overview of the modal split at Malpensa and Linate airports can be found in reports and surveys. In particular, past information is available from reports ((IRER, 2009), (IRER, 2010a) and (IRER, 2010b)) and more recent data is available from the survey carried out in 2016 by the airport manager.
Not surprisingly, the private car is the dominant transport mode for passengers travelling at both airports.

For Malpensa, the modal split of the private car is found unchanged when comparing the data of 2009 and 2016 (i.e., 69%)[16]. The modal share of collective transport has changed through time, being the percentage of rail services increased from 13% to 17% and inducing a corresponding decrease of road collective services.

According to data of the latest survey, it is worth noting the difference existing between the terminals of the airport. Notably, the modal share of the services provided by coaches is found slightly higher at Terminal 2 compared to rail mode and vice versa for Terminal 1. This could be explained considering that travelling by coach from Milano (i) Terminal 2 is the closest stop and (ii) the cheaper price of the ticket. The perceived cost of the journey can be an important aspect for users travelling from Terminal 2, being the operating

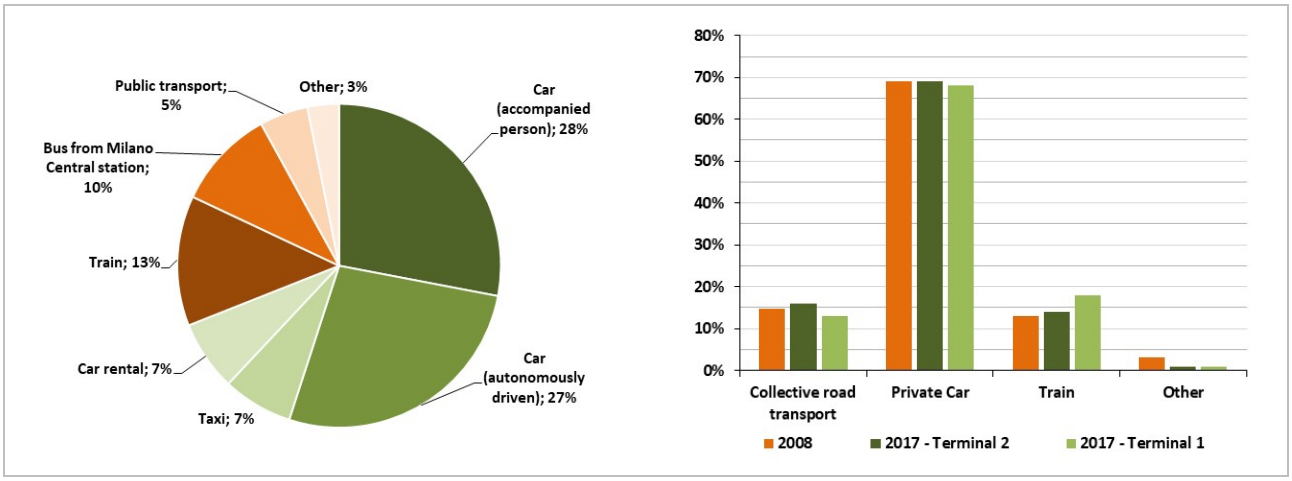
[14] The maximum number of movements is limited at 18 per hour and flights can be operated connecting only capital cities of other Member States (see D.M. 3 marzo 2000, D.M. 5 gennaio 2001 and D.M. 1 ottobre 2014).

[15] Available at https://assaeroporti.com/statistiche/.

[16] The data on the modal split of the private car in 2009 can be further disaggregated as follows: accompanied passenger 28%, driver 27%, taxi 7% and rental car 7%.

base of a major European important low-cost airline. Figure 4 shows the modal split at Malpensa airport comparing figures of 2008 and 2017.

Figure 4: Modal split at Malpensa airport and comparison between 2008 and 2017



Source: Elaboration on data of SEA (2017) and (IRER, 2009)

For Linate, the information on the modal split is available from surveys carried out by the airport manager. In particular, the latest data of 2017 indicates a modal share of 67% for the private mode and 32% for the collective modes[17], respectively.

The traffic study developed for the 2015-2030 airport masterplan (Vescia, 2016) provides an estimation of the impact of the new metro line M4 on the modal split. Comparing model outputs of scenarios developed at 2016 and assuming the Sustainable Urban Mobility Plan (SUMP) implemented, the envisaged modal shift from private to public transport could be around 10%.

As regards the origin of the journeys to access to Malpensa and Linate, the data of passengers' survey carried out in 2016 allows to draw a comprehensive picture of the mobility of SubNodes and catchment areas. Table 6 summarises the results of the elaborations.

Table 6: Percentage of passengers by origin (SubNode and catchment area) and airport

Origin	Linate		Malpensa Terminal 1		Malpensa Terminal 2	
	SubNode	Catchment	SubNode	Catchment	SubNode	Catchment
Bergamo	1.7%	1.6%	1.7%	0.8%	0.6%	0.3%
Brescia	1.3%	1.2%	2.0%	0.7%	0.5%	0.5%
Como	1.6%	1.1%	2.1%	1.8%	2.0%	2.3%
Varese	0.6%	1.5%	1.9%	9.9%	3.1%	12.9%
Milano	63.3%		41.5%		44.1%	
Other	26.3%		37.7%		33.6%	
Total	**100.0%**		**100.0%**		**100.0%**	

Source: Elaboration of the authors on data of SEA (2016)

[17] It is worth noting the difference between the data of 2016 and 2017 for the road mode (i.e., +13%). More information would be necessary to investigate this aspect. The new position of the terminus of line 73 close to Duomo (with respect to the previous at San Babila metro station) does not provide sufficient evidence for sound conclusions. Car sharing service has been introduced even before, in 2014.

For Malpensa, overall, the terminals attract more than 20% of the passengers originated by the SubNodes and catchment areas. Interestingly, they show some diversity regarding the degree of attractiveness of the origins. As far as Bergamo, Brescia, and Como are concerned, the SubNodes generate more travels to Terminal 1 compared to their catchment area. As regards Terminal 2, this holds true for Bergamo and Brescia, but with smaller shares and differences between SubNode and catchment area. Como shows figures relatively comparable to the previous two cities, although a different level of attractiveness emerges between SubNode and catchment area looking at the terminals. For Varese, the closer distance to the airport becomes relevant, especially for its catchment area, which shows percentages around 10% for Terminal 1 and 13% for Terminal 2, respectively.

For Linate, the total percentage originated from SubNodes and catchment areas is found equal to 10.4% and considering the previously noted substantial share originated by the city, the finding confirms its role of "city airport". No specific differences are found for the shares of the SubNodes, as they are in the interval between 0.6% and 1.7%. With the exception of Varese, the other SubNodes generate slightly more travels compared to their catchment areas.

SubNodes air transport demand and characteristics – Orio al Serio

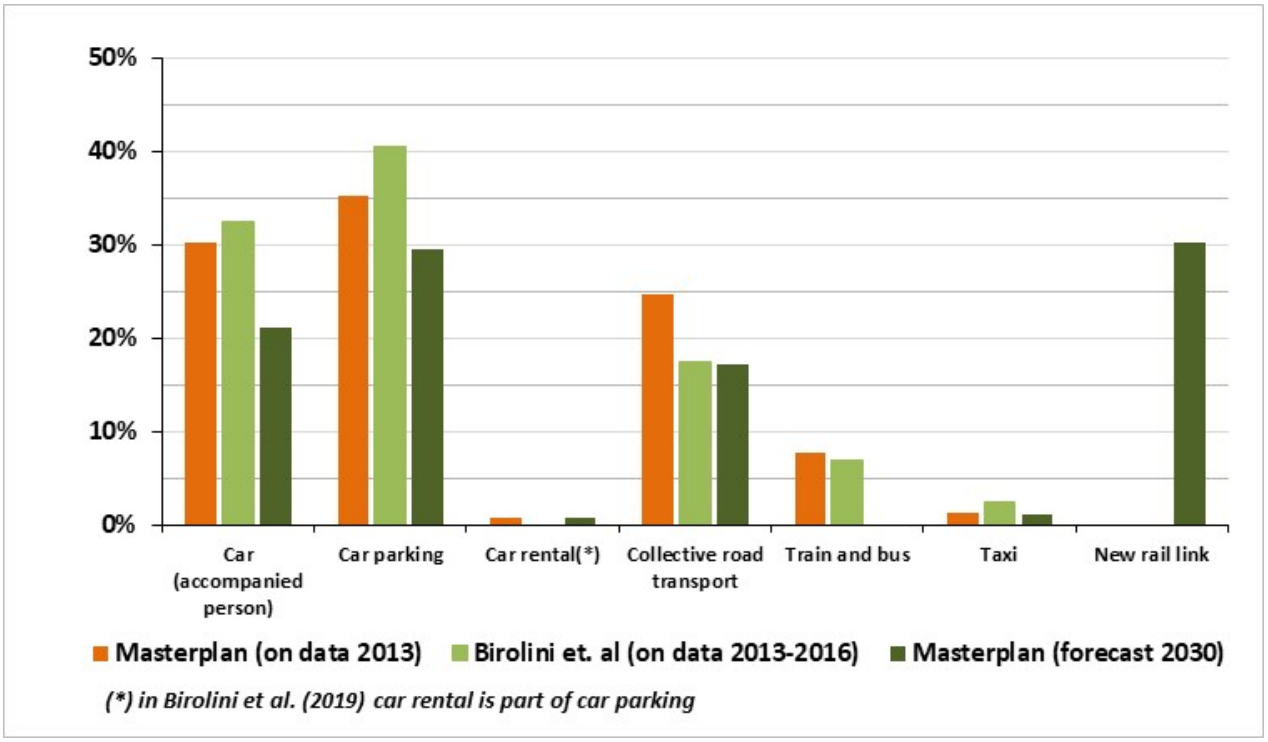
Information on the modal split to access to Orio al Serio is available from the airport's masterplan (SACBO, 2016) and more recent data available from the survey carried out by the airport manager on a sample of users.

The private mode was dominant in 2013, being nearly 68% of the users found travelling by private car, 25% by coach and 8% by bus. The data of the recent survey conducted at the airport indicates that the situation has slightly changed. The preferred transport mode is still the private car, namely 63% of the total, some 28% of the passengers travel by coach, 5% change train and urban bus at Bergamo Central station and 4% use other modes.

In view of implementing a new rail link between Bergamo Central station and the airport terminal, the research paper developed on this specific project (Birolini, et al., 2019) presents an estimation of its effect on the modal split. The authors found that the new rail link could attract some 30% of the total demand. Net of the closure of the bus line from the Central Station, around 20% of the users could be diverted from the road mode, either as accompanied persons or drivers leaving their own cars parked at the airport.

Figure 5 compares the modal spit of the research paper at 2013-2016 and 2030 with the observed data at 2013 of the airport masterplan.

Figure 5: Modal split at Bergamo airport and comparison of data of masterplan and forecasts



Source: Elaborations of the authors on data of SACBO (2016) and Birolini et al. (2019)

The analysis of the travels originated by SubNodes and catchment areas is based on the latest available data from the survey carried out by the airport manager. Not surprisingly, a substantial share of passengers originates from the SubNode and catchment area of Bergamo (i.e., 27.5%), followed by the area of Brescia (i.e., 5.2%). Como and Varese together represent a mere 1.3% of the total, basically due to the distance from Bergamo and the proximity to Malpensa airport. Table 7 presents the outcomes of the elaborations.

Table 7: Percentage of passengers per origin, subdivided in SubNode and catchment area

Origin	SubNode	Catchment
Bergamo	21.2%	6.3%
Brescia	4.9%	0.3%
Como	0.8%	0.1%
Varese	0.3%	0.1%
Milano	23.7%	
Others	42.4%	
Total	**100.0%**	

Source: Elaboration of the authors on data of SACBO (2018)

2.3. SWOT

In this section the main findings emerged analysing the status quo are summarised and organised in form of a SWOT analysis. The goal is to elaborate the amount of qualitative and quantitative information gathered throughout the process in view to identify prospective measures that could improve connection services and accessibility of SubNodes and catchment areas to the three airports considered.

This chapter is organised as follows. Section 2.3.1 briefly introduces and explains what a SWOT analysis is and its rationale. Section 2.3.2 develops the SWOT analysis with respect to each SubNode throughout dedicated subsections.

2.3.1. Approach to the SWOT analysis

Broadly speaking, a SWOT analysis (i.e., Strengths, Weaknesses, Opportunities and Threats) is a strategy analysis tool[18]. It combines the study of the strengths and weaknesses of a concerned area with the study of the opportunities and threats to their environment. As such, it is instrumental in development strategy formulation. The aim of the SWOT analysis is to take into account internal and external factors, maximising the potential of strengths and opportunities, while minimising the impact of weaknesses and threats.

The SWOT analysis is normally used to identify possible strategic approaches. Although originally designed for planning, this tool is used in evaluation to ensure a certain strategy fits with the situation described in the analysis. As such, it can be used for ex-ante evaluations, in order to determine or check strategic approaches.

The rationale of the SWOT analysis is summarised in Table 8.

Table 8: Rationale of the SWOT analysis

Factor	Positive aspect	Negative aspect
Internal	Strengths	Weaknesses
External	Opportunities	Threats

Source: elaboration of the authors on European Commission guidelines on SWOT analysis

When the object of the SWOT analysis is a specific sector, which in this application is transport planning, every action carried out in this sector constitutes an internal factor and the rest represent external factors. For this exercise, the four components will be treated and studied as follows:

- Strengths are positive internal aspects that under control and which provide foundations for future developments.
- Weaknesses are negative internal aspects under control and for which key improvements can be made.
- Opportunities are external positive aspects that can take some advantages of internal strengths and weaknesses. Opportunities may be beyond the influence of decision makers, or at the margins (e.g., change of users' behaviour, growth of the economy, high propensity to technology developments, etc.).

[18] See also European Commission guidelines on SWOT analysis.

- Threats are difficulties, impediments, or external aspects which can prevent future developments. Akin to opportunities, threats may be beyond the influence of decision makers, or at the margin (e.g., inflation, downturn of the economy, scarce propensity to technology developments, etc.).

Finally, the SWOT analysis is developed mindful of the advantages and limitations summarised in Table 9.

Table 9: Advantages and limitations of the SWOT analysis

SWOT aspect	Description
Advantages	▪ It quickly underlines the adequacy (or inadequacy) of a strategy, in relation to the problems and issues under consideration. ▪ In ex-ante evaluation, it supports decision-making and incorporation of the strategic approaches within the evaluation.
Limitations	▪ Even when the tool is well-conceived, it remains subjective and general consensus should be sought prior to the analysis completion. ▪ Distinguishing between internal and external factors may sometimes be challenging. ▪ Similar to all tools that result in a matrix, SWOT analysis is reputed to be to some extent simplistic in its approach.

Source: elaboration of the authors on European Commission guidelines on SWOT analysis

2.3.2. The SWOT analysis with respect to the four SubNodes

The tables throughout the following sub-sections present the SWOT analysis developed for each SubNode. In analysing the points of Strengths, Weaknesses as well as Opportunities and Threats the following dimensions have been considered in order to develop a uniform evaluation of the current situation:

- Socio-economic characteristics to take account of key drivers that can generally influence transport demand of passengers and freight (i.e., population, income per capita, unemployment rate, industrial and production activities, etc.);
- Transport infrastructures and services to consider the offer, in terms of possibility to travel and accessibility to SubNodes, catchment areas and airports;
- Governance and planning to include the dimension of the decision-making process and influence of the decisions of public and private stakeholders in the context of analysis.

SWOT analysis of Bergamo SubNode

STRENGHTS	WEAKNESSES
▪ High per capita income ▪ Low unemployment rate ▪ Widely extended and high density of the road network ▪ Presence of many relevant companies, industrial activities and business opportunity ▪ Important environmental and landscape heritage ▪ Substantial importance of the tourism industry. Also considering low cost flights at Bergamo airport and the volume of passengers from origins abroad travelling for vacation or tourism ▪ Existence of two different direct rail link between the SubNode and Milano ▪ Operating tramway system connecting the SubNode to northern catchment area ▪ Efficient intermodal connections between railway, tramways and bus services, connecting the SubNode with its catchment area ▪ Availability of innovative mobility services in the SubNode (bike sharing and car sharing) ▪ Proximity to Mediterranean and Rhine-Alpine CNCs	▪ Relatively peripheral geographical position with respect to Malpensa airport ▪ Volume of passengers travelling for vacation or tourism purposes can fluctuate depending on actual economic conditions ▪ High motorisation rate and propensity to car use ▪ Increase of urban sprawl (e.g., ill-conceived real estate and commercial development plans) ▪ Road transport main mode the access to Orio al Serio airport ▪ Lack of a direct railway link from **S**ub**N**ode to Orio al Serio airport ▪ Insufficient connections to Linate and Malpensa airports ▪ Increase of road congestion, in turn influencing the reliability collective urban transport by bus operated between Bergamo station and Orio al Serio airport ▪ Need to connect to the transport network to Mediterranean and Rhine-Alpine CNCs
OPPORTUNITIES	THREATS
▪ More efficient use of railway system, for example introducing suburban services around Bergamo ▪ Extension of tramway network towards north (e.g. “Val Brembana” and “Val Seriana”) and south (e.g., Dalmine and Cologno al Serio) in order to diminish average travel time in the catchment area; ▪ New railway link from Bergamo rail station to Orio al Serio airport ▪ Infrastructural improvements of railway network will create new links and reduce travel time ▪ Potential future increase of passengers to Orio al Serio (according to airport masterplan forecast) ▪ Current level of road congestion making private car not advantageous with respect to public transport	▪ Reduction of road congestion level due to network development, in turn making private car even more advantageous with respect to public transport ▪ Delays and cost overruns in building planned infrastructures ▪ Difficulties in finding extra funding resources to develop new infrastructures and services ▪ Poor strategical planning involving public administrations at different levels (local, regional and national) and private sector ▪ Obsolescence of existing infrastructures (e.g. San Michele bridge[19])

Source: elaboration of the authors

[19] Recently reopened to road vehicles. For rail, the services are expected to be operating in November 2020 (RFI, 2019).

SWOT analysis of Brescia SubNode

STRENGHTS	WEAKNESSES
▪ Higher number of inhabitants in the SubNode and in the catchment area compared to other the SubNode ▪ High per capita income ▪ Low unemployment rate ▪ Presence of many relevant companies, industrial activities and business opportunity ▪ Important environmental and landscape heritage ▪ Tourism industry ▪ Widely extended road network, also including two motorways (e.g., A4 and BreBeMi); ▪ Automatic metro line ▪ Local railway line Brescia – Iseo - Edolo ▪ Efficient connections between railways, automatic metro line and bus services, connecting Brescia with its catchment area ▪ Innovative mobility services (e.g., bike sharing and car sharing) ▪ Alignment on Mediterranean CNC	▪ Peripheral geographical position with respect to Malpensa, Linate and Orio al Serio airports ▪ Lack of public transport connections to Linate and Malpensa airports ▪ High motorisation rate and propensity to car use ▪ Increase of urban sprawl (e.g., ill-conceived real estate and commercial development plans)
OPPORTUNITIES	THREATS
▪ Presence of high-speed railway line ▪ Presence of the automatic metro line, which can allow to reorganise Brescia mobility and create an efficient passengers' hubs; ▪ Extension of the automatic metro line towards the catchment area; ▪ Railway infrastructure improvements could reduce travel time (i.e., high-speed line Brescia-Verona) ▪ Orio al Serio airport link improvement due to passengers increase ▪ Brescia Rail-Road Terminal ▪ Current level of road congestion making private car not advantageous with respect to public transport	▪ Reduction of road congestion level due to network development, in turn making private car even more advantageous with respect to public transport (i.e., new road connection SP19 and new Valtrompia motorway) ▪ Delays and cost overruns in building planned infrastructures ▪ Difficulties in finding extra funding resources to develop new infrastructures and services ▪ Poor strategical planning involving public administrations at different levels (local, regional and national) and private sector ▪ Development of Montichiari airport, which is a comprehensive node of the Mediterranean CNC ▪ Verona airport, as an alternative to Orio al Serio

Source: elaboration of the authors

SWOT analysis of Como SubNode

STRENGHTS	WEAKNESSES
▪ High per capita income ▪ Presence of many relevant companies, industrial activities and business opportunity ▪ Important environmental and landscape heritage ▪ Tourism industry ▪ Relatively close position to Malpensa airport ▪ Existence of two railway networks to travel to the interchange station in Saronno (RFI and FNM) where connections transit to Malpensa airport ▪ Railway link to Switzerland and suburban rail services up to Bellinzona ▪ Recent completion of part of southern highway ring ▪ Widely extended road network in the catchment area (e.g. A9 highway to Milano and Switzerland) ▪ Alignment on the Rhine-Alpine CNC, although Como is not part of the list of urban nodes	▪ Peripheral geographical position with respect to Orio al Serio airport ▪ Higher unemployment rate in the province compared to regional average ▪ High motorisation rate and propensity to car use ▪ Poor connection between RFI and Ferrovie Nord railway services ▪ Insufficient links to Linate and Orio al Serio airports ▪ High degree of road congestion in SubNode and in the catchment area ▪ Increase of urban sprawl (e.g., ill-conceived real estate and commercial development plans)
OPPORTUNITIES	**THREATS**
▪ More integration between RFI and Ferrovie Nord railways systems and operations ▪ Improvement of railway link service towards Malpensa (link to existing Malpensa Express service) ▪ Opening of AlpTransit railway service ▪ Current level of road congestion making private car not advantageous with respect to public transport	▪ Reduction of road congestion level due to network development, in turn making private car even more advantageous with respect to public transport (i.e., Pedemontana motorway and Varese-Como-Lecco motorway, new road connection SS340 “Tremezzina”) ▪ Delays and cost overruns in building planned infrastructures ▪ Difficulties in finding extra funding resources to develop new infrastructures and services ▪ Poor strategical planning involving public administrations at different levels (local, regional and national) and private sector

Source: elaboration of the authors

SWOT analysis of Varese SubNode

STRENGHTS	WEAKNESSES
▪ High per capita income ▪ Presence of many relevant companies, industrial activities and business opportunity ▪ Important environmental and landscape heritage ▪ Tourism industry ▪ Close position and good accessibility to Malpensa airport ▪ Existence of two railway networks RFI and FNM where connections transit to Malpensa airport ▪ Rail service S50 connecting Malpensa airport to Switzerland, via Mendrisio and up to Bellinzona ▪ Presence of freight hubs (i.e., Malpensa Cargo City and Hupac Terminal)	▪ Peripheral geographical position with respect to Orio al Serio airport ▪ Insufficient links to Linate and Orio al Serio airports ▪ High motorisation rate and propensity to car use ▪ Varese subnode close, but not onto the Rhine-Alpine CNC alignment ▪ High degree of road congestion in subnode and in the catchment area ▪ Increase of urban sprawl (e.g., ill-conceived real estate and commercial development plans)
OPPORTUNITIES	**THREATS**
▪ More integration between RFI and Ferrovie Nord railways systems ▪ New Malpensa airport masterplan, also envisaging increase of passengers to Malpensa forecast by airport masterplan ▪ Infrastructural improvements of railway network will create new links and reduce travel time (e.g. new railway link between Malpensa Terminal 2 and Gallarate-Sesto Calende line) ▪ Presence of some areas for development of logistic services ▪ Current level of road congestion making private car not advantageous with respect to public transport ▪ Improvement of tourism industry	▪ Reduction of road congestion level due to network development, in turn making private car even more advantageous with respect to public transport (i.e., Pedemontana motorway) ▪ Delays and cost overruns in building planned infrastructures (for example for Rho-Gallarate railway upgrade[20] and new railway link between Malpensa Terminal 2 and Gallarate-Sesto Calende line[21]) ▪ Difficulties in finding extra funding resources to develop new infrastructures and services ▪ Poor strategical planning involving public administrations at different levels (local, regional and national) and private sector

Source: elaboration of the authors

[20] Approval process ongoing and beginning of works envisaged in June 2020 (RFI, 2019).

[21] Project considered as future development (Baccelli, et al., 2017).

3. Regional Strategy

This chapter starts recalling the general and specific objectives of the SubNodes strategy that are in close relationship with the regional strategy (section 3.1). This is the prerequisite to identify fields of action (section 3.2), also in combination with the findings stemming from the analysis of the status quo and the SWOT analysis. Section 3.3 presents the infrastructure projects and services, as well as the soft measures, envisaged at regional level and concerning the geographical scope under consideration.

This chapter of the action plan provides the elements upon which develop the next one, where (i) possible revisions of the regional transport plan for improvements of the accessibility levels and (ii) the success and risks factors related to the high-level and context-specific factors will be addressed.

3.1. Objectives

The general objective of the SubNodes strategy is to improve the current connectivity level of three primary airports in Lombardy, via secondary transport hubs, the so-called SubNodes. In this approach, the SubNodes also act as transport nodes ensuring smooth accessibility of passengers travelling from their catchment areas. On this basis, the following specific objectives are addressed:

- upgrade transport nodes to link and coordinate intra-regional collective transport services (i.e., buses, coaches and train services) to the three regional airports, also part of the TEN-T network;
- make the intermodal travel option more attractive and advantageous, not only to divert users from private cars, but also to induce new passengers demand; and
- develop tailored transport strategies fitting SubNodes actual user needs. As the SubNodes strategy aims to enhance transport conditions of the peri-urban TEN-T contexts, this objective requires (i) a better level of coordination for the variety of concerned actors and stakeholders and (ii) improve experience and knowledge on such transport realm that is by far less in the focus of research and public attention.

To achieve the general and specific objectives, the SubNodes strategy aims to develop reliable collective transport services for passengers, allowing for smooth and sustainable intermodal connections at nodes.

The PRMT recognises the potential of intermodality to provide alternatives to travel by private cars. However, road transport is found substantially dominant in the territorial context of the SubNodes. First, especially outside more densely populated urban areas where car dependency is normally higher and accessibility to collective transport generally lower. Second, because road transport (and its forms) is the preferred mode to access to the three airports.

This specific characteristic makes (i) efficiency improvements and better coordination between collective modes and (ii) development of facilities for private (sustainable) modes, alternative to private car, underlying to match door-to-door users demand to travel from peripheral and small urban areas.

Likewise, the PRMT recognises intermodality strategic to improve network connections and accessibility, but also acknowledges the broad diversity of territorial contexts and needs existing throughout the region. In order to be properly developed, actions addressing intermodality must seek for optimising users' generalised transport cost of travel time, *vis-à-vis* to road transport.

As first step, this goal can be achieved through cooperation between transport operators, not only with respect to better coordination of services at nodes, but then also developing tools facilitating travel planning, ticketing integration, real time information on services and information campaigns to make users fully aware of available opportunities. In particular, availability of information for travel planning and

technology (e.g., Intelligent Transport System (ITS) solutions for infomobility) are deemed an essential and crucial prerequisite to ensure smooth intermodal transport.

Finally, it is worth noting that the PRMT already identifies sub-regional functional areas (i.e. Pedemontana, Valtellinese and southern). Amongst them, the sub-region Pedemontana to some extent overlaps the geographical context of the subnodes and, within this functional area, rail and road infrastructure projects are identified to improve airports accessibility.

3.2. Fields of action

The starting point to identify the fields of action considers the findings stemming from the analysis of the status quo and the outcomes on the behavioural aspects of the passengers surveyed at the three airports.

In general, the analysis of users' behaviour found a strong inclination to travel by private car from SubNodes and catchment areas, either as driver or accompanied person. This finding can be explained by individuals' socio-economic conditions, characteristics of passengers' segments at the three airports (i.e., for business and leisure purposes), travel convenience, substantial concentration of collective transport services in the core hub of Milano and weak (or absence) of direct collective transport connections from concerned secondary transport hubs.

Such strong preference found for travelling by private car makes apparent two things. First, collective transport might be perceived by the users (existing and potential) as a non-sufficiently competitive option (in turn, this situation contributing to road congestion of concerned areas). Second, collective transport remains underused also because the users might not be not fully aware of available options and services.

The SWOT analysis categorised negatively affecting aspects in terms of weaknesses and threats in relation to general and specific objectives. On the other hand, the SWOT analysis emphasised other positively affecting aspects worthwhile of consideration in terms of strengths and opportunities. These aspects can be used to address the issues found in the current situation and identify improvements and developments to enhance the overall competitiveness of collective transport modes.

On these bases, the SWOT analysis is instrumental to identify fields of action, which can be related to a twofold approach. First, addressing the development of suitable infrastructure projects and soft measures. Second, improving the characteristics of collective transport services to make them more attractive and enhancing their current level of patronage. Considering the characteristics of the users travelling between SubNodes, catchment areas and airports, suitable projects and measures need to address specific demand segments, like for example, less car-dependent and low-budget users, which may travel for tourism, leisure or own family purposes.

In particular, to pursue such fields of action, adaptations of the PRMT should be undergone focussing on aspects aiming at ensuring smooth, fast and reliable intermodal connections. This also keeping in mind the relevant modal choice criteria of passengers travelling on collective services and the broadest scope of demand segments. In this respect, Table 10 presents a qualitative ranking of importance for rail transport performance criteria based on the literature review developed in (den Boer, et al., 2018).

Interestingly, the research found that for rail passengers the most important performance criteria for rail as modal choice are: travel time, reliability, comfort, accessibility, price and frequency. This holds true across the three identified demand segments.

Table 10: Main performance criteria influencing modal choice of passenger rail transport

Criteria	Commuting	Business	Leisure
Travel time	+++	+++	++
Reliability	+++	+++	++
Comfort	++	++	+++
Accessibility	++	++	++
Price	++	+	++(+)
Frequency	++	++	+
Convenience	+	+	+
Safety	+	+	+
Environment	+	+	+

Source: (den Boer, et al., 2018)

Travel time is at the highest importance[22] and for collective transport is highly dependent on the means of getting from origin to the departure station and from arrival station to final destination. Due to travel time from door-to-vehicle and vehicle-to-door, the total travel time of collective transport is, in most of the cases, considerably higher than for private car travel. Because this implies that the collective transport alternative is in general slower, in order to be more competitive, the total door-to-door travel time travelling on collective transport needs to be decreased.

In SubNodes' territorial context, as the level of urban and inter-urban road congestion is often high, the reliability of travel time can be an important competitive advantage of collective transport[23]. Another key criterion to enhance the patronage and attractiveness of collective services is their frequency. According to (den Boer, et al., 2018) countries displaying a relatively high share of rail in the modal split (i.e., above 8%) have also high rail frequent services.

The are other aspects equally important and of merit. First, the ease of buying the tickets and the quality of the sale service. Second, the level of satisfaction of the users increases with the satisfaction of the level of comfort, maintenance and cleanliness of stations and vehicles.

Some additional insights to corroborate the approach to improve the performance of collective transport and attract private car users can be found in (Redman, et al., 2013)[24] (see also Table 11). Almost all identified studies focussed on improvements of physical attributes of collective services, rather than perceived attributes. Most improvement strategies targeted several quality attributes simultaneously, while service reliability and frequency are important collective transport attributes in general. Those attributes are most effective in attracting private car users and connected to individual perceptions, motivations and contexts.

(Redman, et al., 2013) conclude that reduced fare promotions and other habit-interrupting transport policy measures can encourage private car users to try collective services initially. However, attributes over and above basic accessibility, reliability and mobility provision, perceived by the target market as important service attributes, must then be provided in sustaining the shift after promotional tactics have expired.

[22] Travel time should be considered with respect to its main components, namely access/egress, in vehicle and waiting.

[23] In general, for scheduled collective services, reliability is often referred to as punctuality of the runs operated.

[24] The research selected 74 studies and assessed which performance criteria were targeted for improvement to attract car users.

Table 11: Improvement strategies for attracting private car users

Strategy	Targeted quality attribute						
	Reliability	Frequency	Price	Speed	Access	Comfort	Convenience
Network upgrades		■		■			
Extended service		■			■		
Rail line replacing bus	■			■			
Underground improvements	■			■			
Integrated public transport systems	■	■	■	■	■	■	■
Price mechanism (discounts, free tickets, integrated ticketing)			■		■		■
Bus Rapid Transit	■	■		■	■	■	■
Improved information							■
Reduced distance between nodes					■	■	

Source: (Redman, et al., 2013)

Besides infrastructure project, services and soft measures, another field of action could be related to the adaptation of the PRMT to future trends, especially for future monitoring the implemented measures. The follow points provide some insights and guidance.

First, the population is ageing. According to (UIC, 2015) the number of elderly (including older than 80) people in industrialised countries will continue to grow over the next decades. Elderly people will use trains more frequently, in particular in urban areas and for long distance journeys. (Litman, 2016) noted that although "Baby Boom"[25] seniors tend to drive more than seniors of previous generations, they drive much less than during their peak driving years, when they were employed and raising children, and use collective transport more.

Second, the other relevant demographic trend is "generation Y or Millennials"[26]. (Frost & Sullivan, 2013) states that they are the important customers of the future because they are tech-savvy and connected 24/7, demanding and impatient, civic and environmentally friendly.

Third, (UIC, 2015) envisaged that the lifestyles of younger age groups with fewer car owners will change in that they use multimodal travel options, including walking and cycling. However, high quality solutions for first and last mile door-to-door long and medium distance travelling need to be provided by the collective transport. The demographic changes could provide more opportunities for the collective transport, because of the increase in transport demand of both younger and older generations and their improved familiarity with an integrated multimodal transport system.

3.3. Regional projects

This section illustrates the projects and measures envisaged at regional level (Regione Lombardia, 2016). In particular, sub-section 3.3.1 describes the infrastructure projects of the PRMT to improve airports accessibility, also taking into account the outcomes stemming from the intermediate monitoring and

[25] "Baby Boom" seniors consist of the demographic cohort of individuals born between 1946 and 1964.

[26] "Generation Y or Millennials" consist of the demographic cohort of individuals born between the early 1980s and mid-1990s/early 2000s.

evaluation of the PRMT (Regione Lombardia, 2019). The review is complemented with additional information on the projects for Orio al Serio, according to data and documents gathered from consulted airport and railway infrastructure manager. Sub-section 3.3.2 summarises the main actions identified in the PRMT and addressing soft measures.

3.3.1. Infrastructure projects and services

The PRMT foresees infrastructure measures to enhance the current level of accessibility of concerned airports and focus on a broad scope of investments to improve metro, railway and road networks. In this respect, it is also worth noting that, for Malpensa airport, two measures have already been completed, namely (i) the extension of the railway line between Terminal 1 and Terminal 2 and (ii) the fifth lane of A8 motorway, between "Milano Nord" toll plaza and the exit at Lainate Arese.

For other projects, either under development or planned, those listed below could influence users' behaviour in choosing the transport mode (or a combination of them), when travelling from the SubNodes and catchment areas to the airports:

- extension of the railway line from Malpensa Terminal 2 northwards (i.e., 5 km in length to close the ring and complete the connections to Swiss Alpine passes Sempione and Gottardo, via Varese-Gallarate)[27] and construction of a new link southwards (i.e., 5.2 km in length, east of Galliate). The development of both projects could allow to operate rail services connecting the high-speed line Milano-Torino with the line towards Switzerland and transiting through airport's terminals;
- "Y-connection" at Castellanza, linking RFI and Ferrovie Nord railway networks. The project consists of a third track for the section between Gallarate and Parabiago and improve the section between Rho and Parabiago to four tracks[28]. This project would also allow for a different operating model of the "Malpensa Express" service, via Rho, instead of the current service operated via Saronno;
- metro line M4 Lorenteggio-Linate, providing a direct link between the urban area of Milano and Linate airport. In this case, it is also important to remark that the M4 will provide options for passenger interconnections at Forlanini stop with other relevant suburban rail services S5 Varese-Gallarate-Treviglio, S6 Novara-Pioltello-Treviglio, S9 Saronno-Albairate and (envisaged) S16 (Abbiategrasso) - Albairate - Milano San Cristoforo - Lambrate - Rho;
- new railway link between Bergamo station to Orio al Serio airport. The construction of the new link would also have effects on the operation of the regional rail services and extend the operation of the line Milano-Bergamo, via Pioltello, to the airport. The service could be operated on a 30-minute frequency throughout an extended day period. Services to the airport will be also ensured by the line Milano-Monza-Bergamo, via Carnate, which will become the suburban line S18 and suburban line Treviglio-Bergamo; and
- selected road works to improve the accessibility of Malpensa airport.

The following Table 12 summarises the information gathered from the PRMT and its 2019 monitoring evaluation about the aforementioned projects. Furthermore, as previously noted, Table 13 presents some additional information gathered for Orio al Serio airport and included in airport's master plan (SACBO, 2016).

[27] Approval process ongoing and beginning of works envisaged in June 2020 (RFI, 2019).

[28] Project considered as future development (Baccelli, et al., 2017).

3.3.2. Soft measures

A number of soft measures are planned by the PRMT. They are not specifically tailored for the needs of users travelling from SubNodes and catchment areas, because they should be rather read as general horizontal measures to improve transport services related to land side accessibility of the three concerned airports. The focus is on rail transport measures for better connectivity and interchange with collective public transport at local level.

In particular, the set of soft measures of the PRMT aims to develop interventions for:

- a better coordination of transport services of different modes;
- improve the current layout and facilities available at stations;
- adopt clear and uniform signing across modes and operators;
- develop ticketing integration; and
- provide facilities for alternative sustainable modes, which can be complementary to collective transport, for first and list miles (i.e., feeder sections).

As part of this strategy, technology innovation will be functional to achieve the objectives above mentioned, as it could support quality improvements, attractivity and efficiency of collective transport, simplify the access to transport services for users and ultimately allow for real time monitoring and programming of services and operations.

The development of Intelligent Transport System (ITS) for real time traffic and mobility management and efficient public transport fleet management could generally improve users' accessibility, services integration, flexibility and safety.

Table 14 on the following pages present the soft measure planned in the PRMT. They refer to improvements of collective and alternative transport modes, which could (to some extent) influence the current level of accessibility of users travelling from SubNodes and catchment areas to concerned airports.

Table 12: Infrastructure projects and services planned to improve the accessibility of Malpensa and Linate airports

Project description	Estimated investment cost [€ million]	Term for implementation		
		Short	Medium	Long
Malpensa airport rail accessibility				
▪ Rail link between Terminal 2 and Simplon line	210			■
▪ Construction of a new southern link	173			■
▪ Completion of the Regional service Novara-Saronno-Milano and extension of the rail service to Gallarate	[29]498			■
Improvement of the railway line Rho-Gallarate				
▪ "Y-connection" and four tracks between Rho and Parabiago	408	■	■	■
▪ Third track between Parabiago and Gallarate	320			■
Extension of the suburban railway line S15 Rogoredo-Parabiago to Malpensa T2	See footnote 30	■	■	■
Operation of the regional service Bergamo-Brescia	See footnote 31		■	■
Metro line M4 (under construction)	1,820			■
Orio al Serio airport accessibility:				
▪ Completion of the Regional service Milano-Bergamo (via Treviglio)	[32]110			■
▪ Extension of the Regional service to Orio al Serio				■
▪ Extension of the suburban rail service S18 (Milano-Bergamo via Carnate)				■
Malpensa airport road accessibility				
▪ Link Milano-Magenta variant at Abbiategrasso and requalification of S.S. 494	420		■	■
▪ Variant S.S. 341 "Gallaratese" and link to Gallarate	262		■	■
▪ Variant S.S. 33 Rho-Gallarate	435			■
▪ Link at Vedano Olona	87			■
▪ S.S. 342 - variant of Solbiate-Olgiate Comasco	30		■	■
▪ New bridge crossing Ticino river in Vigevano	[33]51		■	

Source: Compilation of the authors based on Regione Lombardia (2016) and Regione Lombardia (2019)

[29] The estimated investment cost includes the amount related to the extension of the service between Terminal 1 and Terminal 2 (already operating).

[30] Project part of a broadest scope of measures to improve the Rho-Gallarate line. Total estimated investment cost for all measures € 728 million.

[31] Project part of a broadest scope of measures.

[32] Total amount for the three projects.

[33] Completion of work envisaged in 2020, according to local press.

Table 13: Infrastructure projects to improve the accessibility of Bergamo Orio al Serio

Project description	Estimated investment cost [€]	Estimated implementation time	Foreseen demand	Foreseen capacity
New rail link between the train station of Bergamo and the airport. The new double track rail link will extend for 4.5 km. The station at the airport will be located near the "P2" parking and connected to the terminal with an underground walking path.	102 million	2022-2023	A percentage varying between 20% and 40% of passengers will use the train to access the airport (i.e., 2.6-5.2 million passenger per year).	-
New east access to the airport. According to masterplan at 2030, the project envisages the construction of a new road link between "via Orio al Serio" in Grassobbio and the terminal. The project could double the current capacity (discussions are ongoing).	The cost of the project and related works for arrangement of parking by the new road amounts to 7 million	2024-2025	Percentage of vehicles which will use the new road link is equal to 40%	2,000 vehicles per hour (1 lane)
North access to new "Area cargo" According to the masterplan at 2030, goods sheds and service will be transferred to facilities to the northern area of the airport. This area will be connected to the Bergamo freeway (SP ex SS671) with a new dedicated road link. This project will greatly reduce heavy vehicle traffic on the access road to the airport (SP 116).	2 million	2021-2022	All the commercial traffic going to the airport will use the new road link	2,000 vehicles per hour (1 lane)
New roundabout on SP116, the main access road to the airport, by the parking P3 (Smart Parking). The roundabout will allow for a new two-way connection between Bergamo and the airport, as an alternative to SP ex SS 591bis.	735 thousand	2019	-	-

Source: Compilation of the authors based on information provided by SACBO and RFI (2019)

Table 14: Soft measure planned and related to improvements of collective and alternative transport

Project description	Estimated investment cost [€ million]	Term for implementation		
		Short	Medium	Long
Development of innovative technologies and electronic ticketing systems	70			
Ticketing integration	Not available			
Integration of public transport with new and sustainable modes (e.g., bike and car sharing)	Not available			
Efficiency improvements of road collective transport	5			

Source: Compilation of the authors based on Regione Lombardia (2016) and Regione Lombardia (2019)

4. Approaches for implementation

This chapter focuses on the approach to adapt the regional transport plan in the light of the SubNodes strategy. The content of this chapter has been structured taking into account the findings stemming throughout the previous chapters and in particular taking stock of: the analysis of the status quo, the SWOT analysis, the identified fields of actions and the regional infrastructure projects and measures of the PRMT.

On these bases, section 4.1 presents the approach for revision of the regional transport plan distinguishing with respect to infrastructure projects, collective transport services and soft measures, in turn analysed over short-, medium- and long term horizons. Section 4.2 addressed success and risk factors related to the implementation of the suggested adaptations of the regional transport plan. Success and risk factors are discussed developing two layers of analysis, namely general and context-specific.

4.1. Revision of the regional transport plan

4.1.1. Infrastructure projects and services

The infrastructure projects and services reported in section 3.3 are substantially in line with the objectives of the SubNodes strategy. However, some additional measures can be considered for revision of the regional transport plan.

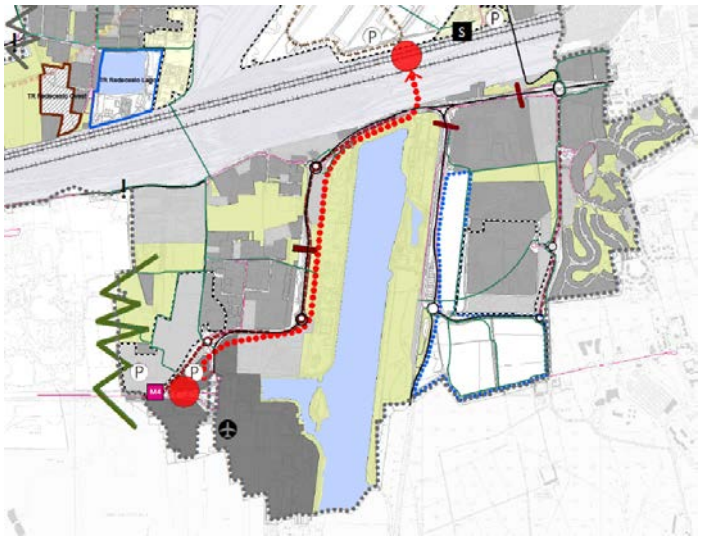
The development of a new eastern railway access gate would enable improved accessibility levels for users travelling from SubNodes and catchment areas of Bergamo and Brescia. The new gate would also avoid, for the concerned passengers, longer travel times to reach Linate airport and, possibly the need of one change at city's major transport hubs. The new eastern railway access gate "Segrate Porta Est" could be located between Redecesio and the station of Pioltello Limito (see Figure 7). An in-depth evaluation of the preliminary feasibility study is ongoing to extend the metro line M4 from Linate to Segrate (Citta Metropolitana di Milano, 2019)[34].

The new metro terminus and railway access gate could operate as an integrated transport hub for intermodal changes between trains of different services (i.e., suburban, regional and high-speed), the extended metro line and other collective local transport services. The new transport services could be integrated over a medium- or long- term period to comprehensively fit the future mobility needs, also considering the winter Olympic games in 2026.

Figure 6 presents one possible option of alignment for a new transport link between Linate and Segrate, according to the development plan of the municipality of Segrate (Città di Segrate, 2017).

[34] See *"Approvazione dello schema di "Accordo tra Regione Lombardia, Città Metropolitana di Milano, comuni di Milano, Segrate, Pioltello, SEA S.p.a., Westfield Milan S.p.a. per il finanziamento e l'affidamento ad MM spa degli incarichi per: (1) analisi di approfondimento dello studio di fattibilità (prima fase del progetto di fattibilità tecnica economica) di hub metropolitano "Segrate-Porta Est Milano" e (2) progetto di fattibilità tecnica economica, coordinamento della sicurezza in fase di progettazione, assistenza al responsabile unico del procedimento della "nuova stazione ferroviaria Segrate-Porta Est" 3 indicazioni per lo studio di fattibilità di un sistema "cable car" da Linate a Segrate"*.

Figure 6: Alignment option for a new transport link between Linate and Segrate



Source: Città di Segrate (2017)

The implementation of the new rail link between Bergamo Central station Orio al Serio airport will give the opportunity to adapt the collective transport services currently operated to future mobility needs. Regularly scheduled and coordinated rail services at Bergamo Central station could give additional travel opportunities for travellers from the SubNode and catchment area of Brescia via-à-vis coach services. The timing for implementation should reflect that envisaged construction programme of the rail link connecting Orio al Serio and be linked with the winter Olympic games in 2026 (i.e., medium-term). The attractivity of the services could be improved by other stops on the rail link, especially in Bergamo city, like "*Fiera*"[35].

For developing this rail service, it is important to note that, because of the change needed at Bergamo Central station[36], the total travel time and ticket prices by train are underlying influencing factors for modal choice decision. Currently, coach services are not regularly scheduled during the day, take approximately one hour (subject to the road congestion level) and the price ticket is equal to € 12 per person. On the other hand, the hourly regional train service from Brescia to Bergamo takes 57 minutes and costs € 4.80 per person.

In addition, the extension of the regional rail services from Orio al Serio to Malpensa Terminal 2 (every 60 minutes), via Carnate Usmate - Seregno - Saronno - Busto Arsizio could enable further travel options from the eastern SubNodes and catchment areas of the Region, also avoiding one train or coach change at Milano Central station. This adaptation could be foreseen over a long-term period. Eventually, the extension of the suburban rail line S5 from Treviglio to Malpensa Terminal 2 (every 30 minutes) could be used by passengers travelling from the its southern catchment area (see Figure 7 and Figure 8).

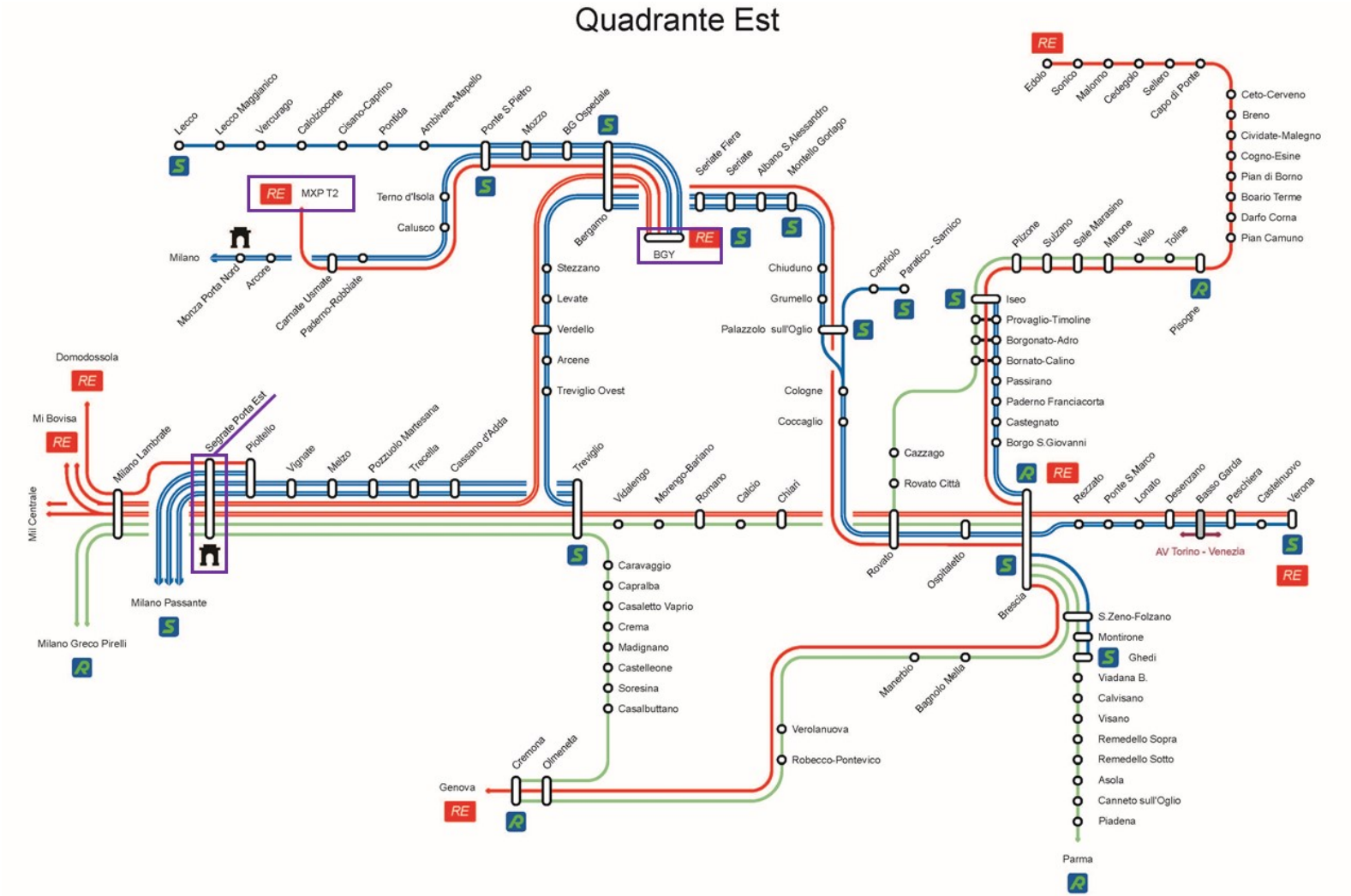
It is also worth reminding the ongoing works at Albate Camerlata, where the RFI and FNM stations will be joined[37]. Over a medium-term period, the train services transiting at the new station could provide other opportunities for the users travelling from the SubNode of Como and catchment area. Because two changes would be necessary for users to travel from the station of Como San Giovanni to Malpensa, a thoroughly optimised coordination of services at Albate Camerlata and Saronno is important. This adaptation would benefit of the extension of the suburban line S9 from Saronno to Malpensa.

[35] The stop at Fiera is envisaged by the masterplan of Orio al Serio airport.

[36] A direct train service from Brescia would need a change of direction of the train at Bergamo central station that could need longer operating time compared to a change of coordinated train services.

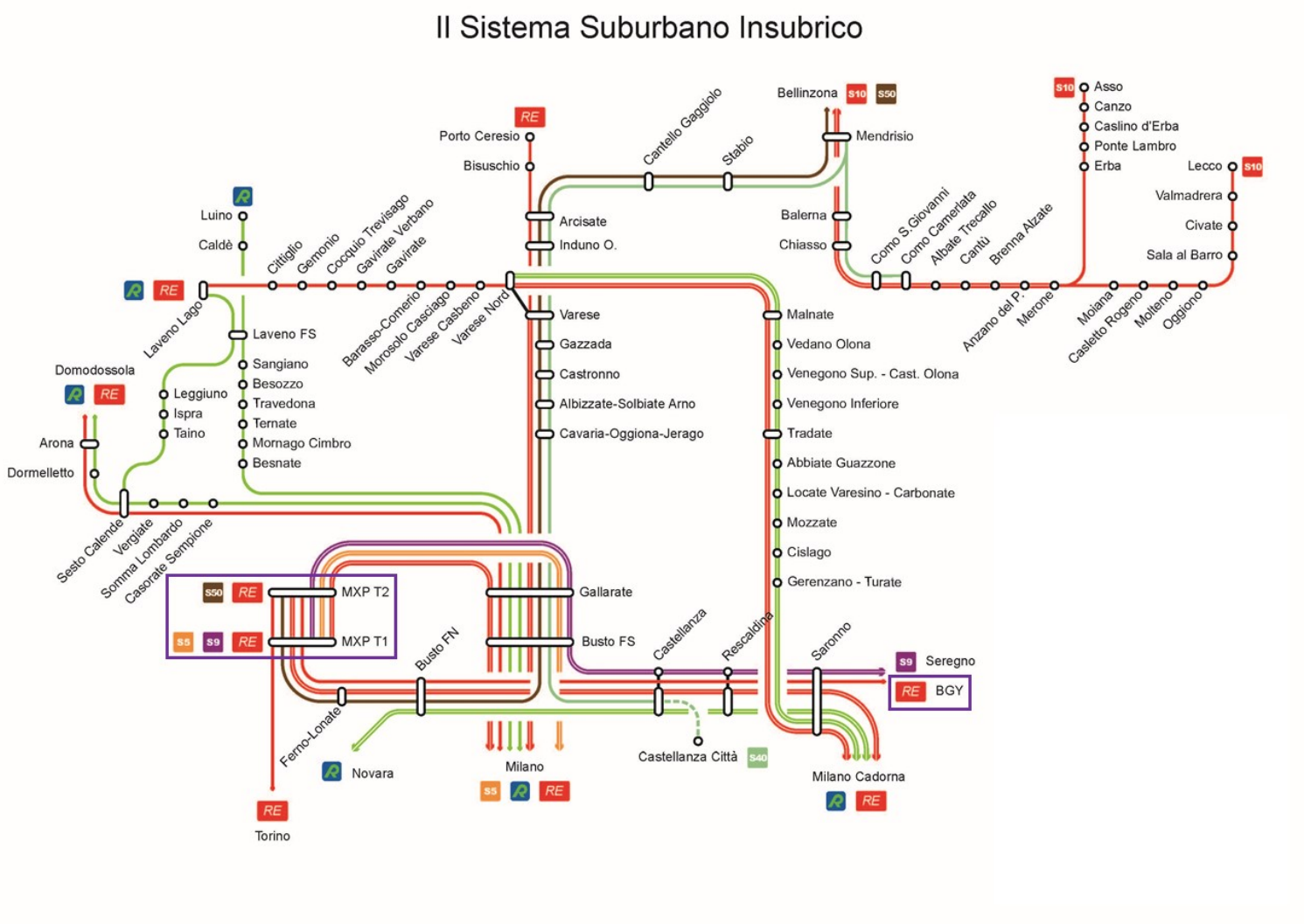
[37] Completion of works envisaged by mid-2020.

Figure 7: Future developments of regional and suburban rail services (eastern regional quadrant)



Source: Regione Lombardia (2020)

Figure 8: Future developments of regional and suburban rail services (north-western regional quadrant)



Source: Regione Lombardia (2020)

4.1.2. Soft and other measures

This section presents the identified soft and other measures. They are illustrated presenting best practices, case studies and relevant literature, in order to provide complementary evidence of real and transferable measures. This is an important aspect to note, because it allows to discuss the identified soft and other measures in the light of their current consideration and envisaged level of development of the PRMT.

This to make possible the introduction of adaptations of the PRMT taking into account the characteristics of the SubNodes. More specifically, adaptations of the PRMT with respect to such context-specific situation are proposed, either as new measures not currently envisaged by the regional programme, or as transitions from high-level strategy towards the implementation of more concrete actions and measures.

Finally, in relation to their affordability and development over the years ahead, the identified measures are distinguished with respect to short-term and medium- and long-term time horizons.

4.1.2.1. Short-term measures

More reliable collective transport

More reliable collective transport services can be implemented considering a better spread of runs during off-peak periods, notably those at nights and weekends. In general, improving the reliability by extending the time of scheduled services could enable a higher patronage level, changing users' behaviour and diverting private demand from cars to collective public transport.

As previously noted, analysing the supply of collective transport modes linking the three concerned airports (see section 2.2.1.3), the spread of the runs operated from Milano during a typical day, already guarantees a satisfactory level of service. However, a comparable spread of runs has not been found for those direct road collective transport services operated between the SubNodes and the airports. It would be beneficial to consider specific actions to adapt start and end time of the runs of road collective transport in order to develop tailored measures that may fit with the characteristics of the demand of the SubNodes[38].

In this respect, an extended start and end time of scheduled services could be especially important when it comes to consider the following aspects. First, according to passenger surveys conducted in the context of the SubNodes, the journeys are more frequent for leisure and personal or family reasons and hence carried out by budget travellers. Second, low-cost airlines ticket prices are on average cheaper if purchased for flights operated off-peak. According to a study of an international engine search for travels and holidays, booking a flight from after sunset until sunrise, compared to the morning period, can ensure a better deal for budget travellers (notably, for evening departures between 6:00 pm and 12:00 am) (Momondo, 2016)[39].

Interestingly, the LAirA project (LAirA, 2019a) found that road collective transport is not a competitive option also for the employees of the investigated airports, amongst the others Linate and Malpensa[40]. The employees are not able to use road public transport, because the time schedule of the services does not adapt to morning or evening working time.

Integrated, simple and smart ticketing

To be a more attractive opportunity compared to private car, the public transport system should provide the users with a dedicated, simple and smart ticketing system, also embedding the option to purchase

[38] See (Regione Lombardia, 2016) in section 6.3.2 and 7.1 (F21). Adaptations should consider also secondary effects on services coordination at transport nodes and interchanges.

[39] See on the webpage https://www.momondo.be/content/annual-flight-study/.

[40] The other airports analysed in this study are: Vienna in Austria, Dubrovnik in Croatia, Stuttgart in Germany, Budapest in Hungary and Poznan-Lawica and Warsaw-Modlin in Poland.

tickets to travel to the airports. In this regard, a past survey (Booz&Co, 2009) reviewed a number of case studies providing evidence that a simplified and integrated ticketing system is best practice to increase patronage. Depending on urban areas across Europe, North America and Australia the increase of patronage was found between 6% and 20%.

A traditional ticket is a piece of paper showing the details of the origin and destination of the journey that one has been paid for, any associated conditions such as flexibility, times of day when the use is permitted and the legal conditions under which the journey is made. To make things simpler public transport operators should introduce an integrated and single ticket to enable travelling between an origin, within the geographical scope of the SubNodes, to an airport and regardless the operator. To make things smarter the purchase of this type of ticket should be electronic, in order to reduce the hassle to perform the purchase via traditional channels, like automatic ticket vending machines, ticket office and station newsagent.

In the context of the SubNodes, this could be a useful option not only to integrate a number of local transport services, but also to avoid operators' deployment and management of traditional purchase channels in low-density areas, which may be costly and where inspectors may not be on duty for the entire period of operation of the services. In so doing, investment costs to start the integration process could be shared between the other operators and own management and operating costs kept at an affordable level.

There are other advantages implementing integrated and electronic ticketing systems such as reduced costs of handling cash, reduced fraud and similar losses, increased business data available in real-time and more flexibility in ticket pricing and implementing changes to fares (UITP, 2017). On the other hand, the design of integrated systems needs much care, especially if local transport operators have already launched their own products to encourage brand loyalty (ERTICO – ITS Europe (editor), 2019).

Tariffs integration and electronic ticketing is amongst the actions of the PRMT[41]. The system involves major public transport operators in the metropolitan area of Milano (i.e., Trenord, ATM and the province of Monza and Brianza) and regional integration is ensured by the system "*Io viaggio ovunque in Lombardia*". The PRMT foresees a full system integration enlarging its scope to local transport basins. This action deserves specific consideration considering the SubNnodes context, as to be beneficial and fit the objectives of the project integration should focus on incorporating the opportunity to travel to the airports.

A number of best practices can be reported. For example, the province of Bolzano (Italy) has introduced an electronic ticketing system throughout the its territory. This system includes a pay-as-you-go concept for which the traveller pays according to the actual length of the journey (i.e., kilometres travelled) and the more a user travels, the lower the unit fare per kilometre becomes. All bus companies operate under this unique integrated system, which resulted in increasing the patronage of public transport (see Figure 9).

[41] See (Regione Lombardia, 2016) in section 7.2 (T9 and T10) and section 8.3 on tools for technology innovation.

Figure 9: Validation machine on public service in Bolzano province

Source: Eltis portal (Di Bartolo, 2013)

Another example can be found in Turku (Finland) looking at its innovative ITS. The system involves 3 main innovations. First, a terminal dedicated to the ticketing and the control of functions within the vehicle which are communicated to the head office to give reliable real-time information to passengers. Second, an integrated on-board smart card reader and barcode scanner to accept digital payments and digital tickets. Third, extensive real-time information on all channels, including displays at stops and over the internet. The head office manages all ticket fares and control the interoperability with other transport company platforms to let them sell public transport tickets on their websites (Kemppainen, 2015).

To enlarge the scope of the available options, a fully integrated system should also encompass other transport networks, like for example motorways[42], and cark parking at stations. This type of measure could improve multimodal travel opportunities. For example, Toulouse (France) developed a multi-services card including public transport, bike-sharing, regional train services, car-sharing, reduced fares for parking and other services, like sports, museums etc (Blaquière, 2015).

Layout and design of stations and stops

A higher level of attractivity and enhanced perception of public transport services can be achieved improving the design and layout of stations and stops. This strategy can be implemented implementing a number of measures.

First, providing the users with clear and understandable presentation of the information they need to travel, and allow them to quickly grasp all relevant aspects. At stations, stops and shelters, clear and identifiable information should be displayed with: a comprehensive transport network map, a timetable with first and last runs and frequency (i.e., weekday, weekend, special night services and holiday variations), the fare for a single ticket or for a season ticket and the location(s) of the automatic ticket vending machine(s), also presenting the broadest scope of electronic payments and directions to the closest ticket selling point and its business time.

For example, the ATTAC project[43] identified and analysed best practices for efficient interconnections for transport networks in contexts where public transport is perceived uncomfortable and rigid. The project found that using a real time information system improves the perception that public transport is more

[42] On the road network side, an electronic tooling system can be further improved deploying free flow portals to allow users to reduce travel time and avoid queuing. On the other hand, the system needs to have an onboard unit and make a registration for payment through mobile application or website.

[43] Attractive Urban Public Transport for Accessible Cities, project funded by the EU Interreg IVB programme (Interreg IV - Transnational Programme).

flexible and accessible, has higher standards and is more welcoming for new users (Klemenčič & Jurič, 2012). It allows also to give a sense that different transport services are part of something bigger, connecting long-distance services (e.g., coaches, high-speed and intercity trains) with local public transport networks (e.g., urban buses and regional and suburban trains) with coordinated runs (Ibraeva & Figueira de Sousa, 2014).

In general, the practices reviewed have shown that the best way for providing arrival and departure time information, along with vehicles route name, is on the station over displays, or over terminals. Notably, providing information at stops with electronic panel display resulted in improved service monitoring (e.g., delays, rerouting and real time updates) and shorter waiting times for passengers. Besides, ATTAC found that for the cases analysed, a dynamic information service improved the patronage between 4% and 10%.

Loud acoustic announces are useful measures, not only to complement the information on displays, but to help visually impaired persons, as a case study in Prague showed on helping visually impaired passengers (de Clerck, 2015). Broadly speaking, a barrier-free system improves the inclusiveness of the transport system and enlarges the accessibility to a broadest scope of users (Modijefsky, 2019).

Where a change of the transport mode is necessary, or for more complex stations, another important aspect deserving attention is the deployment of clear wayfinding[44]. Airports can provide useful best practices and cases drawing from the experience earned and resources invested in this field. In transport, wayfinding is important to quickly locate facilities and move to the next transport mode with a minimum of stress, especially for new users. If the passengers cannot find the facilities on their own, they may ask information to the staff on duty, distracting them from their main activities and increasing staffing requirements and costs. The LAirA project (LAirA, 2019b) has stylised the ideal journey from an airport terminal to public transport as follows:

- orientate the passengers as early as possible upon arrival, as soon as they are inside the terminal;
- promote public transport, introducing iconography and making travel options known;
- make the association with the transport destination;
- avoid any risk of doubt and stress that would lead to “losing” the passenger;
- use icons to lead the way through the terminal;
- providing reassurance along the whole way;
- identifying the transport destination, letting the passenger know that they have reached the transport hub.
- draw a picture of complicated transport connections.

For rail transport, an example of best and recent practice is the renewed London Bridge station. Its wayfinding project started with a study of the station layout, pedestrian flow and the station connections with the surrounding areas and attractions. Passenger types were identified and segmented in commuters, tourists, families with young children and impaired passengers that may require extra assistance. The best solution was designed for every category, according with their needs and capabilities.

The output of the study was a new set of dynamic information signs and a graphic template and elements which were relevant to the station, its architecture and its unique design issues (see Figure 10). The national railway infrastructure manager (i.e., Network Rail) already had a wayfinding standard that was adopted with some reviews and adaptations to the specific needs of London Bridge station. This aspect is relevant

[44] Outside transport, wayfinding is important also for the health care sector. For the hospitals, Mollerup (2009) argued that architecture is of paramount importance to easy wayfinding, notably for the way buildings are located and connected. Toponomy, or giving names and numbers to places and functions, was an often-ignored means for helping users. To avoid this issue the author identified, amongst the others, the following strategies: track following (i.e., signs, arrows and coloured paths), route following (i.e., short text describing the route to follow), educated seeking (i.e., use of syllogisms), inference and map reading.

to stress that it is important to follow some precise guidelines for wayfinding (and icons) throughout a wider system.

Figure 10: London Bridge station wayfinding example

Source: (Maynard, 2019)

The PRMT gives importance to aspects related to the layout of the stations at the strategy level, because it can enable smooth modal change, through clear display of the information and ease in finding the paths in general[45]. Its specific actions consider to refurbish public transport stops with clearly identifiable standards and readability of the information.

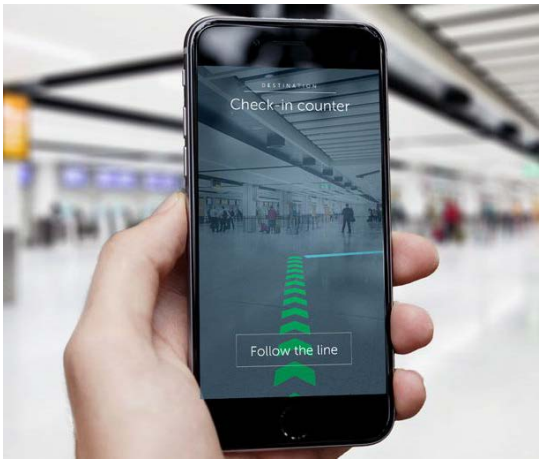
In the context of the SubNodes, orienting the envisaged actions following the approaches illustrated above to attract new users would improve the general and widespread sense of belonging, uniform style of signs and branding. This especially highlighting the airports as destinations, as well as dedicated services and tickets where necessary. Considering the significant share tourists and immigrants that may of travel through the region, written information should be clearly displayed not only in common European languages (e.g., English, French and Spanish), but also in Chinese, Japanese and Arabic.

As a way for further improvements of the regional actions, infomobility could be another point to focus on and combined with stations design and layout to deliver a new approach on the subject. Using mobile technologies and navigation beacons, a specific mobile application could show the best path to follow on a map, or directly on the screen exploiting augmented reality functions.

For example, Gatwick airport manager has developed a mobile application showing wayfinding indications on a map and is currently developing an augmented reality (AR) tool to help passengers find their way inside the airport. As Figure 11 shows these technologies can give information tailored to user needs and destination.

[45] See (Regione Lombardia, 2016) section 6.3.2 and 7.2 (T13)

Figure 11: Gatwick airport app and its development with AR technology



Sources: Gatwick airport (2018) and Business Traveller (2017)

Facilities for sustainable transport modes

Facilities for sustainable transport modes provide alternatives to travel by car when it comes to consider feeder sections of a journey (i.e., first and last mile). They encompass a very broad scope of measures, amongst the others: sheltered parking and depots for bikes, mopeds and motorcycles, as well as facilities for car sharing and charging stations for electric vehicles. The following best practices focus on cycling and electric vehicles.

The Dutch experience shows that providing accessible and numerous bicycle parking facilities at public transport hubs, such as railway stations, is crucial in fostering multimodality. In fact, a wide spreading of parking facilities has shown that it can increase the attractiveness toward bicycle in commuting and other trips (Ripa, 2019). Dutch municipalities and provinces are responsible for constructing bicycle tracks and encouraging the use of bicycles and work together at the local level to increase the capacity of bicycle parking facilities, also in coordination with the other actors involved in rail transport (see also Figure 12)[46].

[46] Data of the initiatives developed in the Netherlands have shown that cycling in combination with public transport has been improving through time. Notably, some 40% of the 1.2 million daily rail passengers ride their bicycles to train stations and all the measures have contributed to meet the increasing demand for more and better parking facilities at stations, thereby encouraging multimodal transport behaviour.

Figure 12: Delft bicycle parking facility

Source: Bicycle Dutch

The European platform on sustainable urban mobility plans (Arndt, et al., 2019) reports that a successful implementation of public bike systems depends on a number of conditions.

First, the spatial availability of rental bikes. Whether the choice is a station-based or free-floating each should be carefully designed. A successful station-based system needs a dense network of stations and lots of available bicycles. Careful network design is crucial because stations anchored to one place determine the structure and the budget determines the number of stations. This holds true also for free-floating systems. Second, the quality of the rental bicycles is a major factor of any system. The bikes must be stable and not requiring much maintenance, have sturdy frames, wide tyres, protected chains and low-maintenance brakes. Third, they need easily accessible information, customer services and functional mobile applications.

Likewise, e-scooter and e-moped sharing are other options. The e-scooter, is pedal scooter with electric drive, small or large wheels, with or without bars. These electric mini-vehicles can be used for the first and last miles, in combination with local public transport, but provided that road infrastructure and pathways have a high-quality and even surface. E-Moped sharing is normally used in cities that have good public transport, but it can offer an easy handling option, because it requires just a driving licence and a smartphone.

Public transport stations and stops can host facilities for shared and electric vehicles. Car sharing can provide great potential to supplement public transport and strengthen eco-mobility, even though the successful implementation of car sharing services is population density (i.e., a critical user mass).

Facilities for electric private vehicles are a suitable option if car dependency is significant, like in the context of the SubNodes. Electric private vehicles can help to reduce the transport impact on environment, but it is important to consider that creating charging stations at attractors, like train stations or stops, needs space and that it could be quite limited if in the urban environment. Cities have the possibility to integrate charging infrastructure in various planning framework, such as parking regulations, building and zoning codes, as well as land use and development plans. Users can benefit from these facilities to reach airports, combining electric cars and collective transport mode (Mendeova, 2013) and (Polis and Rupprecht Consult (eds.), 2019).

Strategies and actions to encourage sustainable mobility are foreseen by the PRMT[47]. They are relatively general and found in line with best practices and common applications at international level. With respect to the context of the SubNodes, where mobility is substantially car-dependent, adaptations of the regional programme could be considered stressing their potential to influence users' behaviour towards more environmental-friendly modes and raise awareness about the available alternative modes. Appropriate signing and icons could help to make the opportunities clearly identifiable on site.

Periodic marketing and advertising campaigns

Periodic marketing and advertising campaigns are an opportunity for public transport to promote products and create an image for the operators. when an operator is deemed modern, reliable and a high-quality provider, users associate themselves with it and are more satisfied. In general, the characteristics that are attributed to a service have impact on the passengers. If the service is considered having poor characteristics, users will have more desire to continue to travel by car, especially when car ownership is high and perceived as a sign of wellbeing (Ibraeva & Figueira de Sousa, 2014).

Public transport has many positive sides which can be promoted. It is sustainable, sometimes it is faster than cars due to traffic congestion and can be represented as an independent choice of an intelligent person who values time and prefers it to a car for one reason and not because it is the only option. Public transport is frequently perceived as a transport mode for those who cannot afford car and it is important to spread the idea to change this perception and show public transport as a valuable alternative to private vehicle.

Besides, marketing strategy demands profound market research and it may also be an instrument of service development because it allows the company to learn more about users' needs and expectations.

The development of marketing and communication strategies is considered in the PRMT at its strategic level. Tailored actions could be an area worth of consideration in the SubNodes context to spread awareness at a larger scale of the characteristics of the services and opportunities to travel to airports, also focussing on transport sustainability and safety aspects.

Other short-term measures

Other more general short-term measures can be suggested as follows.

- Give clear indications for accountability, complains, or to report issues in relation to services and infrastructure quality and redress to the transport operator(s) that run the services, infrastructure manager(s) and transport authority that oversees.
- Consider adequate budget allocation, not only to develop the abovementioned measures, but also to monitor and maintain them on a regular basis once operating. This is important to secure users' patronage through time, and in this light, envisage a monitoring process of the measures developed in the context of the SubNodes could be a useful adaptation of the PRMT.

4.1.2.2. Medium- and long-term measures

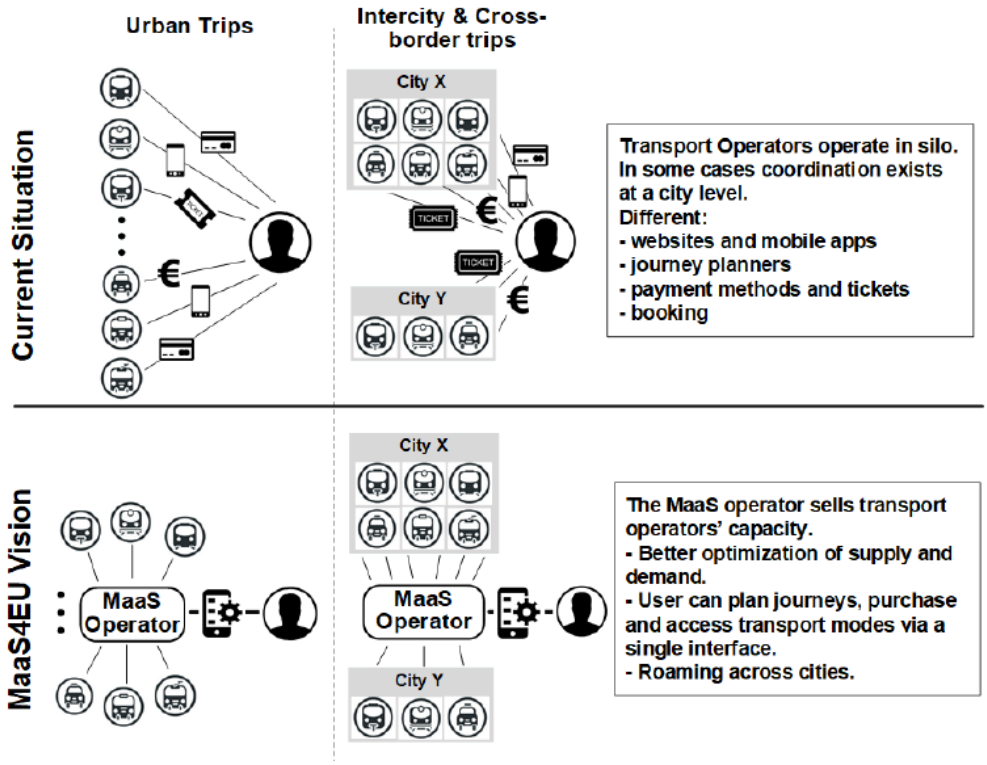
Mobility-as-a-Service operator

Over the medium- and long-term period, the current level of connectivity could be simplified introducing a Mobility-as-a-Service (MaaS) operator. MaaS is the integration of various forms of transport services into a single mobility service platform, accessible on demand. For the user, MaaS can offer added value through the use of a single application to provide access to mobility, with a single payment channel instead of multiple ticketing and payment operations.

[47] See (Regione Lombardia, 2016) section 6.3.2 and 7.2 (T12). See also the Annex 3 on the strategy on electric mobility.

The EU-funded research project MaaS4EU[48] has developed and analysis of the progresses achieved so far beyond the state of the art and expected potential impact, also including the socio-economic impact and the wider societal implications[49]. Figure 13 stylises the overall MaaS vision to bridge the gap between the supply side (i.e., transport operators and infrastructure) and the demand side to integrate existing fragmented tools in between[50]. In this vision, the users can configurate and buy a bundle of services (composed of different modes) and can make informed decision about which one (or combination) to use for each of their trips by using the single interface. In addition, the MaaS operator can propose the ideal combination of transport modes to them for each trip by knowing the network conditions in real time and the preferences of the users, optimising supply and demand sides.

Figure 13: The MaaS vision



Source: MaaS4EU project

Example of a MaaS platform are "whim" and "Qixxit". Whim[51] operates in Helsinki and other cities in Europe (i.e., Antwerp, Vienna and Birmingham with West Midlands county) (see Figure 14) bundling public transport, bike sharing, taxi, car rental and e-scooter easy access into a single mobile application. Quixxit[52] joins trains, long distance bus lines and airplane alternative to give the best combination of modes to make the traveller reach his final destination.

[48] See http://www.maas4eu.eu/project/ and http://www.trt.it/en/PROGETTI/maas4eu-project/

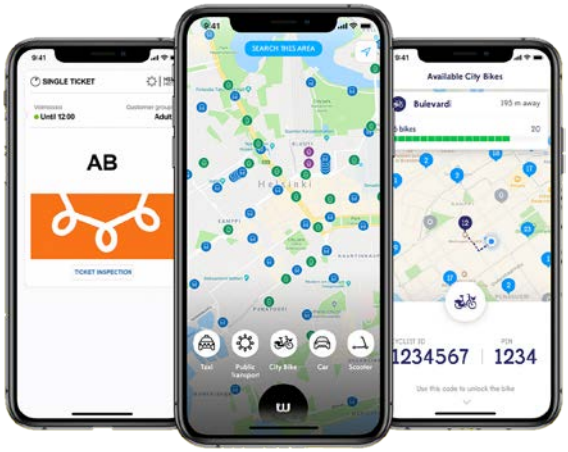
[49] See https://cordis.europa.eu/project/id/723176/results.

[50] It is important to note that a MaaS platform assumes that data and information can be made available and shared between involved transport operators.

[51] See https://whimapp.com/.

[52] See https://www.qixxit.com/en/.

Figure 14: whim app presentation



Source: whimapp

The PRMT does not envisage to develop a MaaS platform yet. Although at a very early development stage, this new approach to travel planning could have a significant impact on future mobility and can be considered at the strategy level for adaptation of the regional programme. In this light, the regional strategy could support the development of integrated platforms for ticketing enlarged to a broad scope of transport operators and modes. This approach implies a user-centric approach (Müller & Meyer, 2019) based on a digital and intelligent mobility model in which users' needs are met via a single platform, namely the MaaS operator.

Other medium- and long-term measures

Other medium- and long-term measures can be more complex and involve aspects just interacting with the transport sector (e.g., urban planning and land use). By way of example, they encompass:

- refurbishment of stations that are part of the urban communities they serve, restoring (historic) buildings for community and business purposes. As noted, discussing the layout of stations and stops, actions valorising the transport nodes would be a sound strategy to focus on, especially in a context where the demand of public transport is low or weak;
- development of collective transport networks that have the capacity to support urban densification, as well as provide attractive gateways and local community and economic hubs for smaller towns;
- development of opportunities for people to live close to stations and stops, reducing urban sprawl and private car dependency. In general, more people leaving to stations could generate positive externalities in terms of increased frequency of public transport.

Table 15 summarises the identified infrastructure projects, services and soft measures for adaptation of the PRMT, also providing the possible terms for implementation.

Table 15: Identified infrastructure projects, services and soft measures for adaptation of the PRMT

Project and measure		Term for implementation		
Category	**Description**	**Short**	**Medium**	**Long**
Infrastructure	Milano eastern railway access gate		■	
Service	Coordination of services to the airport at Bergamo Central station with the regional service from Brescia		■	
	Extension of the regional rail services from Bergamo to Malpensa Terminal 2, via Carnate Usmate - Seregno - Saronno - Busto Arsizio			■
	Extension of the suburban line S5 from Treviglio to Malpensa			■
	Coordination of services at the new station of Albate Camerlata		■	
	Extension of the suburban line S9 from Saronno to Malpensa			■
Soft and other measures	More reliable collective transport	■		
	Integrated, simple and smart ticketing	■		
	Layout and design of stations and stops	■		
	Facilities for sustainable transport modes	■		
	Periodic marketing and advertising campaigns	■		
	Clear indications for accountability, complains, or to report issues	■		
	Adequate budget allocation to develop monitor and maintain	■		
	Develop MaaS platform		■	■
	Refurbishment of stations which are part of the urban communities they serve		■	■
	Support urban densification and provide attractive gateways		■	■
	Develop opportunities for people to live close to stations and stops, reducing urban sprawl and private car dependency		■	■

Source: Compilation of the authors

4.2. Success and risk factors

This chapter presents success and risks factors developing a two-layer level of analysis.

The first layer of analysis lists general success and risks factors that can be considered holding across the SubNodes (see Table 16). They are presented with respect to three dimensions. First, socio-economic characteristics to take account of key drivers that generally influence passenger demand. Second, transport infrastructures and services, in terms of scope of options and quality of accessibility to SubNodes, catchment areas and airports. Third, governance and planning to address the dimension of the decision-making process and influence of the decisions of public and private stakeholders in the overall context of analysis.

Table 16: Identified general success and risk factors

Success	Risk
Socio-economic characteristics	
▪ High per-capita income and low unemployment rate ▪ Widely extended and highly dense road network ▪ Presence of many important companies, industrial activities and business opportunities ▪ Developed tourism industry ▪ Remarkable environmental and landscape heritage	▪ High motorisation rate and propensity to car use ▪ Demand of passengers travelling for vacation or tourism purpose strongly depends on own economic conditions ▪ Increase of urban sprawl (i.e., ill-conceived real estate and commercial development plans)
Transport infrastructure and services	
▪ Availability of infrastructures for intra- and inter-modal connections ▪ Availability of innovative and sustainable mobility services (e.g., car and bike sharing, electric cars, etc.) ▪ Infrastructure improvements and services extensions could improve travel options and journey flexibility ▪ High quality of collective transport vehicles ▪ High quality and broad scope of services at stations ▪ Envisaged growth of air passengers demand ▪ Unchanged or worsened level of road congestion could make collective transport more advantageous ▪ Develop MaaS platform ▪ Periodic marketing and advertising campaigns for visibility of developed projects and measures ▪ Tailored services for elderly persons and persons with reduced ability or mobility	▪ Generally low demand to travel to the airports, especially by collective transport (road and rail) ▪ Weak demand may imply low frequency of collective services and longer waiting time off-board ▪ Non-direct collective transport services need interchange at nodes, increasing the journey time ▪ Missing completion of intra- and inter-modal connections ▪ Road transport main mode to access to airports ▪ Reduced level of road congestion due to network improvements could make private car even more advantageous with respect to collective transport ▪ Low quality of collective transport vehicles ▪ Low quality or poor services at stations
Governance and planning	
▪ Proximity to TEN-T Core Network Corridors ▪ Regional airports are TEN-T core nodes	▪ Delays and cost overruns in building planned infrastructures or developing collective transport services ▪ Poor strategical planning involving public administrators at different levels (local, regional and national) ▪ Poor budget allocation and difficulties in gathering extra funds to develop infrastructures and services

Source: Compilation of the authors

The second layer develop a tailored analysis with respect to specific success and risk factors of each SubNode. It relies on specific elements and finding stemming from the work carried out (see Table 17) and provide a punctual and territorial-specific analysis, also pointing out critical aspects or best practises.

Table 17: Identified specific success and risk factors

SubNode	Success	Risk
Bergamo	▪ Orio al Serio very close to the city and inside the catchment area ▪ Higher share of passengers originated from the SubNode, where the demand is denser, with respect to the catchment area ▪ Propensity of passengers to travel by collective transport to Malpensa (both terminals) ▪ Project of new rail link from Central station ▪ Extension of the regional rail services from Bergamo to Malpensa ▪ Extension of the suburban line S5 from Treviglio to Malpensa ▪ Linate could be accessible by regional rail service (via Treviglio and avoiding the transit in Milano) extending the metro line M4 to the eastern access gate in Segrate	▪ Orio al Serio base of only one major European low-cost airline (no service operator diversification) ▪ Substantial share of demand travelling from Milano by highly competitive collective road services
Brescia	▪ Linate could be accessible by high speed rail extending the metro line M4 to the eastern access gate in Segrate ▪ Propensity of passengers to travel by collective transport to Malpensa (notably, by train at Terminal 2)	▪ Travelling by train to Orio al Serio needs one change at the Bergamo Central station for both current and future situations. Two changes are needed travelling via Treviglio ▪ Development of other airports (i.e., Verona Villafranca and Brescia Montichiari) ▪ Very high share of passengers travelling at Malpensa Terminal 2 for leisure, personal or own family reasons (higher elasticity to income variation)
Como	▪ Coordination of timetables of rail services from San Giovanni and Como Lago at the new station of Albate Camerlata ▪ Linate accessible combining rail services (IC/Regional and S9) and M4 at Milano Forlanini ▪ Projects improving road accessibility to Malpensa	▪ Longer travel time by train to Malpensa (one change at Saronno from Como Lago and two changes at Albate Camerlata and Saronno from Como San Giovanni)
Varese	▪ Malpensa relatively close to city and catchment area ▪ Malpensa accessible by direct suburban line (S50), but low frequency ▪ Projects improving road accessibility to Malpensa	▪ High share of passengers originated by the catchment area, where demand is less dense, compared to the SubNode ▪ Very high share of passengers travelling at Malpensa Terminal 2 for leisure, personal or own family reasons (higher elasticity to income variation)

Source: Compilation of the authors

5. Synopsis

5.1. Status quo

5.1.1. Transport and socio-economic context

The Lombardy Region is crossed by three TEN-T Core Network Corridors: the Rhine-Alpine corridor, the Scandinavian-Mediterranean corridor and Mediterranean corridor. The Rhine-Alpine corridor passes through the areas of Como and Varese, while the Mediterranean corridor crosses the areas of Bergamo and Brescia. For the Scandinavian-Mediterranean corridor there is no particular significance, as it runs on the far eastern side of the Lombardy Region.

Malpensa, Linate and Orio al Serio are core airports and this definition implies that they are of the highest strategic importance for achieving the objectives of the TEN-T policy.

Not considering Milano, the main metropolitan area of the Region, the SubNodes and catchment areas are other important agglomerations. Out of around 10 million inhabitants, the four areas gather 1.6 million inhabitants, of which 0.5 million in the SubNodes and 1.1 million in the catchment areas, respectively.

The figures of the economic indicators, like income per capita and unemployment rate, are relatively in line with the regional average, although the SubNodes slightly outperform the catchment areas. Regarding the structure of the productive sectors, and comparing them to the regional data, the SubNodes show higher shares for industry production and conversely for service-related activities.

5.1.2. Demand of mobility

The demand of mobility is relatively intense and observed in the range of 0.7-0.9 journeys for an average working day (in 2016). The direction of the journeys is quite unbalanced, as the SubNodes attract more journeys from the catchment areas compared to those they generate. The mobility of SubNodes' residents substantially rely on private cars, being around 1 million the total number of vehicles of the four areas. The motorisation rate is in line or higher than the regional average (i.e., 0.61).

The observed volume of passengers at Malpensa and Orio al Serio has been constantly growing over the past years. For Linate, the volume of passengers is relatively stable through time, but limitations are enforced by law on the number of flights per hour and destinations.

According to surveys carried out on passengers' behaviour, the private car is the dominant mode to travel to the airports. For Malpensa, the modal share of the private car is unchanged comparing data of 2009 and 2016 (i.e., 69%). The modal share of collective transport has changed, being the share of rail increased from 13% to 17% and conversely that of road collective services decreased. This outcome depends on the construction of the rail link between the terminals. Interestingly, some difference for the modal shares between terminals. The modal share of the road collective services is slightly higher at Terminal 2 compared to the rail mode, and vice versa at Terminal 1.

According to surveys, the terminals attract more than 20% of the passengers originated from the SubNodes and catchment areas and show some diversity as regards the flows. As far as Bergamo, Brescia, and Como are concerned, the SubNodes generate more journeys to Terminal 1 compared to the catchment areas. As regards Terminal 2, this holds true for Bergamo and Brescia. For Varese, the closer distance to the airport is an underlying factor, especially for its catchment area which generates around 10% of the total journeys bounded for Terminal 1 and 13% of those bounded for Terminal 2.

For Linate, the survey of 2017 shows 67% of journeys by car and the rest by public transport. With respect to the total, the share of passengers originated from SubNodes and catchment areas is equal to 10.4% and considering the substantial share originated from Milano, this confirms Linate as "city airport".

For Orio al Serio, again the data show the private car dominant in 2013 (i.e., 68%). A more recent survey shows a slightly changed situation between 2013 and 2016, being the private car still preferred, but at a lower share (i.e., 63%). Not surprisingly, a substantial share of passengers originates from the SubNode and catchment area of Bergamo (i.e., 27.5%).

5.1.3. Collective transport services

The bulk of collective transport services is provided by coaches linking Milano Central station with Malpensa and Orio al Serio. Three companies operate the services with frequent runs. The volume of passengers has been increasing from 2014 to 2018, with some 2.8 million for both Malpensa and Orio al Serio.

Other scheduled coach services and dedicated (on demand) lines are operated between the SubNodes and the airports of Malpensa and Orio al Serio. Their frequency is low and the observed demand little, or negligible. Urban bus lines connect the city centre of Milano with Linate and the Bergamo Central station with Orio al Serio.

Milano is the hub also for the rail services linking Malpensa, which originate from the Central and Cadorna stations, have high frequency and travel time depending on the number of stops. The suburban line S50 links Malpensa with Varese and Mendrisio (every 2 hours) and line S40 makes also possible to reach Como (with one change at Mendrisio station). It is also worth noting that currently Malpensa can be reached from Como Lago with one change in Saronno.

Orio al Serio is not yet connected with the national railway network. However, regional services from Milano Central station link Bergamo Central station every 30 minutes, either with a direct service, or with one change in Treviglio.

5.2. Regional strategy

5.2.1. Objectives and fields of action

As regards the regional context of Lombardy, the SubNodes strategy aims to improve the connectivity level between 3 core airports and the 4 identified SubNodes. To achieve this objective, the strategy targets to develop reliable collective transport services for smooth and sustainable intermodal connections at nodes.

The PRMT acknowledges the relevance of ensuring efficient intermodal changes to provide alternatives to private cars and deems the development of smooths connections strategic. In this view, the characteristics of the context stemming from the analysis of the status quo combined with the SWOT analysis allowed to identify fields of action to pursue the strategy. The fields of action can be related to (i) the development of infrastructure projects and soft measures and (ii) the improvement of the characteristics of collective transport services to make it more attractive and eventually enhancing the current level of patronage.

Efficiency gains for intermodal change optimisation must target users' transport costs and travel time and adaptations of collective services should focus on relevant modal choice criteria.

Travel time is at the highest importance and for collective transport highly dependent on the mode(s) to travel from the origin to a departure station and from an arrival station to the final destination. Because the total travel time of collective transport is in general higher than that of private cars, collective transport is in general slower, and to be more competitive, its total travel time has to be reduced.

The territorial context of the subNodes is characterised by high congestion levels, which may make the reliability and the frequency of collective transport key competitive advantages. Other aspects are equally

important, like (i) the quality of sale services, which simplifies tickets purchase and (ii) the level of comfort, maintenance and cleanliness of stations and vehicles, which increases the users travel experience.

5.2.2. Projects and measures of the PRMT

The PRMT foresees a number of infrastructure projects to enhance the current level of accessibility of the three airports. They mainly focus on rail and road transport.

The most important rail projects envisage (i) the completion of northern and southern links to Malpensa, (ii) the improvement of the section between Rho and Gallarate, (iii) the construction of the metro line M4 in Milano and (iv) the construction of a new link between Bergamo Central station and Orio al Serio. Considering the improvements of the rail services, the estimated cost amounts to some € 3.5 billion. For the road projects, they aim to enhance the accessibility of Malpensa and amount to some € 1.4 billion.

A number of soft measures are also envisaged. They are not specifically tailored for users travelling from SubNodes and catchment areas and should be considered as measures to improve the accessibility in general. The soft measures encompass (i) layout and facilities improvements at stations, (ii) adoption of standardised signs, (iii) ticketing integration, (iv) provision of facilities for sustainable modes at first and list mile sections and (v) technology innovations functional to the previous ones. The estimated cost is € 75 million.

5.3. Approachies for implementation

5.3.1. Revision of the regional transport plan

The envisaged infrastructure projects, modifications of transport services and soft measures of the PRMT are broadly in line with the general and specific objectives of the SubNodes strategy, as conceived to improve the current accessibility levels of users travelling to the airports. For further accessibility improvements, the following adaptations of the PRMT have been identified.

For infrastructure projects, a new eastern rail access gate near Linate would improve the accessibility for users travelling from SubNodes and catchment areas of Bergamo and Brescia, avoiding longer travel times to reach Linate via Milano. Such new eastern rail access gate could be located between Redecesio and the station of Pioltello Limito, extending the metro line M4 from Linate, and making the new terminus an intermodal hub for changes with suburban, regional and high-speed train services.

For rail services, the following fit the objectives of the SubNodes strategy. First, the new rail link between Bergamo Central station and Orio al Serio could allow to optimise and coordinate rail services at Bergamo Central station. Second, the extension of the regional rail services from Bergamo to Malpensa Terminal 2, (via Carnate Usmate - Seregno - Saronno - Busto Arsizio) could provide more travel options from the eastern SubNodes, also avoiding one modal change at Milano Central station. Third, once the connection between RFI and FNM stations at Albate Camerlata will be completed, adaptations and coordination of the services could be another option for users travelling from Como.

For soft measures, a broad scope of strategies and actions have been identified over short-, medium- and long-term time horizons.

Over a short-term horizon, they are as follows.

- More reliable collective transport by implementing adaptations of start and end time of the runs of road transport in order to develop tailored measures that fit with the characteristics of the demand of the SubNodes.
- Integrated, simple and smart ticketing through fully integrated systems, also including local basin authorities. Notably, systems should focus on incorporating the option to travel to the airports.

Besides, smart ticketing could avoid deploying and managing traditional purchase options in low-density areas, which may be costly and where inspectors might not be always on duty.

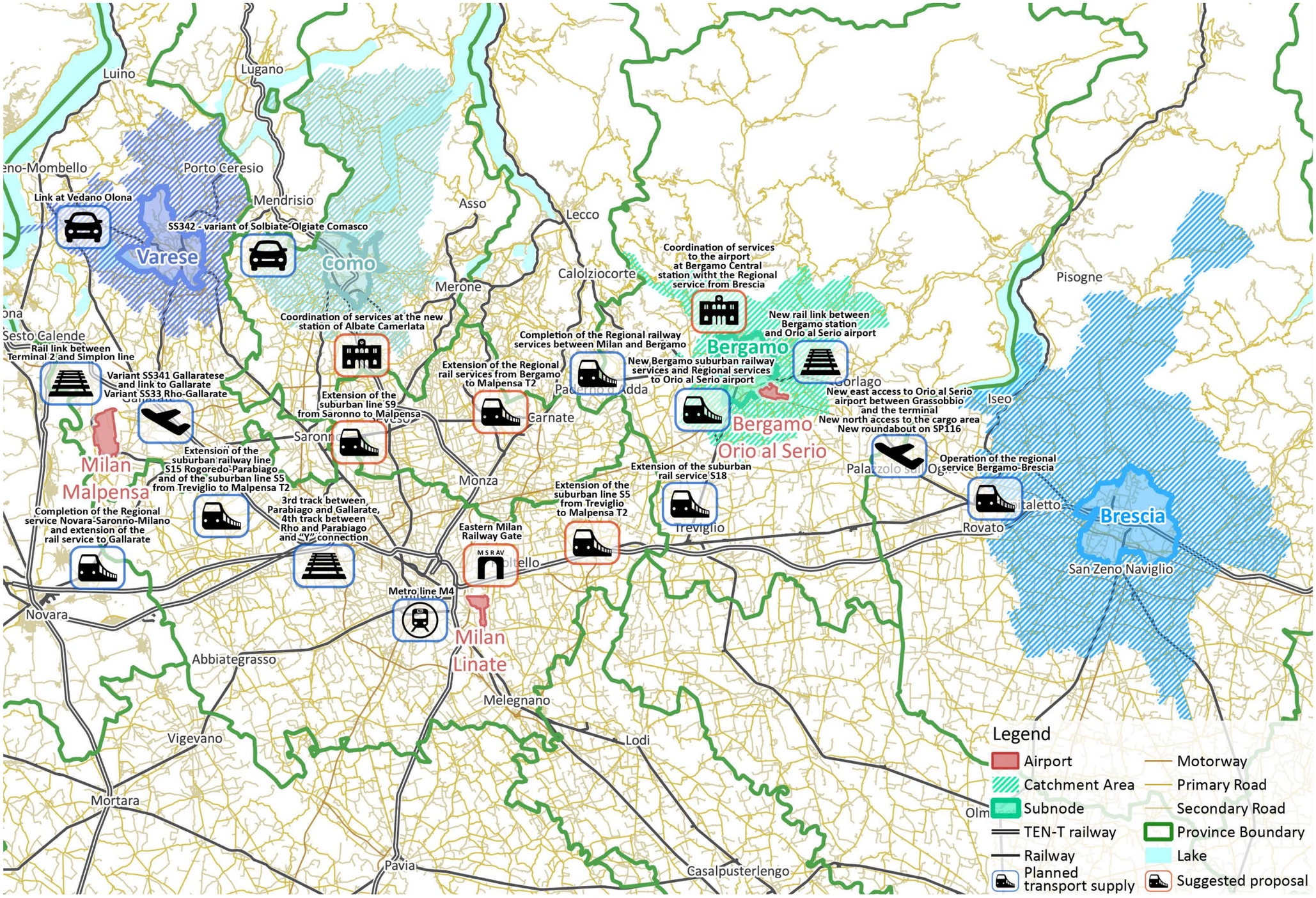
- Layout and design of stations and stops could be improved to attract new users, providing a general and widespread sense of belonging, uniform style of signs and branding. This especially highlighting the airports as destinations, dedicated services and tickets options. Considering the significant share foreign tourists and immigrants that may potentially travel, written information should be displayed also in other non-European languages.
- Facilities for sustainable transport should be developed to stress the potential of diverting users to environmental-friendly modes and raise awareness about the broadest scope of options. Appropriate signing and icons could help to make such options clearly identifiable.
- Periodic marketing and advertising campaigns are tailored actions that could make users aware of the characteristics of the services and options to travel to airports, also focussing on transport sustainability- and safety-related aspects.
- Other measures:
  - give clear indications for accountability, complains, or to report issues in relation to services and infrastructures quality; and
  - allocate adequate budget to develop, monitor and maintain infrastructures and services.

Over a medium- and long-term horizon, they are as follows.

- Maas platforms are still at an early stage of development, but concept of travel planning behind could have an impact on future mobility. This make the development MaaS platforms suitable candidates to adapt the regional programme at the strategy level.
- Other measures:
  - refurbishment of stations that are part of the urban communities they serve, restoring (historic) buildings for community and business purposes;
  - development of collective transport networks that have the capacity to support urban densification; and
  - development of opportunities for people to live close to stations and stops, reducing urban sprawl and private car dependency.

Figure 15 on the next page shows the overview of transport services, infrastructure projects and measures in the broadest context of SubNodes and catchment areas.

Figure 15: Overview of transport services, infrastructure projects and measures in the broadest context of SubNodes and catchment areas



Source: Elaboration of the authors

5.3.2. Risk and success factors

Final considerations on success and risk factors are useful to effectively develop the SubNodes strategy, when implementing the measures of the PRMT and enlarging their scope through suggested adaptations. In particular, success and risk factors address aspects that are related to socio-economic elements, transport infrastructures and services characteristics and governance and planning dimensions.

An underlying success factor to stress is related to the status of the economy and employment level, because transport demand stems from them and any change may have an impact. This specially holds true for users travelling for vacation or tourism purposes, which show a higher elasticity to personal income variation.

With respect to the dimension of transport infrastructures and services, aspects like a direct connection, smooth intra- and inter-modal changes at nodes, better spread of runs during day and night times (and their frequency) and the availability of tools for travel planning, as well as innovative, sustainable and smart transport alternatives, may indeed positively matter. They can be success factors to reduce journey time travelling by collective transport, improve the quality of collective services and enhance accessibility levels, also for users with reduced mobility.

Finally, the proximity to three TEN-T Core Network Corridors and the fact that the three airports are Core nodes in the EU transport policy makes them of strategic importance when deciding on actions involving the governance and planning realms. However, such favourable prerequisites may be hampered by poor budget allocation and resources management, ultimately affecting actions implementation timing.

References

Arndt, W.-H.et al., 2019. *Integration of shared mobility approaches in Sustainable Urban Mobility Planning.* s.l.:PROSPERITY project.

Baccelli, O., Brenna, C. & Galdi, R., 2017. *Lo sviluppo dell'intermodaità ferroviaria a Milano Malpensa, Scenari e prooste operative.* CERTET , Università Bocconi.

Birolini, S., Malighetti, P., Redondi, P. & Deforza, P., 2019. *Access mode to low-cost airports: Evaluation of new direct rail services at Milano Bergamo airport.* Transport Policy 73, (2019) 113-124.

Blaquière, A., 2015. *Innovative multimodal PT contracts, services and electronic ticketing in Toulouse.* Eltis portal.

Booz&Co, 2009. *The benefits of simplified and integrated ticketing in public transport.* United Kingdom, October 2009, Passenger Transport Executive Group.

Città di Segrate, 2017. *Piano di Governo del Territorio, Documento di Piano, Elaborato DdP 6.* Segrate

Citta Metropolitana di Milano, 2019. *Atti del Sindaco Metropolitano.*

de Clerck, L., 2015. *Helping visually impaired passengers travel around Prague (Czech Republic).* Eltis portal.

den Boer, E. et al., 2018. *Modal choice criteria in rail transport, Assessment of modal choice criteria in various rail transport market segments.* September 2018, CE Delft.

Di Bartolo, C., 2013. *Introducing smart-card travel in Bolzano (Italy).* updated January 2015, Eltis portal.

ERTICO – ITS Europe (editor), 2019. *Intelligent Transport Systems (ITS) and SUMPs – making smarter integrated mobility plans and policies*.

European Commission, 2013. *Regulation (EU) No 1315/2013 of the European Parliament and of the Council of 11 December 2013 on Union guidelines for the development of the trans-European transport network and repealing Decision No 611/2010/EU.* Strasbourg, 11 December 2013: Official Journal of the European Union.

Frost & Sullivan, 2013. *Rail Outlook Study 2013-2022: Paradigm Shift Towards Intermodal Mobility Boosts Growth in All Rail Segments*.

Ibraeva, A. & Figueira de Sousa, J., 2014. *Marketing of Public Transport and Public Transport Information Provision.* Procedia - Social and Behavioral Sciences 162 (2014), 121-128.

IRER, 2009. *Indagine conoscitiva sull'accessibilità dell'aeroporto di Malpensa, Rapporto finale.*

IRER, 2010a. *Indagine conoscitiva sull'accessibilità dell'aeroporto di Malpensa, Sintesi.*

IRER, 2010b. *I servizi di collegamento aeroportuale, Rapporto di legislatura*.

Kemppainen, S., 2015. *Improving Turku's bus network through an innovative ITS (Finland).* Eltis portal.

Klemenčič, M. & Jurič, B., 2012. *Joint Best Practice Report, Work Package 3, Collection of Best Practices.* Fabruary 2013, Faculty of Civil Engineering, University of Maribor.

LAirA, 2019a. *Multimodal and sustainable low carbon mobility integration of airports and their catchment areas*.

LAirA, 2019b. *Wayfinding at airports*.

Litman, T., 2016. *The Future Isn't What It Used To Be : Changing Trends and their Implications for Transport Planning.* Victoria Transport Policy Institute.

Maynard, 2019. *Developing intuitive wayfinding for London Bridge Station,* London.

Mendeova, J., 2013. *Supporting the development of electric mobility in Prague.* last revision, 2015, Eltis portal.

MIT and ENAC, 2012. *Piano nazionale degli aeroporti.* Febbraio 2012.

Modijefsky, M., 2019. *Lyon: putting accessibility at the heart of city life.* Eltis portal.

Momondo, 2016. *Annual Flight Study*.

Müller, B. & Meyer, G., 2019. *Towards User-Centric Transport in Europe, Challenges, Solutions and Collaborations.* Springer.

Polis and Rupprecht Consult (eds.), 2019. *Topic Guide: Electrification - Planning for electric road transport in the SUMP context*.

Redman, L., Friman, M., Garling, T. & Hartig, T., 2013. *Quality attributes of public transport that attract car users: A research review.* Volume 25, pp. 119-127, Transport Policy.

Regione Lombardia, 2016. *Programma Regionale Mobility e Trasporti*, DG Infrastrutture e Mobilità.

Regione Lombardia, 2019. *Programma Regionale Mobilità e Trasporti, Relazione di monitoraggio intermedio.* Regione Lombardia in collaborazine con Polis Lombardia.

RFI, 2019. *Piano Investimenti per la Lombardia.* 20 Febbraio 2019.

Ripa, F., 2019. *How Dutch railway stations encourage multimodality,* Eltis portal.

SACBO, 2016. *Piano di Sviluppo Aeroportuale. Relazione illustrativa degli interventi,* si veda in particolare, Scheda 5.1 Viabilità e Scheda 11.1 Infrastrutture Programmate (Reti TEN-T).

UIC, 2015. *Global Vision for Railway Development.* Paris.

UITP, 2017. *Digitalisation in public transport, Report*.

Vescia, G., 2016. *Aeroporto di Linate, Nuovo Masterplan di Milano Linate, Studio di Impatto Viabilistico Analisi Modellistiche, Descrizione del sistema viario, dei trasporti e della rete di accesso, Dicembre 2016*.

Annex

The annex presents estimations of passengers annual volume originated from SubNodes and catchment areas, the current and planned supply of transport services, as well as the identified projects and measures in the territorial contexts under consideration.

The estimations of passengers annual volume have been developed on the data and information available from the surveys conducted on users' behaviour by airports' managers in 2016 and 2018. In particular, the tables on the next pages present the estimated (i) volume of passengers and percentages originated from SubNodes and catchment areas and (ii) modal split by airport.

The data used as starting point refer to the data presented in Table 6 and Table 7 and in other relevant figures reported throughout the note. In order to harmonise different sources and years, some intermediate elaborations have been carried out by the authors where necessary.

As regards the supply of transport services and identified projects and measures, they have been located drawing the information from Table 12 and Table 13. Magnified portions of the overview (see Figure 15 in section 5.3.1) provide dedicated illustrations for each SubNode. They display (i) the estimated percentages of passengers generated by the SubNodes and catchment areas and that are bounded for the three airports and (ii) the planned and suggested interventions (i.e., infrastructures and services) that are of specific relevance for the concerned area.

SubNode of Bergamo

Transport demand

The data in Table 19 shows that the largest share of the passengers originated from Bergamo SubNode and its catchment is found travelling to Orio al Serio. In particular, around 2.7 million passengers travel from the SubNode, which consists of 85% of the total for this area. Moreover, some 814 thousand passengers are estimated travelling from the catchment area, namely 73% of the total. Although the estimation suggests a by far less volume, the second destination travelling from the SubNode is Malpensa Terminal 1.

Not surprisingly for Orio al Serio, a substantial share of the estimated passengers (i.e., 59% for the SubNode and 77% for the catchment area) travel from EU Member States, which underlines its remarkable role acting as hub base of one major European low-cost airline.

Table 18: Estimated annual volume of passengers originated from Bergamo SubNode and catchment area

Airport	Total				SubNode				Catchment Area			
	SubNode	%	Catchment Area	%	Italian	EU	Extra-EU	Total	Italian	EU	Extra-EU	Total
Orio al Serio	2,741,000	85%	814,200	73%	36%	59%	5%	**100%**	20%	77%	3%	**100%**
Malpensa T1	274,100	8%	134,700	12%	79%	7%	14%	**100%**	95%	2%	3%	**100%**
Malpensa T2	52,500	2%	29,400	3%	80%	16%	4%	**100%**	54%	15%	31%	**100%**
Linate	158,500	5%	143,000	13%	73%	20%	8%	**100%**	87%	12%	1%	**100%**
Total	**3,226,100**	**100%**	**1,121,300**	**100%**								

Source: Estimation of the authors on data of SEA (2016) and SACBO (2018)

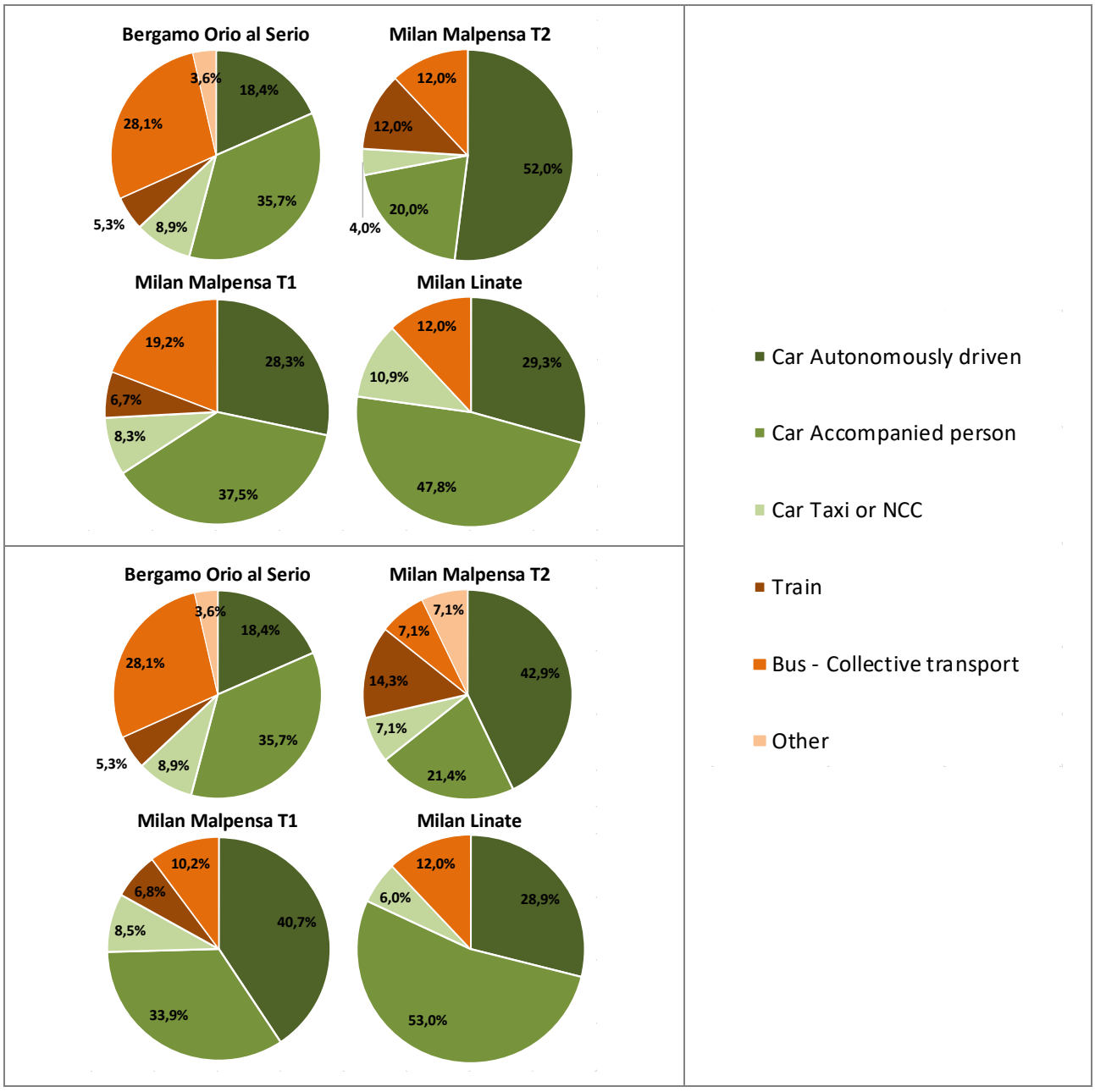
With respect to the transport mode (see Table 20 and Figure 16), the majority of travellers originating from Bergamo SubNode reach the airports by car. In particular, for Orio al Serio 63% of the travellers is estimated to use a private car, either driving personally or as accompanied person. Some 74% of the travellers is estimated to reach Malpensa Terminal 1 from the SubNode travelling by car and 83% from the catchment area. The second preferred transport mode is the collective road transport, in particularly to travel to Orio al Serio (28%).

Table 19: Estimated modal split of passengers of Bergamo SubNode and catchment area by airport

Area	Airport	Car			Train	Bus - Collective transport	Other	Total
		Autonomously driven	Accompanied person	Taxi or NCC				
SubNode	Orio al Serio	18.4%	35.7%	8.9%	5.3%	28.1%	3.6%	**100.0%**
	Malpensa T1	28.3%	37.5%	8.3%	6.7%	19.2%	0.0%	**100.0%**
	Malpensa T2	52.0%	20.0%	4.0%	12.0%	12.0%	0.0%	**100.0%**
	Linate	29.3%	47.8%	10.9%	0.0%	12.0%	0.0%	**100.0%**
Catchment	Orio al Serio	18.4%	35.7%	8.9%	5.3%	28.1%	3.6%	**100.0%**
	Malpensa T1	40.7%	33.9%	8.5%	6.8%	10.2%	0.0%	**100.0%**
	Malpensa T2	42.9%	21.4%	7.1%	14.3%	7.1%	7.1%	**100.0%**
	Linate	28.9%	53.0%	6.0%	0.0%	12.0%	0.0%	**100.0%**

Source: Estimation of the authors on data of SEA (2016) and SACBO (2018)

Figure 16: Estimated modal split of passengers of Bergamo SubNode (above) and catchment area (below)



Source: Estimation of the authors on data of SEA (2016) and SACBO (2018)

Current transport supply

Currently, Bergamo is linked to Orio al Serio with the urban bus line number 1, which operates 53 runs on a daily basis between the central station and the airport. Services by coach are operated between the airport and Milano and other touristic destinations, like for example Ponte di Legno. Indeed, the central station is an important intermodal node, where regional rail services, suburban and urban services are connected.

Also Malpensa airport can be reached by coach from Bergamo. The service operates 8 links per day and the journey takes 1 hour and 50 minutes. Otherwise, it is possible to combine the regional and Malpensa Express rail services transiting in Milan Central Station.

Planned transport supply and new proposal

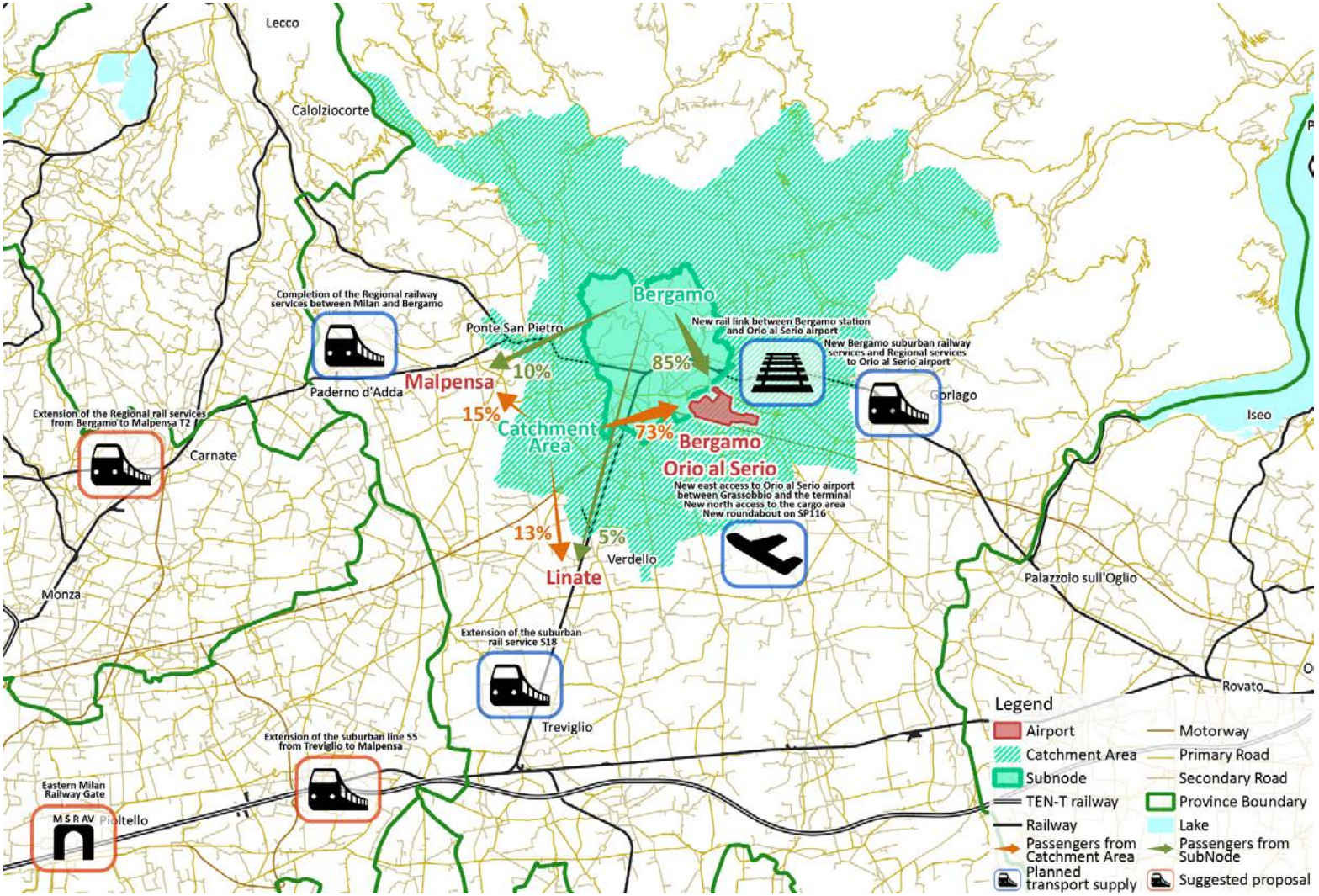
The following projects are envisaged in the PRMT to improve the current transport infrastructures and services between Bergamo SubNode, its catchment area and the concerned airports:

- new rail link between Bergamo station and Orio al Serio airport;
- new Bergamo suburban railway services and regional services to Orio al Serio airport;
- completion of the regional railway service between Milan and Bergamo;
- extension of the suburban rail service S18;
- new east access to Orio al Serio airport between Grassobbio and the terminal;
- new north access to the cargo area;
- new roundabout on SP116;
- development of innovative technologies and electronic ticketing system;
- ticketing integration;
- integration of public transport with new sustainable modes; and
- efficiency improvements of road collective transport.

The following projects and measures are suggested proposals to improve the current accessibility from the SubNode and catchment area:

- more reliable collective transport, e.g. better spread of runs;
- simple ticketing and clear understanding of the relevant information for travellers;
- improve design and layout of station and stops to make them easy to find and provide clear walking paths, using well marked horizontal wayfinding for access and egress (colour differentiation is useful); with facilities for elderly people and persons with reduced ability or mobility; with facilities for sustainable transport modes, which can be alternative to private car for feeder segments;
- eastern Milan railway access gate;
- extension of the regional railway services from Bergamo to Malpensa Terminal 2; and
- extension of the suburban line S5 from Treviglio to Malpensa.

Figure 17: Transport services, infrastructure projects and measures of Bergamo SubNode



Source: Elaboration of the authors

SubNode of Brescia

Transport demand

The estimations presented in Table 21 show more than half of the passengers travelling from the SubNode to Orio al Serio, being around 632 thousand and consisting of 56% of the total of this area. On the other hand, Malpensa is the airport of the passengers estimated travelling from the catchment area, because attracting around 149 thousand passengers (i.e., 105 thousand for Terminal 1 and 44 thousand for Terminal 2).

With respect to the nationality, the majority of the passengers originates from EU Member States at Orio al Serio (i.e., 72% of travellers from the SubNode). Travellers at Malpensa terminals and Linate are found mostly domestic for both SubNode and catchment area.

Table 20: Estimated volume of passengers originated from Brescia SubNode and catchment area

Airport	Total				SubNode				Catchment Area			
	SubNode	%	Catchment Area	%	Italian	EU	Extra-EU	Total	Italian	EU	Extra-EU	Total
Orio al Serio	631,900	56%	43,500	14%	24%	72%	4%	**100%**	0%	100%	0%	**100%**
Malpensa T1	324,300	29%	105,100	35%	83%	6%	11%	**100%**	71%	22%	7%	**100%**
Malpensa T2	46,200	4%	44,100	15%	77%	14%	9%	**100%**	57%	33%	10%	**100%**
Linate	117,200	11%	108,500	36%	78%	15%	7%	**100%**	70%	25%	5%	**100%**
Total	**1,119,600**	**100%**	**301,200**	**100%**								

Source: Estimation of the authors on data of SEA (2016) and SACBO (2018)

Passengers are estimated travelling mostly by private car between the SubNode and the airports (see Table 22 and Figure 18). In particular, to reach Orio al Serio, some 63.0% is estimated travel by private car, either driving personally or as accompanied person. For Malpensa the share is estimated to be even higher, as 86.6% of the passengers could travel by car to reach Terminal 1 from the SubNode and 80.4% is the estimated share for the catchment area.

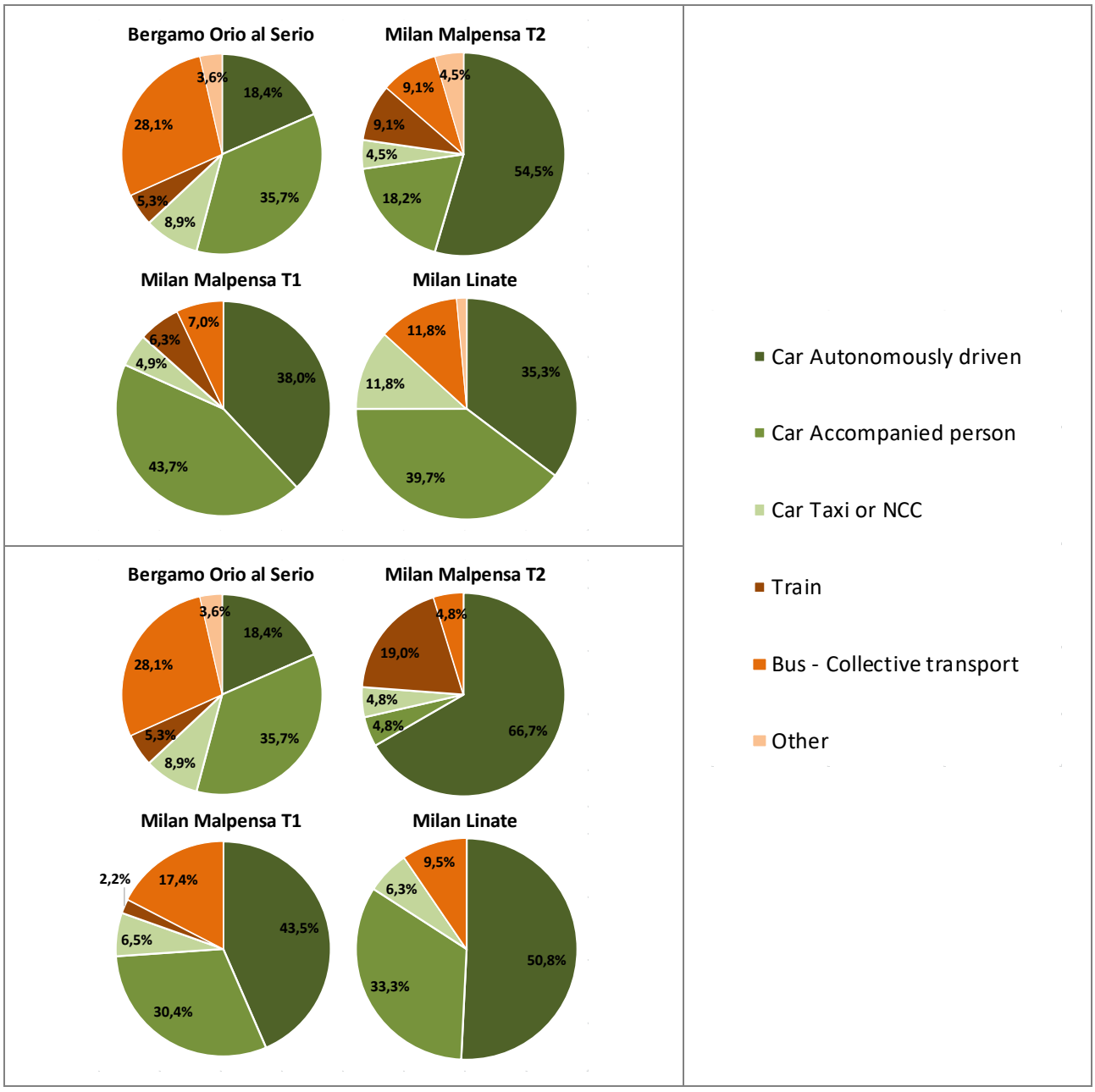
The second estimated mode is road collective transport, in particular to reach Orio al Serio (i.e., 28.1%). It is worth noting that Malpensa Terminal 1 is estimated to be reached by 17.4% of the passengers travelling from the catchment area by road collective transport. Likewise, Malpensa Terminal 2 shows a relatively high share of travellers reaching the airport by train from the catchment area (i.e., 19.0%).

Table 21: Estimated modal split of passengers of Brescia SubNode and catchment area by airport

Area	Airport	Car			Train	Bus - Collective transport	Other	Total
		Autonomously driven	Accompanied person	Taxi or NCC				
SubNode	Orio al Serio	18.4%	35.7%	8.9%	5.3%	28.1%	3.6%	**100.0%**
	Malpensa T1	38.0%	43.7%	4.9%	6.3%	7.0%	0.0%	**100.0%**
	Malpensa T2	54.5%	18.2%	4.5%	9.1%	9.1%	4.5%	**100.0%**
	Linate	35.3%	39.7%	11.8%	0.0%	11.8%	1.5%	**100.0%**
Catchment	Orio al Serio	18.4%	35.7%	8.9%	5.3%	28.1%	3.6%	**100.0%**
	Malpensa T1	43.5%	30.4%	6.5%	2.2%	17.4%	0.0%	**100.0%**
	Malpensa T2	66.7%	4.8%	4.8%	19.0%	4.8%	0.0%	**100.0%**
	Linate	50.8%	33.3%	6.3%	0.0%	9.5%	0.0%	**100.0%**

Source: Estimation of the authors on data of SEA (2016) and SACBO (2018)

Figure 18: Estimated modal split of passengers of Brescia SubNode (above) and catchment area (below)



Source: Estimation of the authors on data of SEA (2016) and SACBO (2018)

Current transport supply

Currently, the city of Brescia is linked to Orio al Serio airport by coach. This service operates 10 daily runs between Brescia city centre and the airport. In addition, one line belonging to the services provided by Brescia basin transport authority reaches Ponte di Legno and Milano, with stop nearby Orio al Serio. In Brescia the train station is an important transit hub, where the travellers can find underground services and a bus station, which is the terminal of most important bus lines operated in the surroundings.

Malpensa airport can be reached by train combining regional or long-distance services with Malpensa Express at Milano central station.

Planned transport supply and new proposal

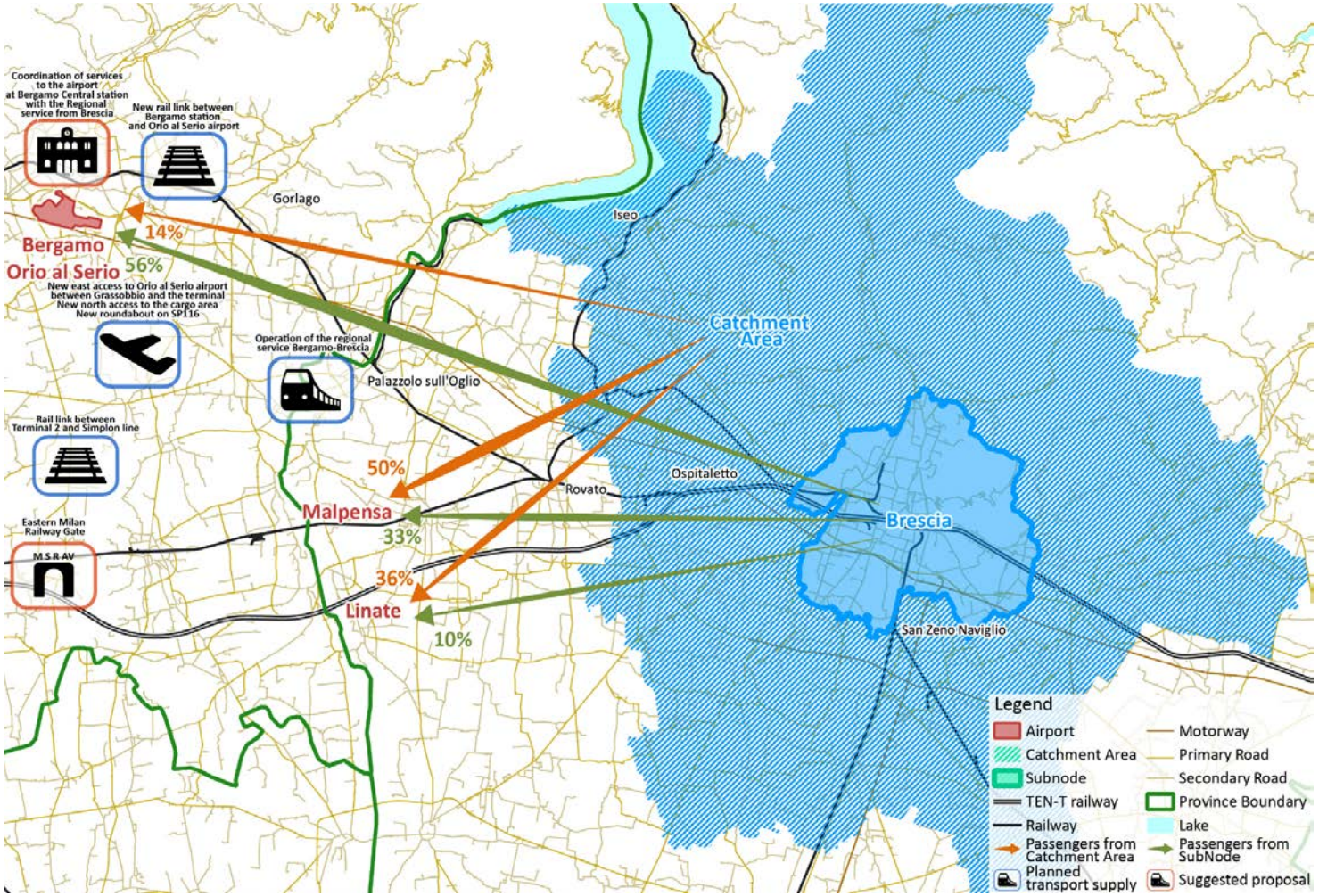
The following projects are envisaged in the PRMT to improve the current transport infrastructures and services between Brescia SubNode, its catchment area and the concerned airports:

- rail link between Terminal 2 and Simplon line;
- new rail link between Bergamo station and Orio al Serio airport;
- operation of the regional service Bergamo-Brescia;
- new east access to Orio al Serio airport between Grassobbio and the terminal;
- new north access to the cargo area;
- new roundabout on SP116;
- development of innovative technologies and electronic ticketing system;
- ticketing integration;
- integration of public transport with new sustainable modes; and
- efficiency improvements of road collective transport.

The following projects and measures are suggested proposals to improve the current accessibility from the SubNode and catchment area:

- more reliable collective transport, e.g. better spread of run;
- simple ticketing and clear understanding of the relevant information for travellers;
- improve design and layout of station and stops to make them easy to find and provide clear walking paths, using well marked horizontal wayfinding for access and egress (colour differentiation is useful); with facilities for elderly people and persons with reduced ability or mobility; with facilities for sustainable transport modes, which can be alternative to private car for feeder segments;
- eastern Milan railway access gate; and
- coordination of services to the airport at Bergamo Central station with the regional service from Brescia.

Figure 19: Transport services, infrastructure projects and measures of Brescia SubNode



Source: Elaboration of the authors

SubNode of Como

Transport demand

Table 23 shows that the majority of passengers is estimated travelling between the SubNode and catchment area and Malpensa airport. In particular for the SubNode, 340 thousand passengers are estimated travelling from Terminal 1 (i.e., 45%) and more than 172 thousand from Terminal 2 (i.e., 23%). Comparable volumes are estimated for the passengers of the catchment area, being 290 thousand for Terminal 1 and 204 thousand for Terminal 2 (i.e., 48% and 34%, respectively). The majority of the passengers at Malpensa airport is estimated to be domestic and in particular 52% for Terminal 1 and 72% for Terminal 2 from the SubNode and 72% and 71% for the catchment area.

The second airport by estimated volume of passengers is Linate, being 143 thousand travellers estimated from the SubNode and some 102 thousand estimated from the catchment area (i.e., 19% and 17%, respectively). Most of the travellers is estimated to be domestic, namely 57% from the SubNode and 81% for the catchment area. Orio al Serio shows comparatively low percentages, for example only 2% of the travellers from the catchment area of Como reaches the airport.

Table 22: Estimated volume of passengers originated from Como SubNode and catchment area

Airport	Total				SubNode				Catchment Area			
	SubNode	%	Catchment Area	%	Italian	EU	Extra-EU	Total	Italian	EU	Extra-EU	Total
Orio al Serio	101,500	13%	10,400	2%	27%	69%	4%	**100%**	0%	100%	0%	**100%**
Malpensa T1	340,300	45%	290,000	48%	52%	26%	22%	**100%**	72%	17%	11%	**100%**
Malpensa T2	172,300	23%	203,800	34%	72%	22%	6%	**100%**	71%	16%	13%	**100%**
Linate	143,000	19%	101,700	17%	57%	32%	11%	**100%**	81%	14%	5%	**100%**
Total	**757,100**	**100%**	**605,900**	**100%**								

Source: Estimation of the authors on data of SEA (2016) and SACBO (2018)

In general, the estimated passengers originating from the SubNode travel by private car (see Table 24 and Figure 20). In particular, 63.0% of the travellers reach Orio al Serio, 84.5% reach Malpensa Terminal 1 and 87.8% travel to Malpensa Terminal 2. Higher shares are estimated for passengers travelling to Malpensa terminals from the catchment area (i.e., 88.2% and 89.7%, respectively).

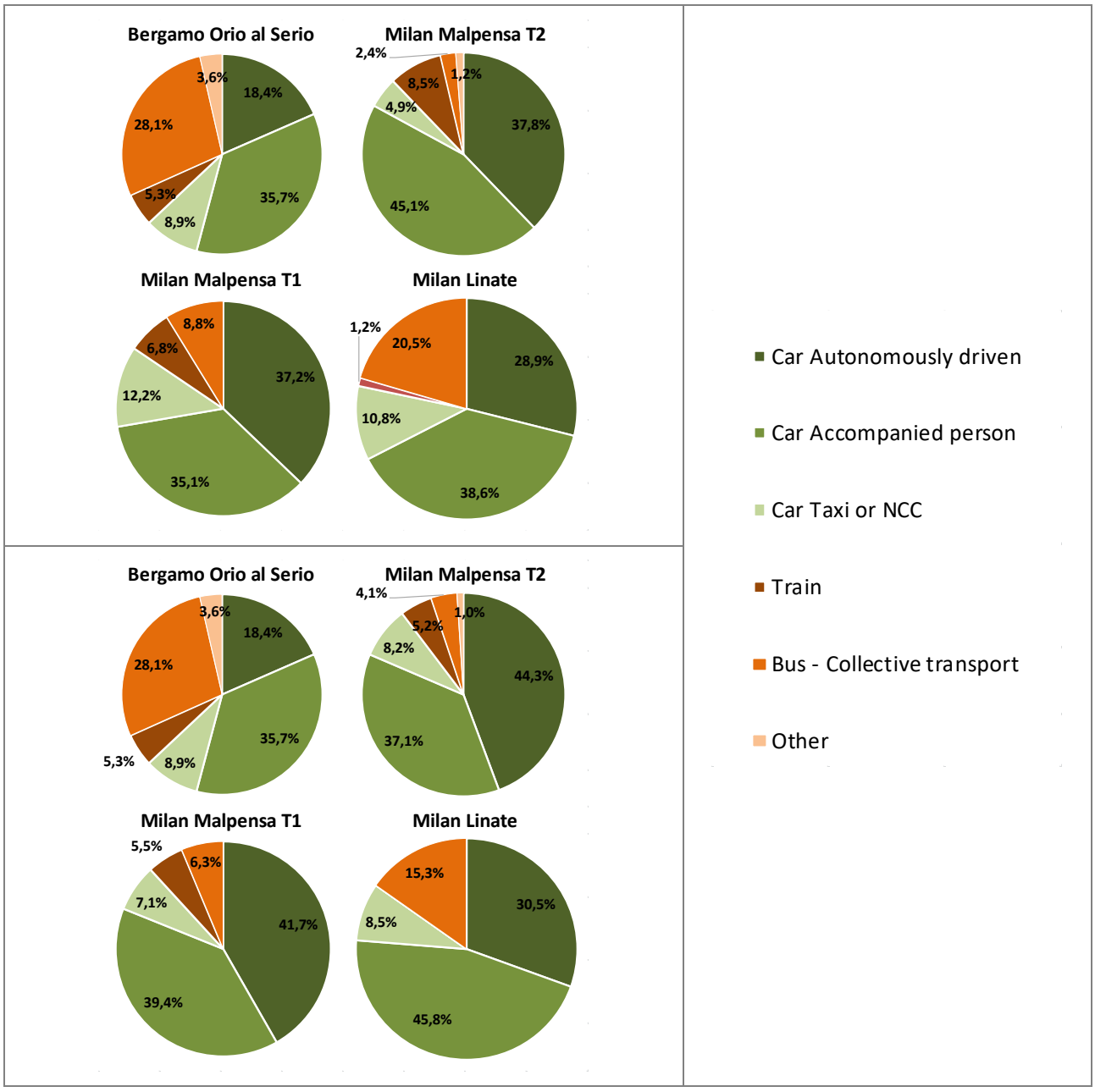
The second most used mode is estimated to be road collective transport and in particular to reach Orio al Serio (i.e., 28.1%). Also for Linate the share of passengers estimated to travel by collective transport is found relatively high, being 20.5% for the SubNode and 15.3% for the catchment area, respectively. The share of passengers estimated travelling to Malpensa terminals by collective transport is estimated to be generally low or negligible.

Table 23: Estimated modal split of passengers of Como SubNode and catchment area by airport

Area	Airport	Car			Train	Bus - Collective transport	Other	Total
		Autonomously driven	Accompanied person	Taxi or NCC				
SubNode	Orio al Serio	18.4%	35.7%	8.9%	5.3%	28.1%	3.6%	**100.0%**
	Malpensa T1	37.2%	35.1%	12.2%	6.8%	8.8%	0.0%	**100.0%**
	Malpensa T2	37.8%	45.1%	4.9%	8.5%	2.4%	1.2%	**100.0%**
	Linate	28.9%	38.6%	10.8%	1.2%	20.5%	0.0%	**100.0%**
Catchment	Orio al Serio	18.4%	35.7%	8.9%	5.3%	28.1%	3.6%	**100.0%**
	Malpensa T1	41.7%	39.4%	7.1%	5.5%	6.3%	0.0%	**100.0%**
	Malpensa T2	44.3%	37.1%	8.2%	5.2%	4.1%	1.0%	**100.0%**
	Linate	30.5%	45.8%	8.5%	0.0%	15.3%	0.0%	**100.0%**

Source: Estimation of the authors on data of SEA (2016) and SACBO (2018)

Figure 20: Estimated modal split of passengers of Como SubNode (above) and catchment area (below)



Source: Estimation of the authors on data of SEA (2016) and SACBO (2018)

Current transport supply

Currently Como is not directly linked to Malpensa Airport, neither by train nor by collective road transport. The same holds for Orio al Serio.

If not travelling by car, all concerned airports have to be reached combining different transport services. For example, to reach Malpensa passengers have to change the train service from regional to Malpensa Express at Saronno, while to reach Orio al Serio passengers have to change mode at Milano Central station from train to coach.

Planned transport supply and new proposal

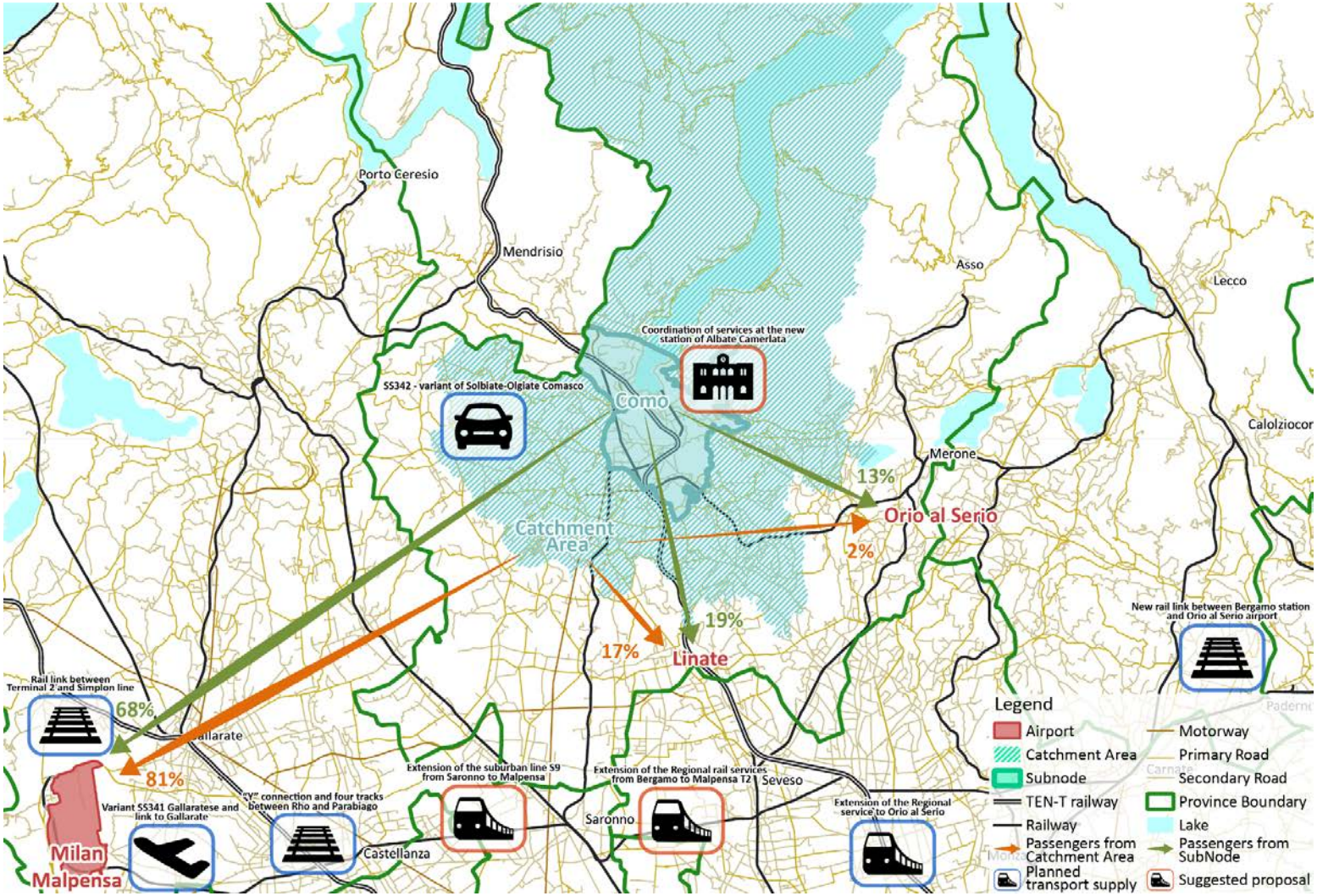
The following projects are envisaged in the PRMT to improve the current transport infrastructures and services between Como SubNode, its catchment area and the concerned airports:

- rail link between Terminal 2 and Simplon line;
- "Y-connection" and four tracks between Rho and Parabiago;
- extension of the Regional service to Orio al Serio;
- SS342 – variant of Solbiate-Olgiate Comasco;
- variant SS341 Gallaratese and link to Gallarate
- new rail link between Bergamo station and Orio al Serio airport;
- development of innovative technologies and electronic ticketing system;
- ticketing integration;
- integration of public transport with new sustainable modes; and
- efficiency improvements of road collective transport.

The following projects and measures are suggested proposals to improve the current accessibility from the SubNode and catchment area:

- more reliable collective transport, e.g. better spread of run;
- simple ticketing and clear understanding of the relevant information for travellers;
- improve design and layout of station and stops to make them easy to find and provide clear walking paths, using well marked horizontal wayfinding for access and egress (colour differentiation is useful); with facilities for elderly people and persons with reduced ability or mobility; with facilities for sustainable transport modes, which can be alternative to private car for feeder segments;
- extension of the regional rail services from Bergamo to Malpensa Terminal 2, via Carnate Usmate - Seregno - Saronno - Busto Arsizio;
- coordination of services at the new station of Albate Camerlata; and
- extension of the suburban line S9 from Saronno to Malpensa.

Figure 21: Transport services, infrastructure projects and measures of Como SubNode



Source: Elaboration of the authors

SubNode of Varese

Transport demand

Table 25 shows that the majority of passengers estimated originating from the SubNode and catchment area travel to Malpensa terminals. In this respect, 306 thousand are estimated from Terminal 1 (i.e., 46%), and 271 thousand from Terminal 2 (i.e., 40%). Similar proportions, but substantially higher volumes, are estimated for travellers from the catchment area, being 1.6 million from Terminal 1 (i.e., 56%) and 1.1 million from Terminal 2 (i.e., 39%), respectively. The majority of passengers estimated at Malpensa airport are national, being 79% for Terminal 1 and 90% for Terminal 2 regarding the SubNode and 69% and 84% for the catchment area.

The second airport for volume of estimated passengers originated is Linate with some 55 thousand travellers for the SubNode and around 134 thousand for the catchment area (i.e., 8% and 5% respectively). The majority of the passengers is national, namely 88% for the SubNode and 82% for the catchment area. Eventually, the estimated volume of passengers travelling to Orio al Serio is found particularly low, as only 1% of the passengers originated from the catchment travel to the airport. It is important to remark that, differently from the previous SubNodes, more passengers have been estimated travelling from the catchment area compared to the SubNode.

Table 24: Estimated volume of passengers originated from Varese SubNode and catchment area

Airport	Total				SubNode				Catchment Area			
	SubNode	%	Catchment Area	%	Italian	EU	Extra-EU	Total	Italian	EU	Extra-EU	Total
Orio al Serio	37,300	6%	14,500	1%	22%	77%	0%	**100%**	0%	100%	0%	**100%**
Malpensa T1	306,000	46%	1,596,400	55%	79%	17%	4%	**100%**	69%	9%	21%	**100%**
Malpensa T2	271,000	40%	1,126,000	39%	90%	10%	1%	**101%**	84%	12%	4%	**100%**
Linate	55,100	8%	134,400	5%	88%	6%	6%	**100%**	82%	12%	6%	**100%**
Total	**669,400**	**100%**	**2,871,300**	**100%**								

Source: Estimation of the authors on data of SEA (2016) and SACBO (2018)

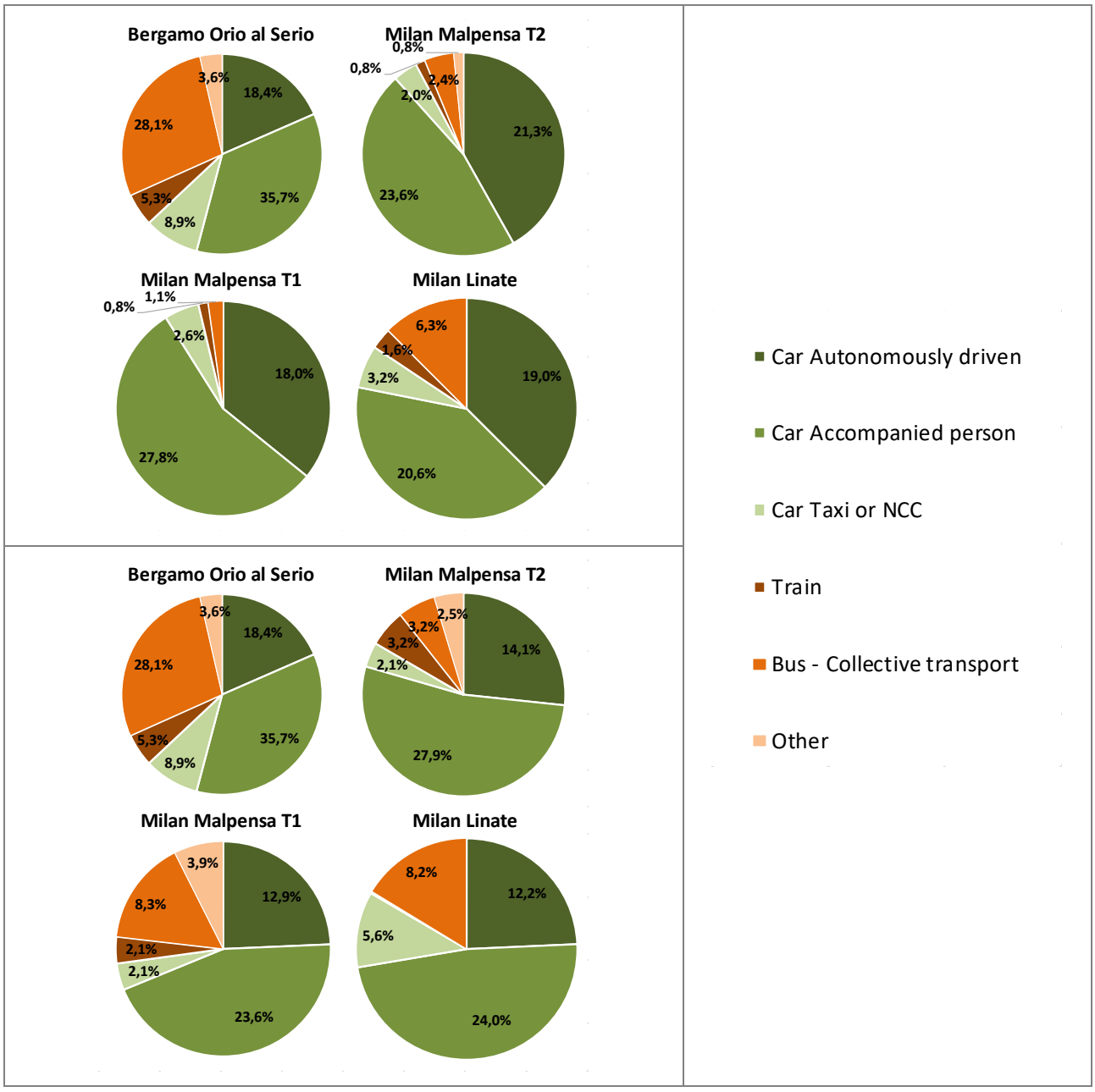
The passengers estimated originating from the SubNode mostly travel by car (see Table 26 and Figure 22). For Terminal 1, 96.3% of the estimated passengers travel by car from the SubNode and 72,8% from the catchment area. Similarly, for Terminal 2 92.2% of the estimated passengers travel from the SubNode and 83.4% from the catchment area. The second estimated mode is road collective transport, in particularly to reach Orio al Serio (i.e., 28.1%) followed by Malpensa Terminal (i.e., 15.7% from the catchment area).

Table 25: Estimated modal split of passengers of Varese SubNode and catchment area by airport

Area	Airport	Car			Train	Bus - Collective transport	Other	Total
		Autonomously driven	Accompanied person	Taxi or NCC				
SubNode	Orio al Serio	18.4%	35.7%	8.9%	5.3%	28.1%	3.6%	**100,0%**
	Malpensa T1	35.8%	55.2%	5.2%	1.5%	2.2%	0.0%	**100,0%**
	Malpensa T2	41.9%	46.5%	3.9%	1.6%	4.7%	1.6%	**100,0%**
	Linate	37.5%	40.6%	6.3%	3.1%	12.5%	0.0%	**100,0%**
Catchment	Orio al Serio	18.4%	35.7%	8.9%	5.3%	28.1%	3.6%	**100,0%**
	Malpensa T1	24.3%	44.5%	4.0%	4.0%	15.7%	7.4%	**100,0%**
	Malpensa T2	26.7%	52.8%	3.9%	6.0%	6.0%	4.7%	**100,0%**
	Linate	24.3%	48.0%	11.1%	0.3%	16.3%	0.0%	**100,0%**

Source: Estimation of the authors on data of SEA (2016) and SACBO (2018)

Figure 22: Estimated modal split of passengers of Varese SubNode (above) and catchment area (below)



Source: Estimation of the authors on data of SEA (2016) and SACBO (2018)

Current transport supply

Currently Varese has a direct train service to reach Malpensa, namely the line S50 every 2 hours. As far as the catchment area is concerned, other two local bus lines are operated, transiting at the airport, namely Gallarate - Malpensa - Calselnovate and Somma Lombardo - Maddalena - Casenuove - Malpensa - Castelnovate.

There is no direct connection neither to Linate nor to Orio al Serio. These airports can be reached only by combining different collective transport services.

Planned transport supply and new proposal

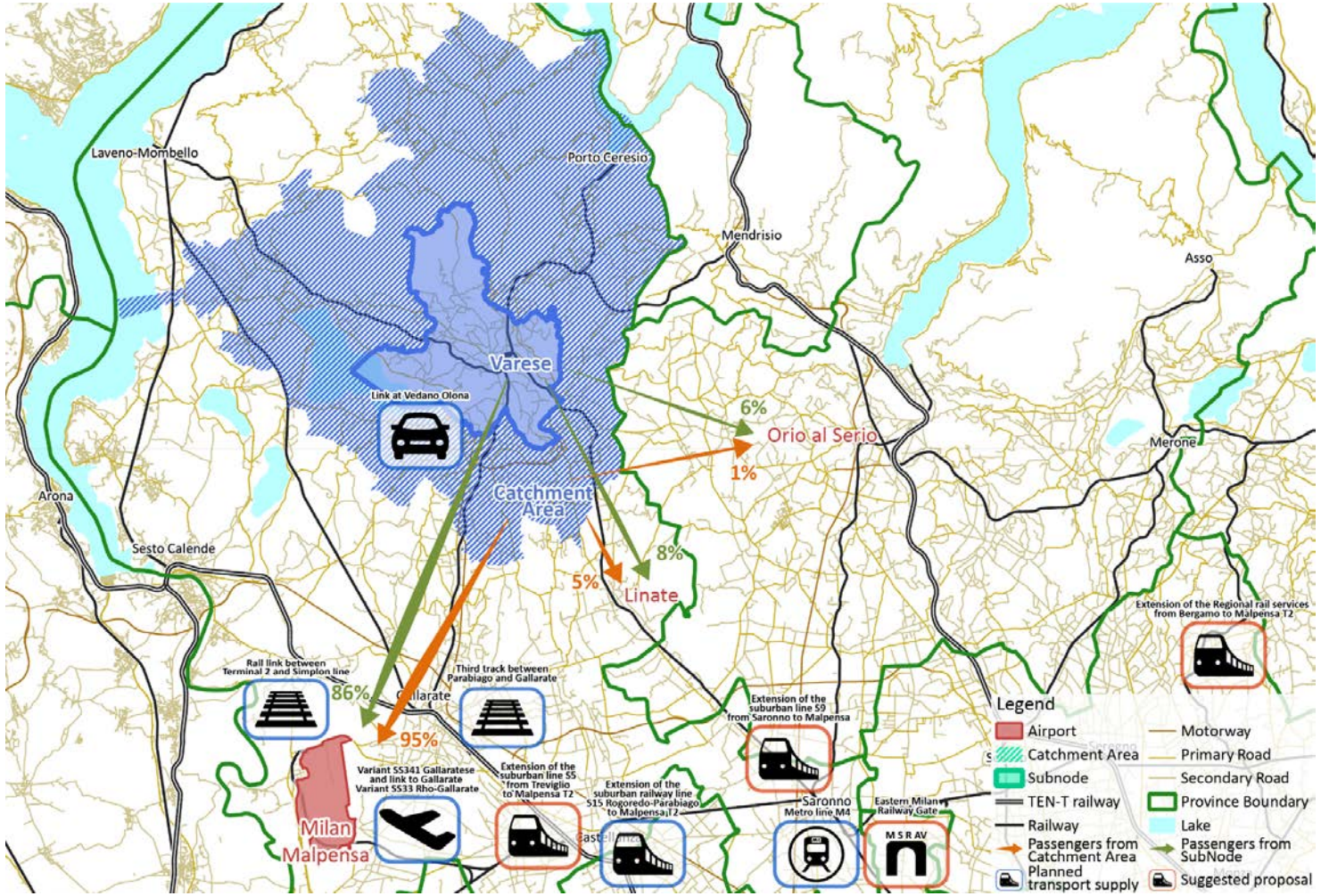
The following projects are envisaged in the PRMT to improve the current transport infrastructures and services between Varese SubNode, its catchment area and the concerned airports:

- rail link between Terminal 2 and Simplon line;
- third track between Parabiago and Gallarate;
- extension of the suburban railway line S15 Rogoredo-Parabiago to Malpensa T2;
- metro line M4;
- variant SS341 Gallaratese and link to Gallarate;
- variant ss33 Rho-Gallarate;
- link at Vedano Olona;
- development of innovative technologies and electronic ticketing system;
- ticketing integration;
- integration of public transport with new sustainable modes;
- efficiency improvements of road collective transport.

The following projects and measures are suggested proposals to improve the current accessibility from the SubNode and catchment area:

- more reliable collective transport, e.g. better spread of run;
- simple ticketing and clear understanding of the relevant information for travellers;
- improve design and layout of station and stops to make them easy to find and provide clear walking paths, using well marked horizontal wayfinding for access and egress (colour differentiation is useful); with facilities for elderly people and persons with reduced ability or mobility; with facilities for sustainable transport modes, which can be alternative to private car for feeder segments;
- eastern Milan railway access gate;
- extension of the regional rail services from Bergamo to Malpensa Terminal 2, via Carnate Usmate - Seregno - Saronno - Busto Arsizio;
- extension of the suburban line S5 from Treviglio to Malpensa;
- extension of the suburban line S9 from Saronno to Malpensa

Figure 23: Transport services, infrastructure projects and measures of Varese SubNode



Source: Elaboration of the authors

End of the document