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THE TIMES THEY ARE A-CHANGIN'

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The cover image is a photo of impacts on transport infrastructure of typhoon Hagibis in Japan (October, 2019)

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HIGH SPEED RAIL AND AIRPORT. FUTURE SCENARIOS FOR MARCO POLO AIRPORT IN VENICE

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ABSTRACT

This paper introduces an analysis of the possible extension of the catchment area of the Venice Marco Polo Airport, due to the implementation of a direct rail connection and the completion of the high speed/high capacity railway between Milan and Trieste. Both interventions are expected to generate an increase in the access thresholds by rail to the airport. By constructing different scenarios based on the analysis of the evolution in mobility trends and settling patterns, retraced considering both demographic dynamics and large scale projects, this article estimates the effects generated by the new railway connections in terms of extension of the Marco Polo airport's catchment area and the possible related impacts on air traffic, in terms of potential new passengers.

KEYWORDS:

Airport; High-speed Rail; Catchment Area; Intermodal Complementarity; Scenario

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高铁和机场。威尼斯马可波罗机场的未来发展

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摘要

威尼斯马可波罗机场开始推行直达轨道交通，加之米兰和里雅斯特之间的高铁高速/大容量铁路建成，这将让机场辐射区在未来成扩大之势。预计这两项干预措施会增加乘坐铁路去机场乘客人数。本文将对机场的这一发展前景进行分析。通过对流动性趋势和服务区模式的演变进行分析，构造不同的情境，对人口动态和大型项目进行回溯思考。本文预估了新铁路连接对马可波罗机场服务区扩展产生的影响进行了预测，从潜在新乘客的角度探讨对空中交通可能的影响。

关键词：
机场；高铁，集水区；联运互补；方案

1 INTRODUCTION: HIGH SPEED RAIL AND AIRPORT

Venice Marco Polo is one of the most relevant airports in Italy¹. There are several reasons behind this success that can be explained considering the proximity of the airport to the city of Venice (around 15 km) and the peculiarities of the North-East area, served by the airport. This territory appears as a functional polycentric system where the increasing differences in the economic structure with some important niches and a relevant diffused cultural heritage both produce a strong complementarity among cities: university, knowledge production and R&D in Padua; international culture and tourism in Venice; relevant specialization in logistics and transport-related activities in Verona and Venice; local manufacture productive systems in Vicenza and Treviso (Boschetto & Bove, 2012; Fregolent & Ventoretto, 2017).

In this context, throughout the years, the airport has known a constant process of expansion and renewal that has contributed to foster its competitiveness, in a national and global frame where an ever-growing demand of air mobility can be registered².

The Marco Polo “*Masterplan 2021*” (2014) with the aim to enhance its competitiveness and to respond to the continuous and solid growth of the civil aviation sector, has defined the main projects for developing the airport activity, identifying also some crucial challenges for the future of the Marco Polo airport. This program is congruent with respect to the strategies of the European Commission that, in the White paper “Roadmap for a single European transport area” approved in 2011, has considered as the primary transportation policy goal to promote the multi-modal integration among different transport and communication networks (airports, ports, railways and roads), in order to support the creation of new connections for passengers and goods linking urban areas, relevant economic platforms and infrastructural nodes. Based on this, the EU was expecting that by 2050, all the major European airports should be linked to the railway system with a stated preference for high-speed rail (HSR) to guarantee a more efficient integration among networks. This transport policy goal has been experienced in France since 1995 where the intermodal complementarity between HSR and air transportation has been promoted in Paris Charles de Gaulle and Lyon Satolas, furtherly supported by other national policies such as the environment program “Grenelle II” (2010), and by a policy framework aimed at facilitating the cooperation among different stakeholders and operators, to optimize the integration in different transport facilities and services (code share, single ticketing and one-stop baggage check agreements between airlines and SNCF – the French railway operator) (Mell, 2013).

In the literature, at least starting from the end of the 80s, the analysis of the effects produced by rail-air intermodality has been devoted to highlight the competition between both transport modes (Bonnafous, 1987; Vickerman, 1997). Based on ex-post evaluation of the impacts on travel demand³ determined by the intermodal integration between HSR and air transport, these studies have proved the competitiveness of HSR on medium-distance routes (Capon et al., 2003; Gao, 2009; Janic, 1993; IATA Air Transport Consultancy, 2003), allowing the acquisition of a relatively large market share, primarily over distances around 400 km (Albalade and Bel, 2012; Klein, 1997; Román et al., 2007). The most recent supply-oriented analysis on the ex-post effects of HSR on air transport (Albalade et al., 2015; Dobruszkes et al., 2014) highlighted relevant new evidence of the effects of HSR–air intermodality not only in terms of competition, but also of potential

¹ Among the Italian airports, in 2018 Marco Polo airport ranked fourth for the passenger traffic, following Rome Fiumicino, Milan Malpensa and Bergamo Orio al Serio airports and showing an increase by 33% with respect to 2013. In 2018, 11.163.736 passengers travelled to and from the airport (6% of the total transits through the Italian airport system), 86% of whom are international (7,9% of the total amount of international passenger traffic at the national level). Concerning cargo traffic, Venice airport ranked fourth at the national level in 2018, with 67.940 tons of goods handled by the airport, with a general increase by 11,8% with respect to 2017 and by 49% with respect to 2013.

² Figures show an increase, in 2018, by 5,9% nationally and 6,5% globally in passenger traffic with respect to the previous year (source: Assoaeroporti, IATA).

³ See Dobruszkes et al. (2014) for a synthetic literature review on ex-post evidence from research on the intermodal impacts induced by HSR on air services and traffic.

complementarities between the two services: the interconnection with the railway led several airports to substitute short-haul services, transferring passenger to the HSR lines, to support medium and long-haul airline services with the side effect of alleviating airport congestion by freeing up slots and generating positive outcomes, especially for the busiest airports. Moreover, it has been recognized that a railway connection contributes to the generation of an integrated *Multi Airport System*, guaranteeing the possibility to manage, in a more efficient and balanced way, landside and airside traffic volumes and the relative congestion-related issues (Xia et al., 2019). Albalade et al. (2015) have also demonstrated that the reduction in the number of flights is higher for the airports that are not served by HSR, because HSR lines allow a potential increase in the number of incoming passengers to the airport, serving as successful feeders for international air traffic as in the cases of Frankfurt Airport and Paris-Charles de Gaulle. However, this side effect, that partially contributes to compensate the decrease in the number of air travelers following the implementation of air-rail intermodality, is not expected to generate a growth in the demand for the flights that were already operated before the realization of the HSR line (Albalade et al., 2015). Furthermore, the presence of low-cost carriers in the airline market guarantees a higher protection from the competitive pressure exerted by HSR, because the emergence of low-cost air companies pushed both air and rail transport companies to reconsider their pricing strategies (Antes et al., 2004).

Once highlighted that ex-post studies carried out concerning air-rail intermodality and its impacts on travel demand and supply don't define a univocal framework, wider range evaluations bring to light different potentialities that may determine broad consequences. From an environmental perspective, air-rail integration may contribute to alleviate congestion and pollution produced by the large amount of displacements to and from the airports, offering a modal solution that is more sustainable (Givoni & Banister, 2006; Xia & Zhang, 2017), considering that a significant amount of CO₂ produced in the airport derives from the displacements of workers and travelers to reach the airport (LAirA Project, 2017). However, despite HSR does not increase neither LAP (Local air pollution) nor GHG (GreenHouse Gas emissions), D'Alfonso et al. (2016) suggest to consider that any environmental impact is closely related to the mix of energy sources from which electric power to feed the HSR network is obtained; this aspect is strongly influenced by the energy policies and mitigation strategies that are in force in every national context of analysis. Concerning an economic perspective, air rail integration produces cross-scale advantages: if the availability of a fast, frequent and reliable connection to reach the airport represents a competitive determinant in passenger's modal choices (DLR-EC, 2010), a modal integration among different networks, by extending the catchment area of the airport, generates opportunities for the local economy and the real estate development (LAirA Project, 2017). Moreover, for the airports characterized by consistent cargo activity, a dedicated railway connection opens opportunities for economic development (EC – CO-ACT Project, 2004). It should also be noted that until the 1970s the airports attracted mostly warehousing and storage activities. Only since the 1980s, in a context of decentralization of the business activities from the central urban areas and in an increased economic competitiveness that rewards multimodal accessibility, a process of polarization has been triggered around airports characterized by good multimodal accessibility, sometimes supported by national and regional policies (see for example among the earlier in Europe the *Schémas Directeurs d'Aménagement et d'Urbanisme* of the Ile de France region and Rhone Alpes region, respectively for Charles de Gaulle and Satolas airports). In these experiences the airport becomes a gateway to international cities and a new polarity in the regional development (Pucci, 1998). The HSR plays an important role in qualifying the airport as an attractive polarity and supporting its real estate developments, because, according to Varlet (1992), it offers the "trinomial of interconnection" (Air, HSR, Motorway).

Additional challenges are related to market competitiveness and to the articulated decision-making frame, involving stakeholders with different interests. Both elements, that concur in increasing the level of complexity

of the design process, can tangle the realization of the air rail integrations. The promotion of air rail intermodality strategies implies the activation of multi-level decisional processes, involving a plurality of actors and operators, some of whom may not be prone to cooperate due to the potential loss of consolidated relevance and interests that may follow this kind of interventions (LAirA Project, 2017). It is well known that the specificity of each context – the air supply and the flights offered by an airport, the geography of HSR connections, the integration between air and train timetables, the degree of commercial and technical integration between air and rail networks (Givoni & Banister, 2006) – conditions the possibility to define replicable development scenarios and specific thresholds in the number of passengers that can justify, in terms of economic efficiency, the realization of an air-rail integration.

Despite this, European development strategies still push towards the implementation of air-HSR integration for communitarian airports (UE, 2011) and at the Italian national level, the new draft of the Piano Nazionale degli Aeroporti (2019) promotes the strengthening of intermodal complementarities of HSR and air transportation, so to comply with the European standards. In Italy are currently reachable by train, with a station directly serving the terminal(s), the airports of Turin, Milan Malpensa, Trieste, Ancona, Rome Fiumicino, Cagliari, Bari and Palermo. Among them, Rome Fiumicino and Trieste are served by HSR, while Milan Malpensa and Triste are linked to Austria, Slovenia and Switzerland by direct international services. Pisa and Bologna (the latter not yet in operation) are connected to the respective cities' main railway stations by people movers. In the next future, new projects of integration are foreseen as stated in the "Contratto di programma 2017-2021" signed between RFI and Italian Ministry of Infrastructures and transport (MIT), where new rail connections to the airport of Genoa and to Marco Polo airport in Venice are outlined and financed. In this framework, the paper introduces in the Section 2 the infrastructure projects affecting Venice Marco Polo Airport, for analyzing the possible extension of the catchment area of Airport, due to the implementation of a direct rail connection and the completion of the high speed/high capacity railway between Milan and Trieste (Section 3). By constructing different scenarios based on the analysis of the evolution in mobility trends and settling patterns, Section 4 estimates the effects generated by the new railway connections in terms of extension of the Marco Polo airport's catchment area and the related impacts on air traffic, in terms of potential new passengers.

2 MARCO POLO AIRPORT AND THE HSR CONNECTION

Marco Polo airport is affected by important short-to-medium period infrastructure projects, both at the local and national scale, that may significantly contribute to extend its catchment area by rail and by sea. Currently, the airport confirms its growing importance when considering passenger traffic, a trend that has been also fostered by the implementation of several direct international routes, which have stimulated indirect flows too, resulting in more than 1 million passengers to/from North America and 500.000 passengers to/from the Far East, growing respectively by +11% and +6% in comparison to the previous year (Assoaeroporti, 2018). In 2018, the international relevance of the airport has furtherly grown, thanks to the presence of more than 50 airlines serving the airport and offering flights to more than 100 destinations, including 10 long-haul and 4 medium-haul relations⁴, that will be sided by a new service to Madrid (starting from march, 2018) providing new opportunities for the south American market. This scenario is expected to change due to the ongoing projects for the airport (Masterplan 2021 Marco Polo Domani) and the new railway connection. The frame that emerges by consulting the available planning documents and legal agreements that have been signed by

⁴ They are the flights to New York JFK, Atlanta, Philadelphia, Chicago, Montreal, Toronto, Seoul, Doha, Dubai and four medium-haul flights to Casablanca, Tunis, Tel Aviv and Shark el Sheik (starting from the winter season).

public and private stakeholders⁵, confirms the intention to expand the airport and to transform the surrounding area for creating a super-local hub fulfilled with relevant territorial-scale functions⁶. In contrast, a relevant change in the strategies of infrastructural development can be highlighted with the overcoming of the hypothesis, foreseen by territorial plans (but already excluded by *PAT Piano Assetto Territoriale*, drafted by the Venice Municipality in 2014), to implement a new HSR line between Venice and Trieste, directly serving the airport. This change has been due to the decision, taken at the national level, to upgrade the existing infrastructure that runs 5 km in the North of the airport, instead of realizing a new HSR line (Fig. 1).

The upgrading of the existing railway line into a “High Capacity Railway” (HCR) will allow to reach a maximum speed of 200 km/h (with respect to the current limit of 150 km/h, RFI), saving around 30 minutes from Venezia S.ta Lucia to Trieste Centrale. The project is expected to be completed in an over-2026 scenario. However, a new rail connection to link, by a 6km spur, the airport with a new station is confirmed. This solution, expected to be operative by 2026 (RFI), would allow HSR/HCR and local trains to directly connect the airport terminal to the city (Mestre, Venezia S.ta Lucia), to the main urban areas in Veneto region and to the most important European transportation corridors (TEN-T). This project has been featured in the contract signed in 2016 by SAVE s.p.a. and RFI and included as a relevant strategy in the Masterplan 2021 *Progetto Marco Polo domani*.



Fig. 1 Planned projects and timing for realization

This Masterplan, that has been modified several times during the years, represents the final outcome of a long and complex decision-making process that has been developed since the signing of an agreement (*Accordo Quadro per il Quadrante Tessera*) between SAVE s.p.a., ENAC and the Venice Municipality (2006-2007). In particular, the Masterplan 2021 (2014) defines a general improvement of the internal and the external infrastructural system, with an expansion of the runway, the apron and the air terminal, new parking lots, the construction of the “*Moving Walkway*” and “*Porta d’acqua*”. *Moving walkway* (a pedestrian covered bridge

⁵ To reconstruct the future scenario for the Marco Polo airport, in a first phase, the most relevant territorial planning documents (PTRC Veneto region 2009, approved in 2013; PTCP Venice province 2010) and local urban plans (PAT Venice municipality, 2014) were consulted. In a second phase, it has been conducted an analysis on the legal agreements and contracts between the municipality of Venice and SAVE s.p.a. as well as on the infrastructural projects, relevant for the future of the airport.

⁶ On 18th October 2018, the City Council of Venice, with the deliberazione n.42, approved the declaration of public interest for the project, aimed at developing a new pole of activities close to the airport to host a new soccer stadium (18.000 – 25.000 seats), a new retail/entertainment park with commercial and food-related activities and a hotel (around 150 rooms). This decision is an important milestone in the transformation process of the area that was already defined in the previously plans and has been the object of a long and complex decision-making process.

equipped with tapis roulants) and *Porta d'acqua* (a system of connected marine piers) are conceived as an integrated system that can serve potentially relevant flows of passengers willing to reach by sea Venice and other localities of the venetian Lagoon. The interventions foreseen in the Masterplan 2021 for the airport, outline a scenario characterized by an increasing competitiveness of the airport in term of passengers (with an estimated growth of 3,2 million/ passengers by year) and air supply (11.000 new flights/years) (SAVE , 2014). These dynamics will be supported by the completion of the HSR between Venice Mestre and Milan, currently operative only between Venice Mestre and Padua and between Brescia and Milan. This infrastructure, which completion is expected by 2028, will allow to save from 20 to 35 minutes on the entire relation with respect to the current travel times.

3 HOW DOES THE CATCHMENT AREA OF MARCO POLO AIRPORT CHANGE IN THE NEAR FUTURE?

The new infrastructural connections, in particular the HSR/HCR, can produce relevant impacts on the role that Venice airport can play in the near future, which will be furtherly confirmed following the completion of the projects outlined in the Masterplan 2021. With the aim of analyzing the possible changes occurring to the role of Marco Polo Airport, due to the realization of the new rail connection to Mestre, we start our analysis defining the catchment area of the airport by train both in the current and future scenario, affecting the basin of potential users. The potential catchment area of the airport has been defined providing a simulation of the impacts that the expected development projects could determine, by considering accessibility thresholds by train and accessibility isochrones by road.

This approach simplifies the accessibility concept and related measures of which Geurs and van Wee (2004) provide an exhaustive example⁷, considering only the time component of the accessibility measures by rail and road. Because accessibility describes “the extent to which land-use and transport systems enable (groups of) individuals to reach activities or destinations by means of a (combination of) transport mode(s)” (Geurs & Wee 2004), their measures depend strongly on what accessibility you want to analyse or to promote, how (mode, speed, reliability, density) and for who.

These conditions also explain why accessibility has been receiving increasing attention from a wide range of transport planning approaches, recently concerned also with the social dimensions of mobility (Pucci & Vecchio, 2019). From the pioneer definition by Hansen (1959) in “*How accessibility shapes land use*”⁸, the accessibility measures are evolving towards multimodal approaches, finalised to analyse the range of available opportunities with respect to their distribution in space and time. In our approach we focus on *infrastructure - based accessibility measures* founded on the observed and simulated performances of the rail transport system, in terms of travel time to reach Marco Polo airport. The goal is to understand the extent of the catchment area of the airport by railway, due to the implementation of the infrastructural projects and considering a 3-hour travel time threshold⁹. By consequence, the concept of accessibility, in this research, is related to the increased number of people that may find convenient, in terms of travel time, to choose the Marco Polo airport as a departure hub for their flights. This is calculated, in a first step, considering the current and future geographical extension of the catchment area and, in a second step, for the scenario construction, by forecasting the trends in mobility habits of the inhabitants of the catchment area.

⁷ Geurs and van Wee (2004) identify four main components of accessibility affecting its meaning and measures: land use, transportation, time and individuals. These elements interact with one another in various ways, influencing themselves and contributing differently to the overall available accessibility.

⁸ According to Hansen (1959), accessibility is “the potential of opportunities for interactions”.

⁹ A maximum 3 hours travel time by train from VCE Marco Polo airport was imposed. The reason for this choice is related to the geographical location of Venice: when overcoming this threshold, it is more convenient in terms of travel time by train, to reach other national airports providing a similar (or greater) level of service, such as Milan Malpensa.

The former has been calculated starting from the current railway services supply and in relation to territorial development scenarios. By consequence, current train travel times have been re-adapted to simulate the presence of the new direct connection based on the estimations provided by RFI on expected travel times from the new airport station to Mestre (Fig. 2).

By calculating train accessibility thresholds (1, 2 and 3 hours respectively) to the airport, three basins of potential users have been identified, each of which constituted by municipalities falling under one of the three isochrones and selected according to their spatial proximity (5 km) to a railway station classified considering the accessibility threshold granted to the new airport station. The analysis revealed also a fourth basin, defined as “residual”, composed of municipalities that, even if located in the study area, do not meet the previous conditions (Fig. 3).

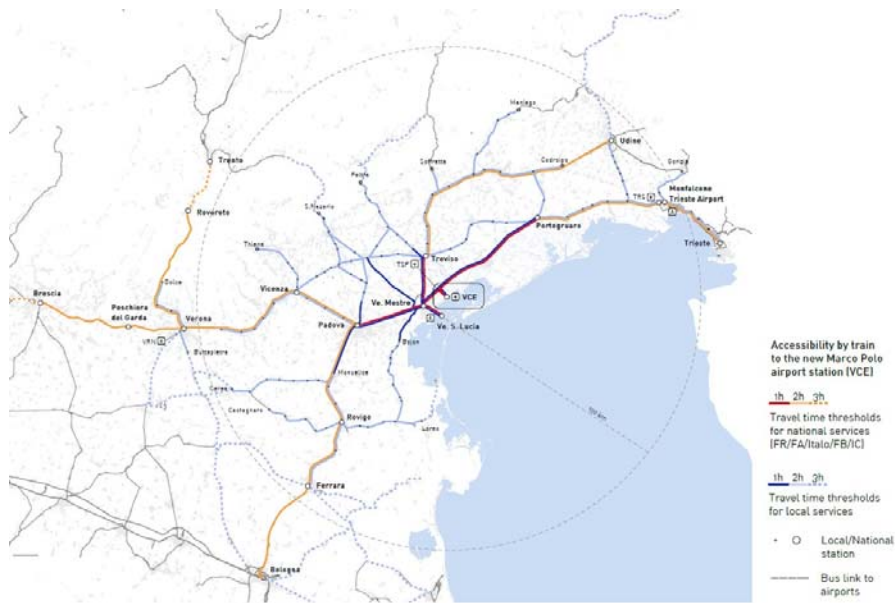


Fig. 2 Isochrones by rail to the new Marco Polo airport station

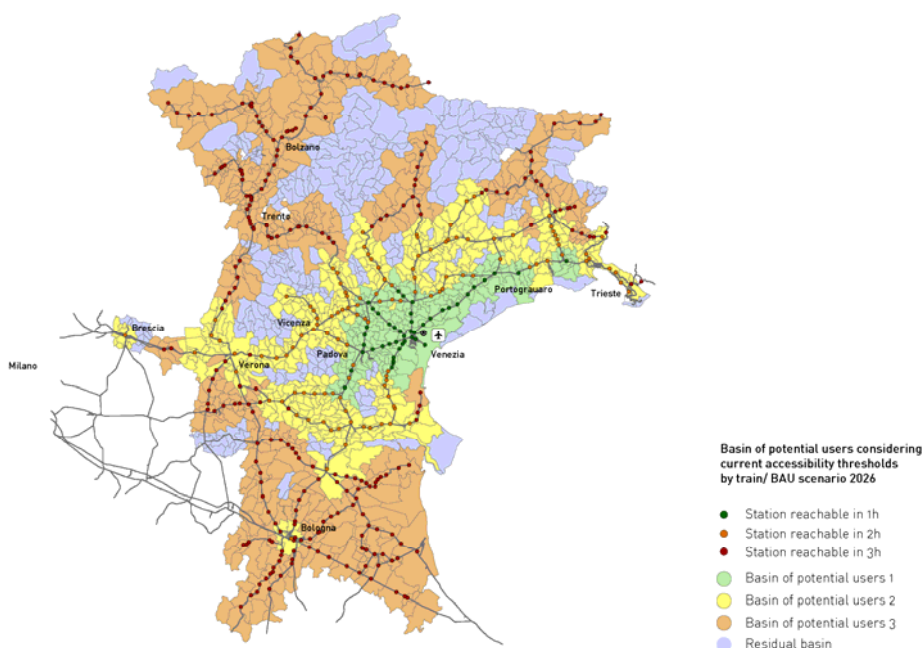


Fig. 3 Basins of potential users, considering current accessibility thresholds by train to the new airport station

To confirm the validity of the achieved results based on the railway network, an analysis on the road accessibility to the airport has been conducted. Isochrones, used in this process, represent an effective criterion to define the airport's catchment area both in the current and future scenario. Isochrones allow to define the potential airport's catchment area by road, considering travel times in a range between 15 and 60 minutes. The indicator is calculated by using a sampling function of the isochrones in which the centroid of a municipality is falling¹⁰. The outcome (Fig. 4), allowing to compare the Marco Polo airport catchment area by road with the ones of other relevant airports in the North East (Verona and Bologna), shows a widespread and balanced road accessibility in each airport; however, in terms of commercial air supply, the airport of Venice is the main hub for the international/intercontinental traffic in the North East of Italy.

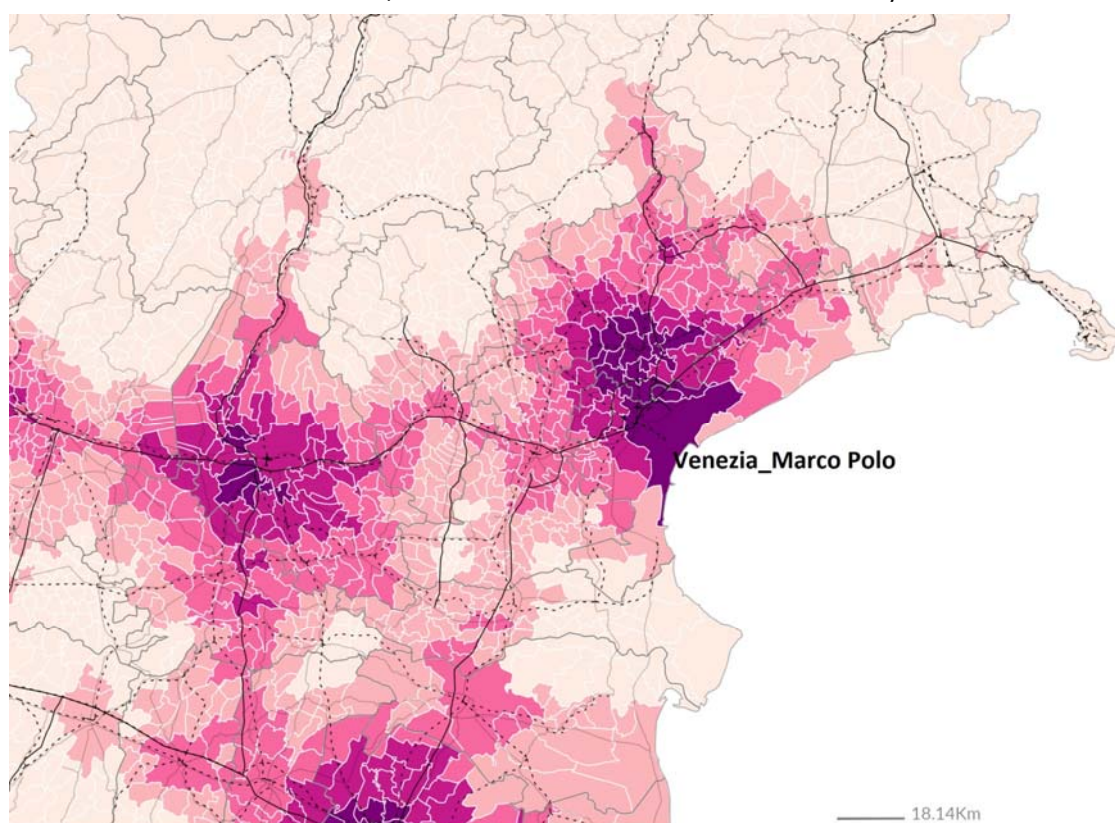


Fig. 4 Catchment area of Marco Polo airport: isochrones of accessibility by road and comparison with other relevant airports in the North East of Italy (source: Postmetropoli, Dastu, Polimi)

4 THE INTERMODAL COMPLEMENTARITIES OF RAIL AND AIR TRANSPORTATION: FUTURE SCENARIOS IN MARCO POLO AIRPORT

With the aim of providing an evaluation of the impacts of the infrastructure projects and the territorial interventions in Marco Polo airport's catchment area, the research defines two scenarios to estimate the evolution on mobility trends and the potential new users:

- a BAU (Business as usual) scenario assumes that the current socio-economic and mobility trends can be expected to continue unchanged to 2026, considering that HSR/HCR lines will not be in exercise, but the dedicated rail connection to the airport will be already operative;

¹⁰ Source: routable road network (OpenStreetMap) featuring information on average speed (data referred to 2014) and the localization of the airport. The results identify a study area at the territorial scale defined according to the following thresholds: class 1 (1-1)= average travel time between 45 and 60 minutes; class 2 (1-2)= average travel time between 30 and 45 minutes; class 3 (2-3)=average travel time between 15 and 30 minutes; class 4 (3-4)= average travel time less than 15 minutes.

- a Project scenario considers the evolutions of mobility trends to 2026, assuming the realization both of HSR/HCR lines and the dedicated rail connection to the airport.

The evolution of mobility trends has been estimated considering the current demand and its evolutions based on socio-demographic trends and to the territorial-scale projects that contribute to modify settling patterns. Data processed are commuter flows for work reasons by Istat Census data (2011), demographic census data (2011, 2017), the average income per capita (MEF 2012-2017) and mobility demand survey by Isfort (2018). The time horizon that was considered is related to the time of completion of the HSR line from Milan to Venice and to the upgrading to a HCR line between Venice and Trieste, as declared by RFI¹¹.

BAU: approach to calculate the scenario

The evolution in the demand for mobility by 2026 has been estimated considering the following hypothesis:

- population trends will remain unchanged due to the stable trend registered between 2011 and 2017 (+0.82% for the whole area of analysis and +0.9% for the Venice city catchment area);
- commuting mobility at the municipal level will increase following the average annual mobility rate¹² registered in the study area in 2018 (84.9). An additional evaluation has been provided assuming that the mobile population (composed by the employed) takes an average of 2.3 daily displacements (Isfort, 2018). By consequence, two different BAU scenarios were calculated, a first “low” scenario, based on the annual mobility rate and a second “high” scenario based on 2.3 average number of displacements per day;
- the modal split at 2026 for the displacements directed to Venice will remain stable, considering that the BAU scenario does not foresee the HSR/HCR line and the rate of car ownership shows a little increase (as observed in the whole area of analysis);
- flows directed to Venice will show the same trends as in the period 2011-2018;
- passenger traffic in the airport will increase by 4% average rate per year, according to the estimations provided by ENAC¹³ in the “Studio trasportistico aeroporto Marco Polo” (2014).

	CURRENT SITUATION (2018)		BAU SCENARIO (2026)	
	Population	Employees*	Flows**	Flows
Catchment area of Venice	5,303,020	2,323,658.92	1,970,664.8	1,987,429.239

Tab. 1 Business as usual scenario

* Employees are estimated based on the population in 2018, and according to the previous employment rate

** Flows are estimated based on the n. of employees in 2018 multiplied by the number of average daily displacements by Isfort (2018).

BAU Scenario has been calculated applying a linear function and considering for the flows estimation a constant mobility rate in line with that of the previous period (84.9). The following maps depict the trends of growth in the number of total flows by 2026 for the municipalities located into the study area considering both BAU scenarios (Figg. 5, 6) and in reference to the flows from the same municipalities to Venice (Fig. 7).

¹¹ Since 2007, HSR line between Padova and Mestre (25 km) is working, while the section between Verona and Vicenza (51.2 km) is under construction and its completion is expected by 2024; the section between Vicenza and Padua (27,6 km) has been financed at the 30% of the total cost (3.1 billion euro) and it is expected to be operative between 2026 and 2028; the section between Venice and Trieste is under upgrading to increase its speed (200 km/h) and the works are expected to be completed by 2024.

¹² Mobility rate is the percentage of employees that make at least one trip in a typical working day.

¹³ The estimation of passenger traffic is based on the scenario by ENAC (2014) that evaluates a consistent increase in the extra-Schengen movements (29% of the total in 2014) until 38% in 2021 with an annual increase rate by 7.5%; as well as a lower increase for Schengen passengers, with an average annual rate by 2.5%-3.0%.

Rail accessibility remains substantially unchanged with respect to the current condition (Fig. 3) in both scenarios, with the only difference due to the openings of the dedicated rail connection and a new station to the airport.

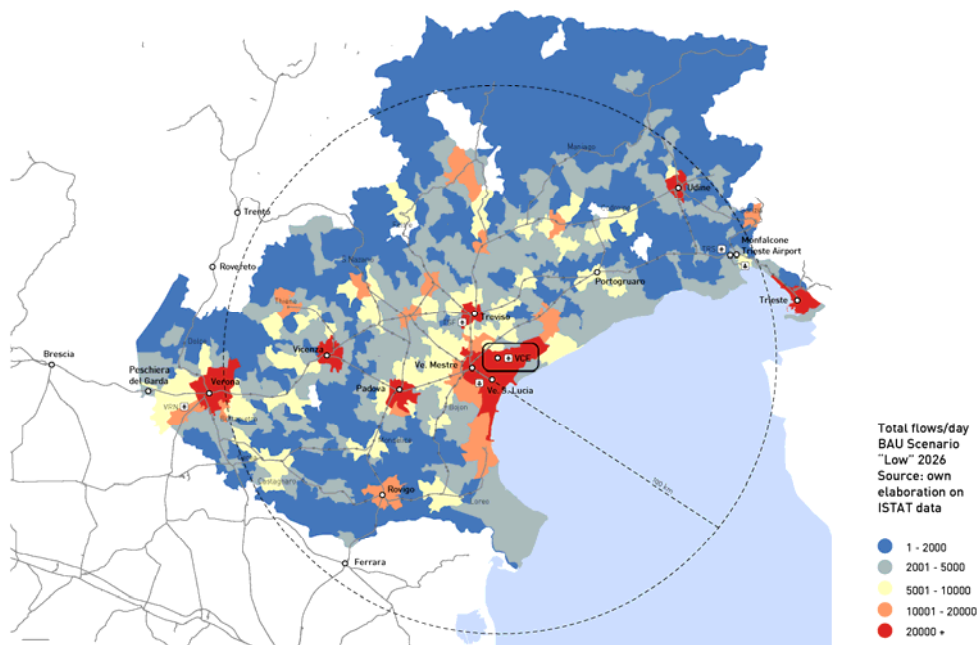


Fig. 5 Estimation of the total daily flows (inflows and outflows, all travel mode) at the municipal level – BAU scenario 2026 "low"

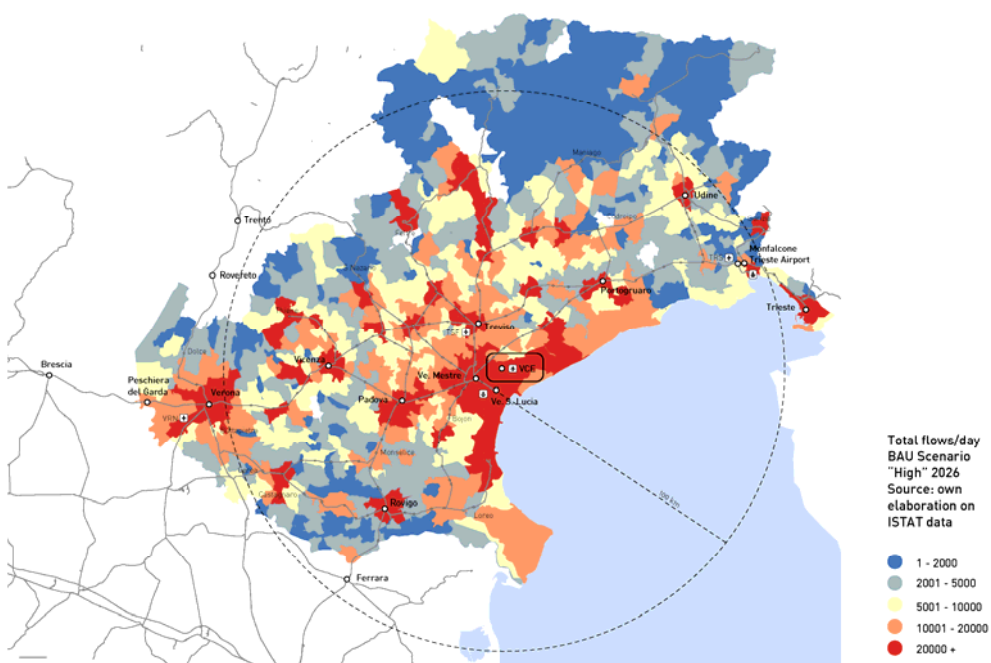


Fig. 6 Estimation of the total daily flows (inflows and outflows, all travel mode) at the municipal level – BAU scenario 2026 "high"

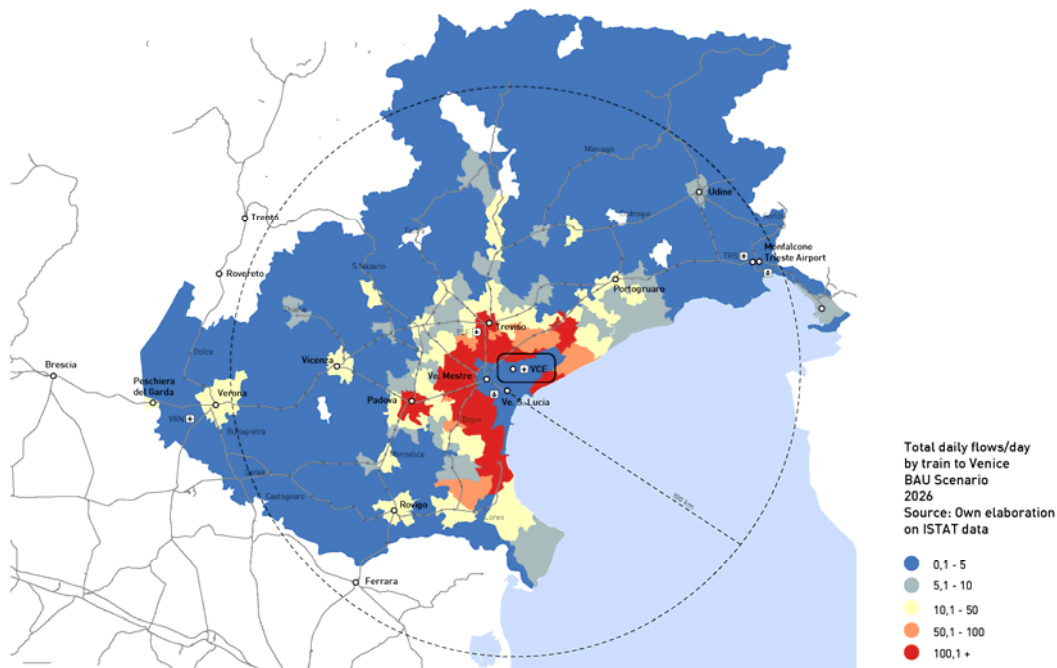


Fig. 7 Estimation of the total daily flows by train at the municipal level directed to Venice – BAU scenario 2026

Project scenario: approach to calculate the scenario

The evolution in the demand for mobility by 2026, when the HSR/HCR lines from Milan to Trieste is expected to be completed, has been estimated considering the following hypothesis:

- population trends will remain unchanged due to the stable trend registered between 2011 and 2017(+0.82% for the whole area of analysis and +0.9% for the Venice city catchment area);
- commuting mobility at the municipal level will increase according to the prevision on annual mobility average rate provided by Isfort (2018) for the North East of Italy (88.7%);
- considering the displacement directed to Venice from the municipalities hosting stations that will be served by HSR/HCR lines, the modal split for train could attest on values between 29.3% and 32.8% of the total flows directed to the airport¹⁴ (SAVE s.p.a. – Oneworks, 2014);
- the use of the local train network (SFMR) for displacements directed to the airport could reach 22.2% (SAVE s.p.a.- Oneworks, 2014);
- passenger traffic from the airport could increase by 4.5% on an average annual basis, exceeding the estimations provided by the ENAC report (*Studio Trasportistico Aeroporto Marco Polo*, 2014) due to the new dedicated connection between the HST/HCT lines and the airport;
- the new HST/HCT lines, once completed, will generate a significant reduction in travel times between Milano C.le and Trieste C.le (50/65 minutes according to RFI) determining the extension of the catchment area of the airport by rail (Fig. 8) and producing a relevant impact on long-distance relations.

Rail accessibility has been calculated considering the current supply, but a re-organization of the services could lead to a better integration with local/regional lines, strengthening the attractiveness of the inter modal air-rail solution, even for short-to-medium relations.

¹⁴ According to the available analysis (SAVE engineering – OneWorks, Studio Nodo Intermodale 2014), the following modal split has been hypothesized: taxi and bus-shuttles 9,7%; bus 11,3%; private car 32,4%; water transit 16,1%; railway 29,3%, others 1,2%. In a 2026 scenario, when the HST/HCT between Venice and Trieste will work, the following split can be hypothesized: taxi and bus-shuttles 9,7%; bus 11,3%, private cars 28,9%; water transport 16,1%; railway 32,8%, others 1,2%. These figures show a transfer of a share by 3,3% from private cars to the railway.

Project Scenario has been calculated applying a linear function and considering for the low scenario a constant mobility rate (commuter flows/employees) in line with the previous period, and for the high scenario an average, the daily displacements calculated by Isfort (2018) as a benchmark.

	CURRENT SITUATION (2018)			BAU SCENARIO (2026) - FLOWS	
	Population	Employees*	Flows**	Low	High
Catchment area of Venice	5,303,020	2,323,658.92	1,970,664.8	2,075,935.507	5,382,921.8

Tab. 2 Project scenario

* Employees are estimated based on the population in 2018, and according to the previous employment rate

** Flows are estimated based on the n. of employees in 2018 multiplied by the number of average daily displacements by Isfort (2018).

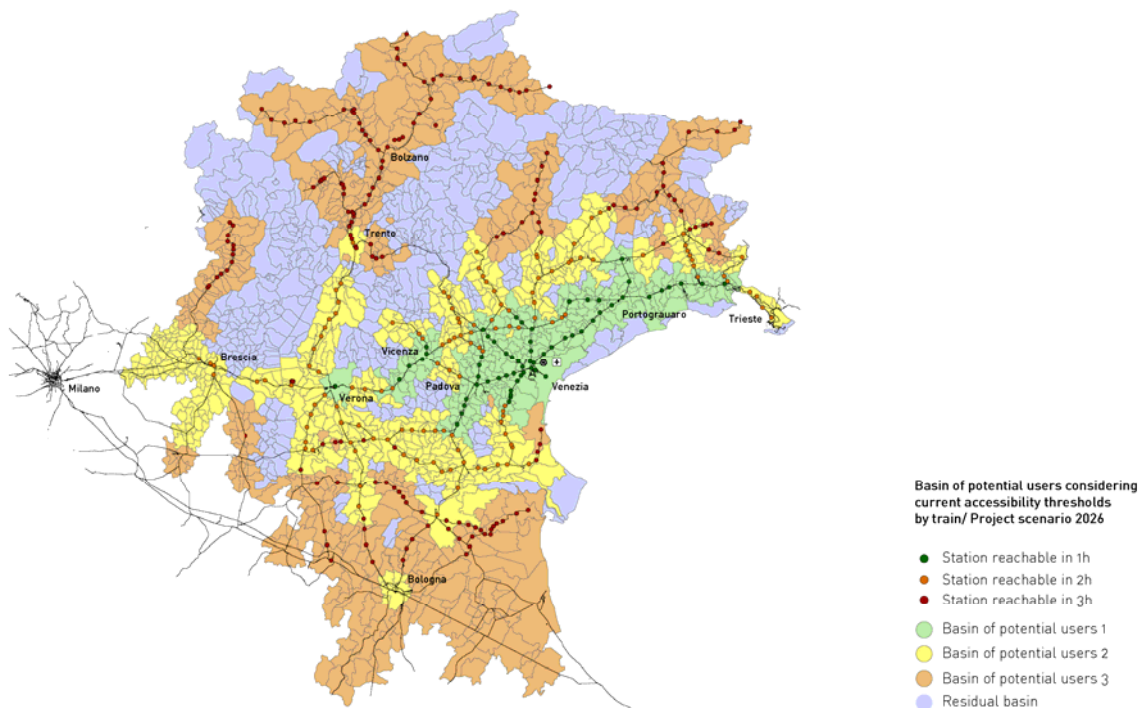


Fig. 8 Basins of potential users by train to the new airport station in the project scenario

As for the BAU scenario, two different scenarios were proposed: the first assuming that socio economic and mobility trend will remain stable (project scenario “low”) and the second project scenario considering 2.3 daily/displacements for employee (project scenario “high”). The following maps (Fig. 9, 10, 11) depict the trends of growth in the number of total flows by 2026 for the municipalities located into the study area.

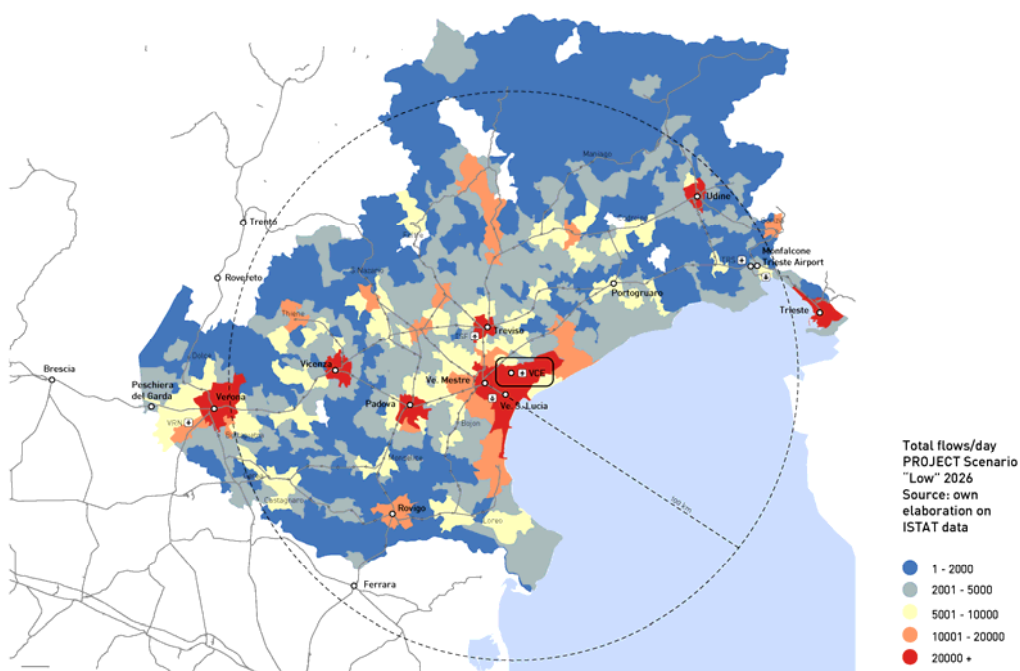


Fig. 9 Estimation of the total daily flows (inflows and outflows, all travel mode) at the municipal level – Project scenario 2026 “low”

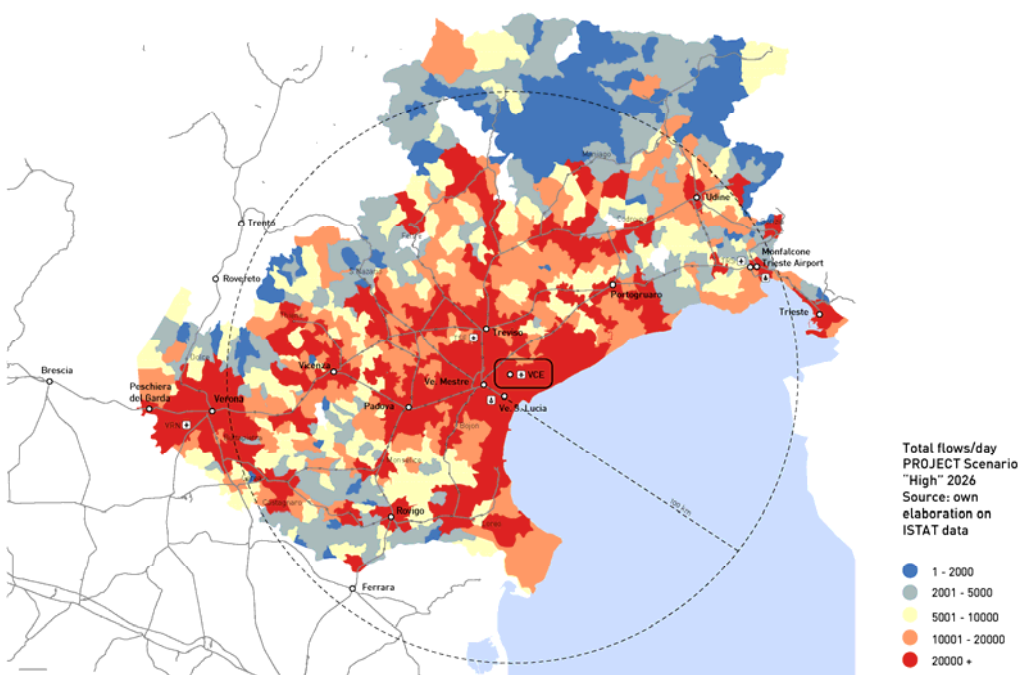


Fig. 10 Estimation of the total daily flows (inflows and outflows, all travel mode) at the municipal level - Project scenario 2026 “high”

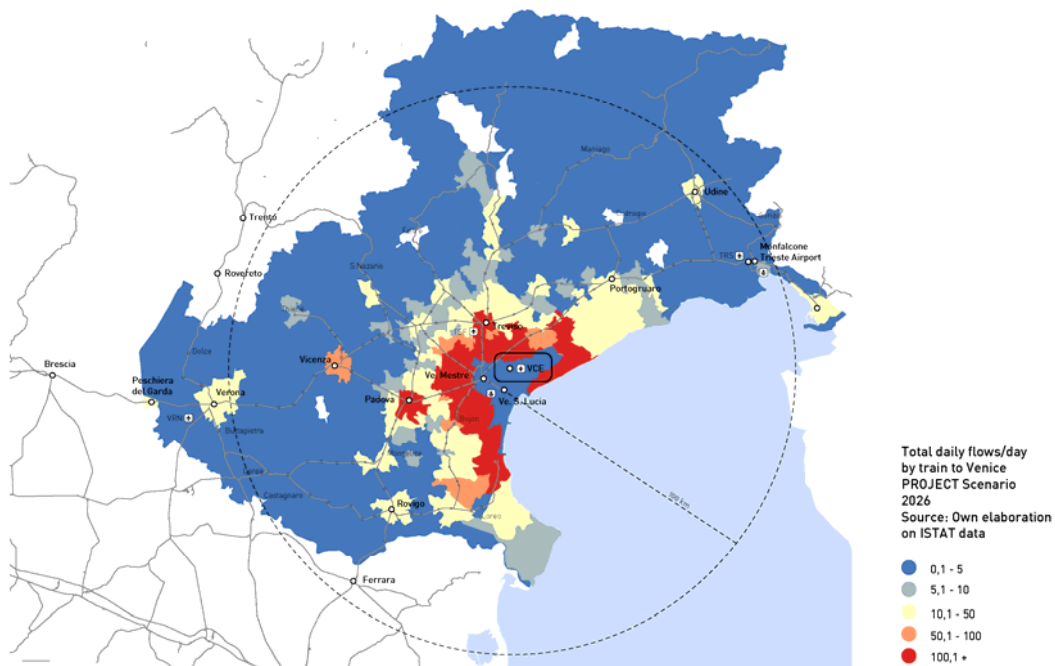


Fig. 11 Estimation of the total daily flows by train at the municipal level directed to Venice – Project scenario 2026

5 CONCLUSIONS AND DISCUSSIONS

In the next years, a further increase of the relevance of Venice Marco Polo airport into the national airport system is expected, thanks to the steady growth in passenger traffic and to the relevant infrastructure projects that will increase the airport’s efficiency. Among them, the opening of the dedicated rail connection and the completion of the HSR/HCR line between Milan and Trieste are the most relevant, due to their effects on the extension of the airport’s catchment area. This effect will be granted by a sensible reduction in travel times by train between Milan Centrale and Trieste Centrale, widening the accessibility thresholds by rail to the airport. Moreover, the dedicated rail connection will allow to directly link the airport with the local and national rail networks, determining the conditions for an efficient air-rail intermodality in accordance with European strategies and with other national and international airports that have already followed this path. This research estimates that, in a project scenario 2026, and considering an accessibility threshold by train of 3 hours, an extension of the basin of potential users of the airport could increase by 18% compared to the current condition, potentially concurring to the increase of the airport’s users.

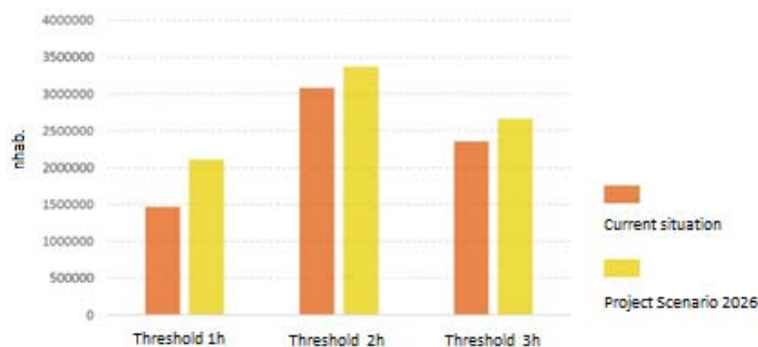


Fig.12 Variation of the inhabitants in the catchment areas of the Marco Polo airport, based on three isochrones (1h, 2h and 3 hour thresholds)

Even though the most relevant extension in the catchment area can be observed in the 1 hour threshold from the airport – namely the territory of “*Veneto centrale*” – it can be assumed that an increased accessibility by

train may produce significant benefits also for more remote areas such as eastern Lombardy (Brescia), Romagna and the settlements that are located along the main HSR/HCR corridors which are already characterized by a significant concentration of economic activities and business facilities and where mobility trends highlight a wider growth than the average per-capita income¹⁵. Furthermore, the new HSR long-distance connections will provide an increased competitiveness for the airport, also in comparison with the hub of Milan Malpensa, both for tourists and business travelers¹⁶. Considering Brescia as an example, the airport of Venice would be reached in around 80 minutes by train, thanks to the completion of the HSR line, while from Brescia to Malpensa airport around 100 minutes, with an intermediate reloading, are required. Considering short-to-medium distance rail connections, the project for a dedicated rail link to the airport will allow both national and local trains transit to reach the new airport station. In addition, the upgrade of the railway line to Trieste, combined with the completion of high speed rail between Venice and Milan, will lead both a decrease in travel times for the medium-long distances, and new time slots for improving the local railway supply in the historical decongested line. The contextual conditions mentioned above, relating not only to the new infrastructural supply, but also to some excellences and peculiarities of the Veneto region, contribute to enhancing the opportunities of the Marco Polo airport under some conditions that may play a significant role in fostering the positive outcomes granted by the development of the ongoing projects. These conditions are related, in particular, to the design solutions for the new dedicated rail connection and terminal rail station, to optimize the passengers transfer and ensure an efficient, integrated and livable interchange with the existing infrastructures (among them an important role is played by the Darsena).

In this framework, to facilitate the integration between rail-air services (code share, single ticketing, one-stop baggage check agreements) and new cooperation among different operators can play a relevant role to fully exploit the intermodal complementarities of HSR and air transportation in Marco Polo airport, with positive effects also for the involved territories. Final remarks refer to the approach followed in this paper and its limits. Estimating the access to the airport using only the travel times on the rail network, we assume that the reduction of these times increases the rail catchment area of the airport. This assumption does not take into account the combined effect of the different means of transport in the definition of the infrastructure accessibility to the airport that a multimodal approach to the airport accessibility should allow. However, the aim of our research focusses on the estimation not of the “new air passengers” but on the “potential users” of the airport, on the basis of a new railway supply and travel opportunities that widen the catchment area of the airport and the target populations affected. Using the definition of “potential users” of the airport, we estimate the inhabitants with a better condition for reaching the airport by train, even if we are aware that this population living in the catchment area does not involve a consequent increase in the air passengers, in particular because the new railway supply could even shift users from road transport to railways, without affecting the airport.

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¹⁵ Beside the analysis on commuter displacements (Istat 2011) and demographic trends (Istat 2011-2018), the research considered also the evolution of the average income per capita (MEF 2012-2017) to introduce the socio-economic dynamisms of our study area.

¹⁶ This scenario does not take into account the possible competition between Venice Marco Polo airport and Bergamo Orio al Serio, even if the two airports are very similar in terms of passenger traffic (Bergamo is the third airport in Italy for passenger traffic with 12.938.572 transits in 2018). This choice is due to the fact that Orio al Serio airport is not reached by the railway network and its commercial air supply is mostly oriented to the low-cost market.

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