



Feasibility study for the efficiency of the Verona-Rovigo-Adria-Chioggia regional railway line

Phase 1: Current offer characterization

Phase 2: Planning New services structure planning

DELIVERABLE

Project partner:



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1 GENERAL OVERVIEW

1.1 Introduction

The study aim is the optimization of the regional railway Verona-Legnago-Rovigo-Chioggia line, that means to improve the performance and consequently to increase the transport demand.

The adopted methodology wants to identify any problems in the infrastructure or within the rolling stock, which makes possible to suggest some planning solutions with the purpose to:

- increase the railway line capacity;
- reduce the travel time;
- encourage the interchange with other regional railway lines.

Relatively to the last point, it is important to point out the node of Legnago, which makes possible to create some connections with other cities like Mantova and Padova.

The performance simulation is used in this study to obtain the ideal graphic timetable, considering the rolling stock, the railway stations and the geometric features of the line.

1.2 Territorial framework

The In this analysis are focused the following Sistemi Territoriali lines:

1. Rovigo-Adria-Chioggia;
2. Verona-Rovigo.

, these lines are classified as complementary by the national law "D.M. 43/2000" and subsequent modifications and integrations. They are lines with lower level of traffic density, which form the linking net and thickly connect the main lines..

Figure 1The classification of all the Regione Veneto railway lines is shown in Figure 1.

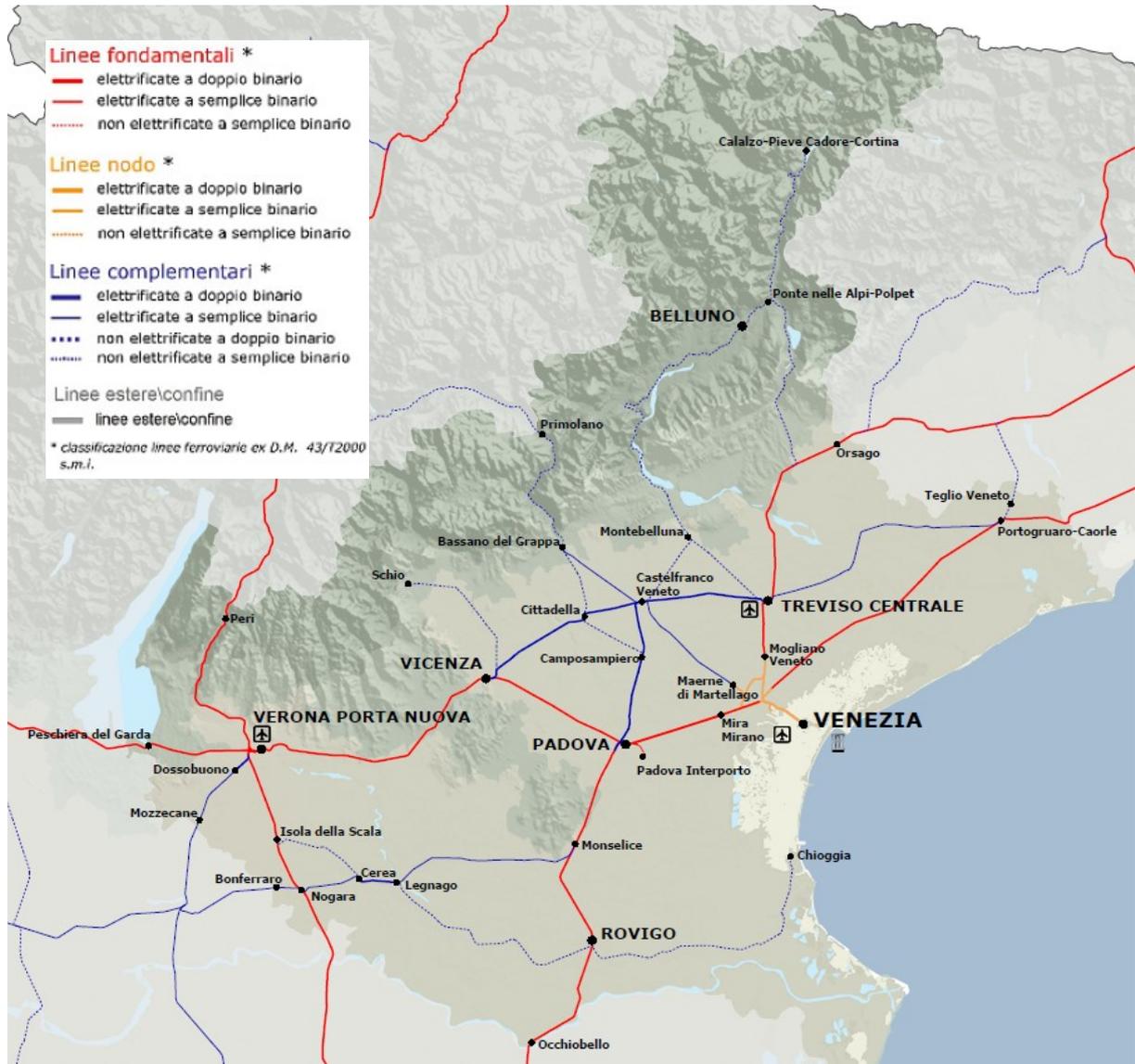


Figure 1 - RFI classification of railway lines (source RFI)

The focused network belongs to the provinces of Rovigo, Venezia and Padova. On the Chioggia-Rovigo line, every train stops at each station: so this is a non-hierarchical service and travel time doesn't change during the day. Otherwise on the Verona-Rovigo line, the first train to Verona in the morning and the last train to Rovigo in the evening don't stop at each station; the travel time is 11 minutes less.

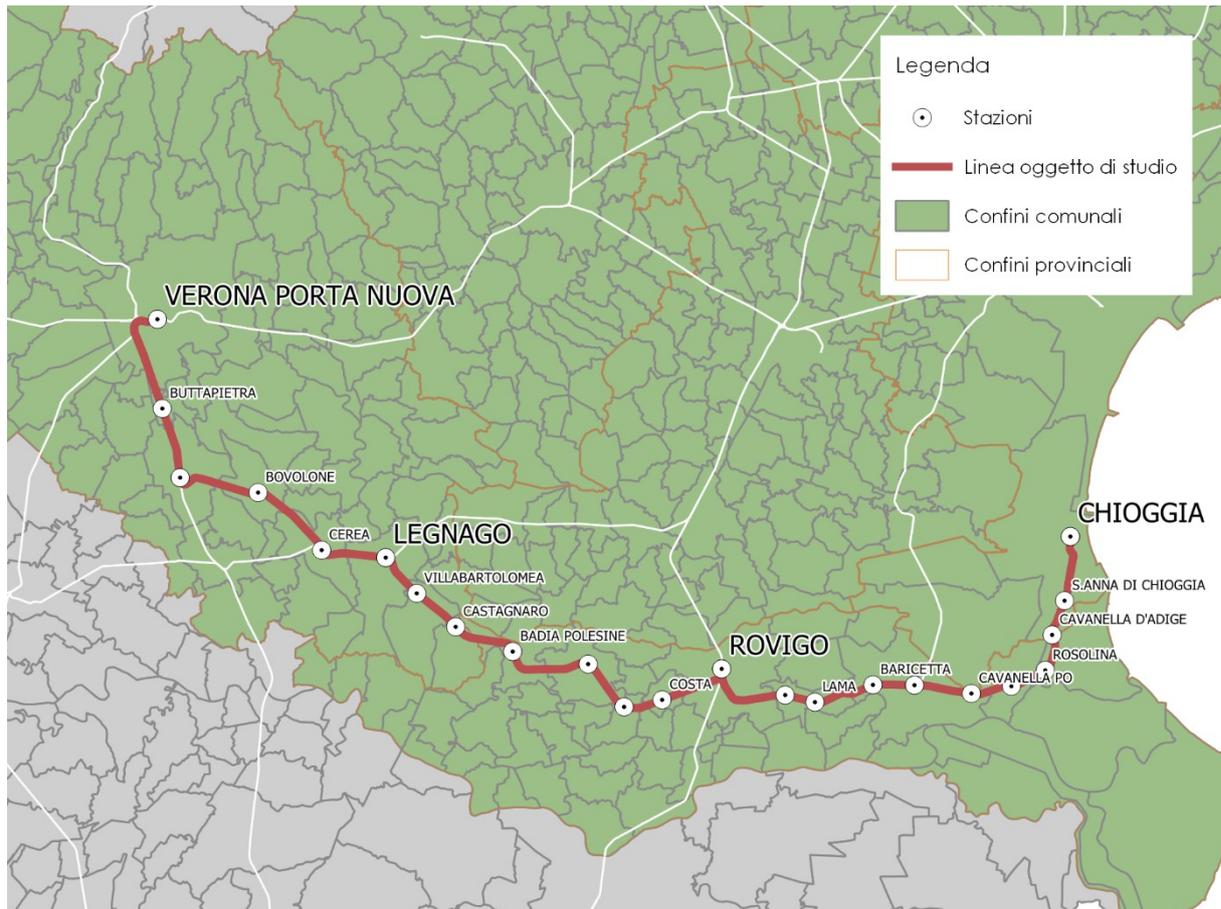


Figure 2 –Analysed lines

The Network Information Prospectus divides the Verona -Rovigo line in separate sections by homogeneous features:

- Verona-Isola della Scala, a part of Verona-Bologna line;
- Isola della Scala-Cerea;
- Cerea-Legnago, a part of Mantova-Monselice line;
- Legnago-Rovigo.

Figure 3The studied line is underlined in red color in In Figure 3.

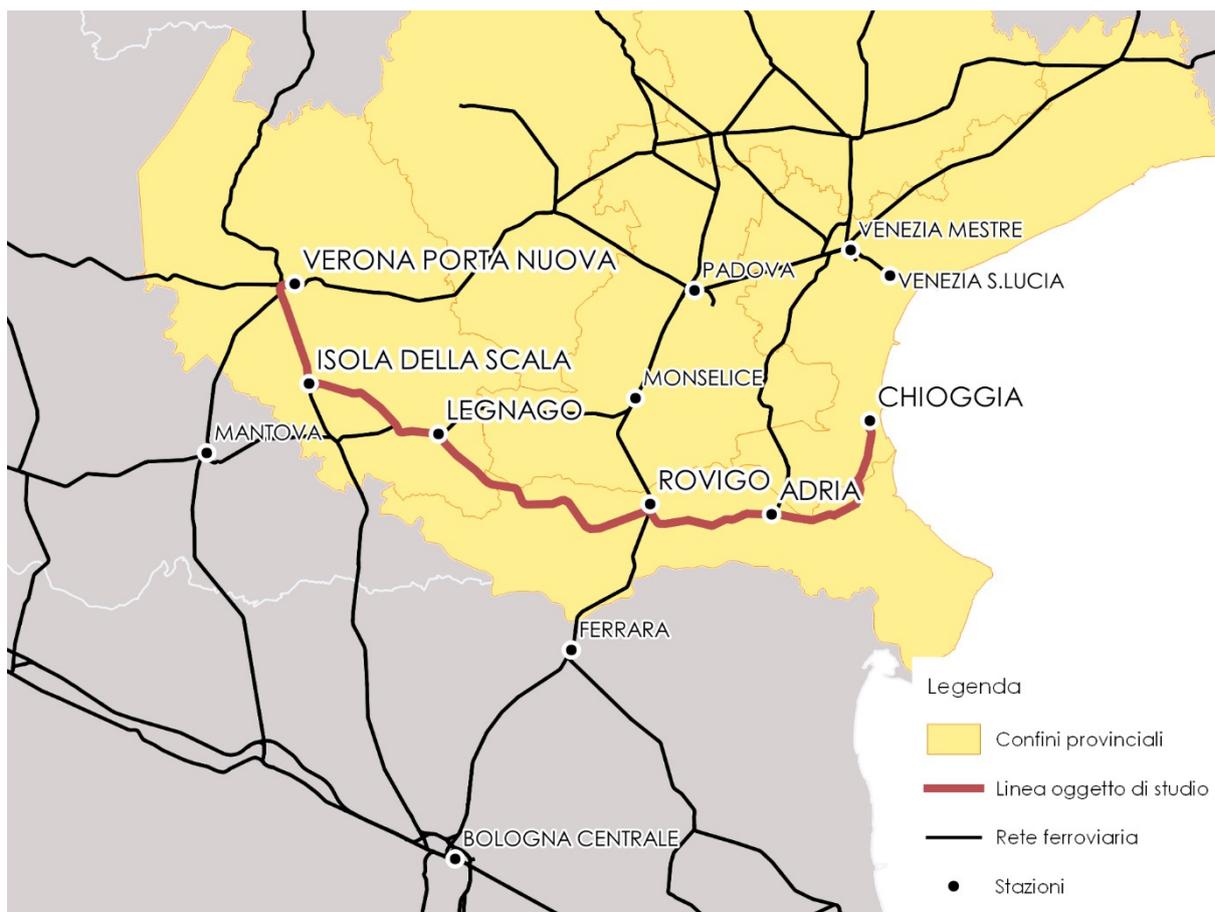


Figure 3 –Railway context

The line is linked with other rail lines like Verona-Bologna, Mantova-Monselice, Rovigo-Padova e Rovigo-Bologna. So, a desirable outcome would be to optimize the train connections and so the interchange with other destinations like Mantova, Bologna or Padova.

1.3 Assessment of current demand

The demand analysis is based on researches that Sistemi Territoriali has done to evaluate the filling percentage of its services, with the passenger boarding and alighting count of every train in every station during three periods of the year (March/April, July and November). In this study the years assumed for the analysis are 2016 and 2017. Moreover, during the months of September and October of 2018, some counts and interviews has been done in a few selected trains, always linked to the European project CONNECT2CE.

In next figures are shown the graphics of the boarding and alighting number of passengers on the stations along the focused lines.

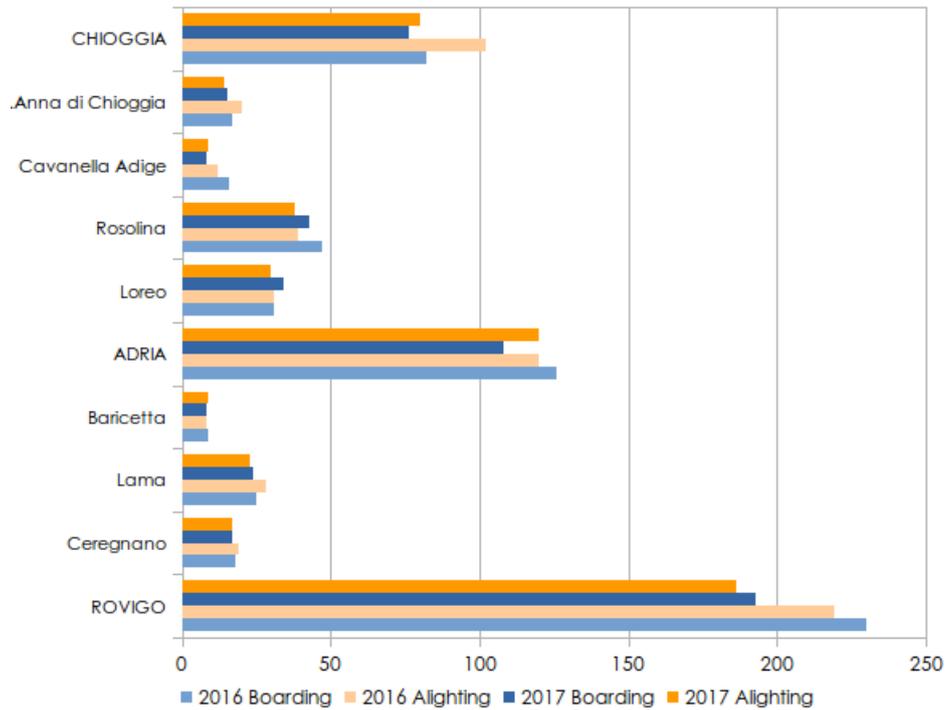


Figure 4 - Daily average passengers on winter weekday over the Chioggia-Rovigo line, comparison between 2016 and 2017

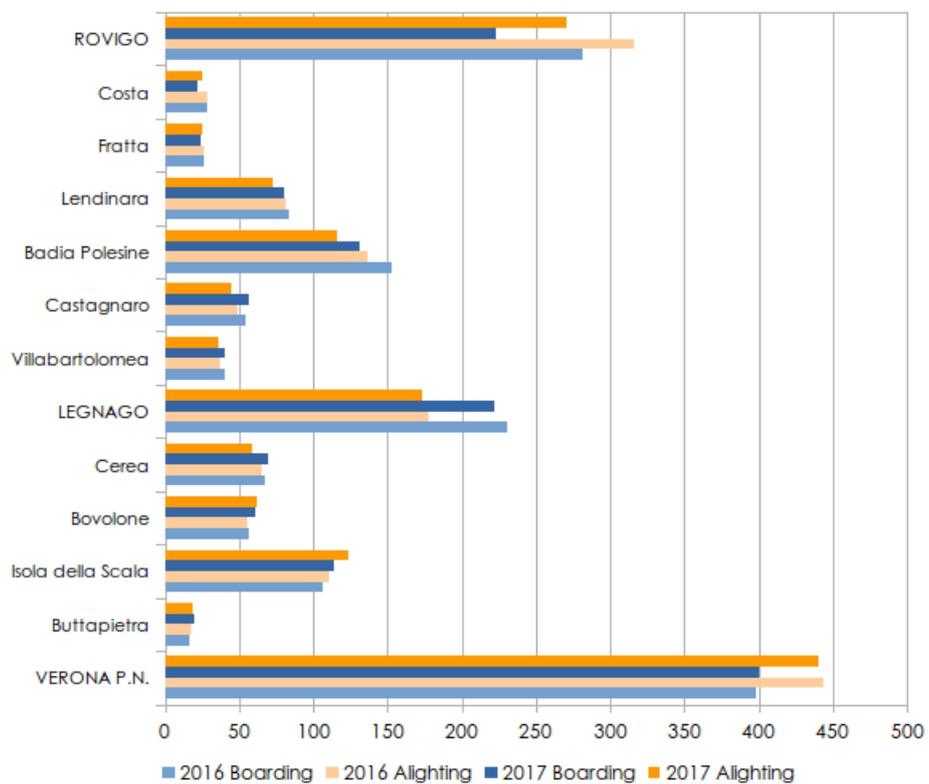


Figure 5 - Daily average passenger on winter weekday over the Rovigo-Verona line, comparison between 2016 and 2017

Comparing the two graphics, it is clear the load difference between the two lines which will lead to different planning considerations in the following paragraphs. The analysis conducted shows that on the Chioggia-Rovigo line passenger hourly trend displays prominent peaks on the typical commuter time slots. Otherwise, on the Rovigo-Verona line the difference between boarding passengers during rush hours and off-peak hours is not so marked like on the Rovigo-Chioggia line, even if some trains catch more than double volume of passengers than other trains.

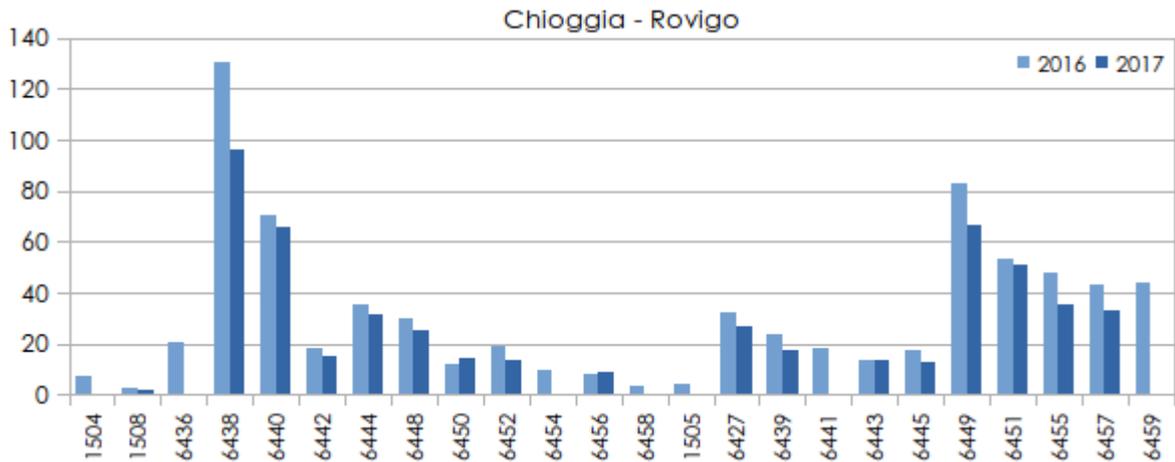


Figure 6 - Average alighting passengers per train on a weekday of the school period over the Chioggia - Rovigo line, comparison between 2016 and 2017

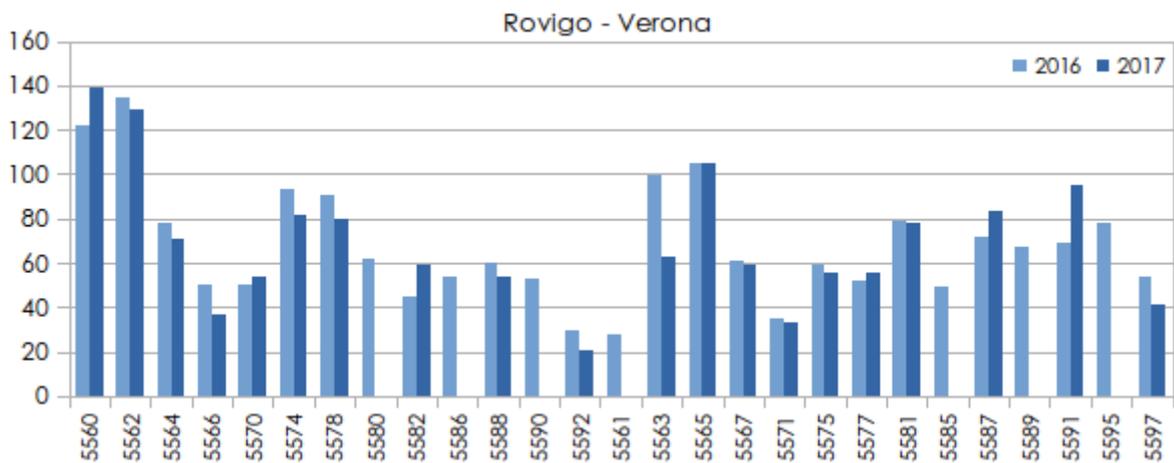


Figure 7 - Average alighting passenger per train on a weekday of the school period over the Verona - Rovigo line, comparison between 2016 and 2017

The aggregate data in terms of mean boarding passengers selected by section (Rovigo-Verona and Chioggia-Rovigo) observed by month (March, July and November 2017) are shown in Figure 8. The difference of demand between the Rovigo-Verona and Chioggia-Rovigo lines appears clear from this comparison.

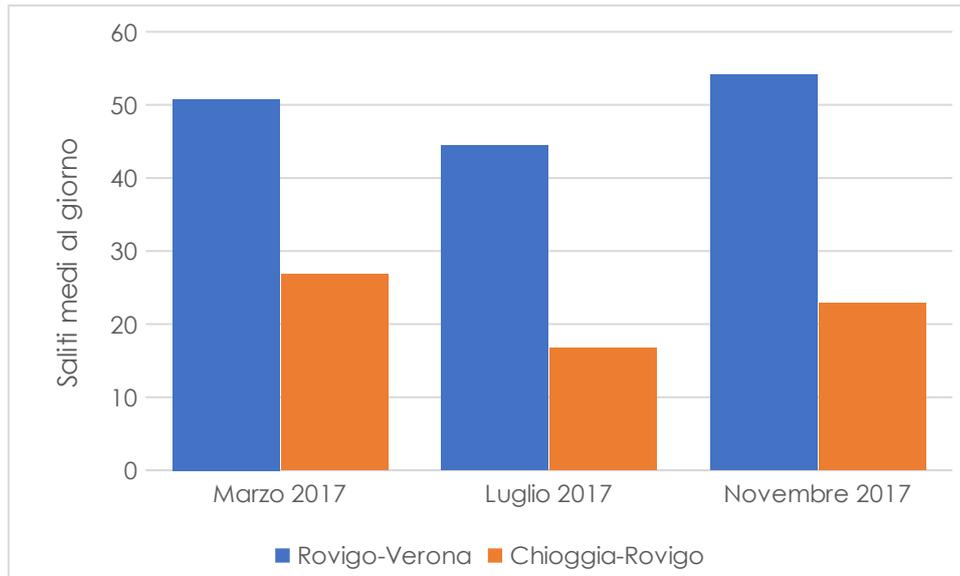


Figure 8 - Comparison of alighting passengers between Rovigo-Verona and Chioggia-Rovigo lines

2 Line FEATURES

Most of the network is composed by single track railways, except the sections between Verona and Isola della Scala (which belong to the Verona-Bologna line) and between Cerea and Legnago (which belongs to the Mantova-Monselice line).

Figure 9 and Figure 10 the lines features are shown. In Figure 9 and Figure 10; these data come from the national infrastructure manager, RFI. It edits documents that describe lines in terms of movement rules, category of axleload, traction system, number of tracks.

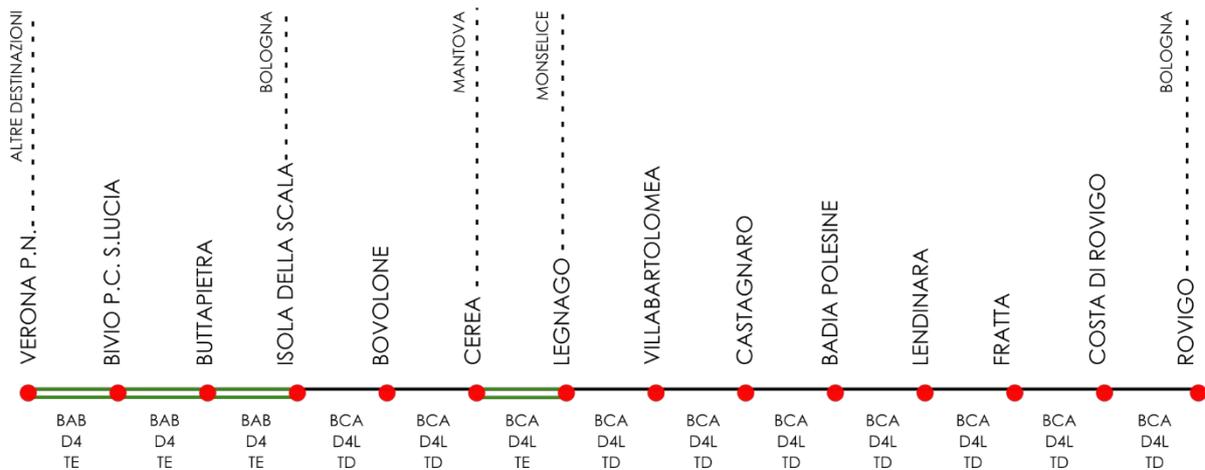


Figure 9 – Features of the Verona-Rovigo line

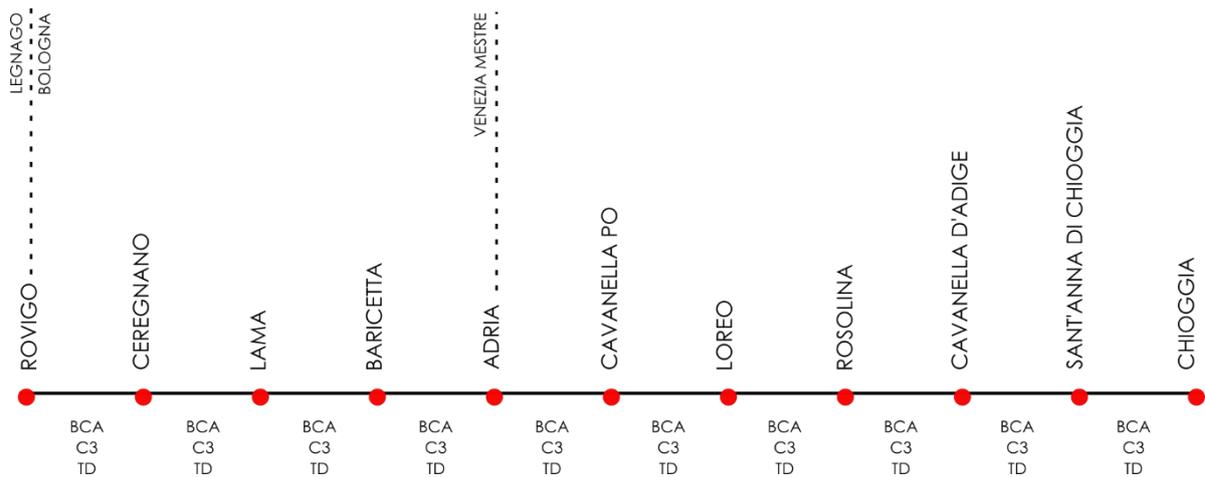


Figure 10 - Features of the Rovigo-Chioggia line

LEGEND

CIRCULATION SYSTEM	BAB	Bi-directional automatic electric block
	BCA	Axle counter block
AXIAL MASS CATEGORY	C3	Axleload 20 tonn Load per meter 7.2 tonn/m Axleload 22.5 tonn
	D4	Load per meter 8 tonn/m Without speed limits Axleload 22.5 tonn
	D4L	Load per meter 8 tonn/m With speed limits (PGOS – art. 118 and art.119)
TRACTION SYSTEM		Non electrified line (TD)
		Electrified line 3Kv (TE)
NUMBER OF TRACKS		Single track
		Double track
INTERCHANGE		Deviation

The flank speed on the lines managed by Sistemi Territoriali varies between 80 Km/h and 160 Km/h. The maximum speed is reachable between Isola della Scala and Verona, which is also a double track section. In Table 1 and Table 2 are shown the flank speeds of Rovigo-Verona and Chioggia-Rovigo lines.

Maximum speed (B) [Km/h]	Progressive mileage [Km]	Railway station	Other
125	0.000	Verona P.N.	
	1.219		Branch VR SC-VR PN
	3.378		Junction/C.C. S. Lucia
160	4.828		Cippus
	8.828		Cippus
90	12.668	Buttalapietra	
	20.658	Isola della Scala	
	30.388	Bovolone	
	40.218	Cerea	
120	42.128		Cippus
80	47.578	Legnago	
130	50.528		Cippus
	51.452		Level crossing
	53.078	Villabartolomea	

	55.267		Level crossing
	56.698		Level crossing
	58.818	Castagnaro	
	61.576		Level crossing
	62.175		Level crossing
	66.158	Badia Polesine	
	69.010		Level crossing
	69.618		Level crossing
	70.893		Level crossing
	71.202		Level crossing
	71.729		Level crossing
115	72.528		Cippus
	73.166		Level crossing
	73.777		Level crossing
	75.938	Lendinara	
	82.298	Fratta	
130	83.528		Cippus
	84.138		Level crossing
	84.525		Level crossing
	86.718	Costa	
	90.732		Level crossing
	91.241		Level crossing
	91.850		Level crossing
90	92.528		Cippus
	94.638	Rovigo	

Table 1 - Flank speed of the Verona - Rovigo line

Maximum speed (B) [Km/h]	Progressive mileage [Km]	Railway station	Other
90	0.000	Rovigo	
	9.435		Level crossing
	9.550	Ceregnano	
	12.960	Lama	
	19.910	Baricetta	
125	24.550	Adria	
	30.980	Cavanella Po	
85	34.000		Cippus
	35.640	Loreo	
125	37.000		Cippus

	39.870	Rosolina	
	40.027		Level crossing
	40.196		Level crossing
	42.540		Level crossing
	42.964		Level crossing
85	44.000		Cippus
	44.230	Cavanella d'Adige	
125	46.000		Cippus
	48.390	Sant'Anna di Chioggia	
	48.409		Level crossing
	49.493		Level crossing
	49.804		Level crossing
70	53.000		Cippus
	55.790	Chioggia	

Table 2 - Flank speed of the Rovigo - Chioggia line

The track gauge of the focused lines is the standard gauge (1435 mm) and the only electrified sections are those between Isola della Scala and Verona and between Cerea and Legnago.

The track vacancy detection is made by the axle counter block, except for the Verona-Isola della Scala sections; where it is obtained by the bi-directional automatic electric block instead.

The block sections have the same length as the distance between stations on almost the whole line, except for the section between Verona and Isola della Scala where there in which are several block sections between stations.

3 SERVICE FEATURES

The service offered is mainly aimed to satisfy the commuters and students: comparing the frequency on weekdays in winter and summer seasons, on Verona-Rovigo it varies from 24 to 16 services a day in both directions. Also, on holidays frequency is reduced to 12 trips. Similar considerations also apply to the Rovigo-Chioggia line. The actual frequencies on the lines are summarized in Table 3.

Line	Winter working day	Summer working day	Winter holiday	Summer holiday
Verona - Rovigo	24	16	12	12
Rovigo - Chioggia	20	18	12	12

Table 3 – Current frequencies

The Verona-Rovigo line is characterized by travel times that depend on the train category:

- *Regionale*, which stops at each station;
- *Regionale Veloce*, which stops only at main stations.

Following tables show the travel times in the above two categories of circulating trains.

Departure Station	Arrival station	Time [h:min]
Verona P.N.	Buttalapietra	0:10
Buttalapietra	Isola della Scala	0:06
Isola della Scala	Bovolone	0:10
Bovolone	Cerea	0:10
Cerea	Legnago	0:07
Legnago	Villabartolomea	0:06
Villabartolomea	Castagnaro	0:06
Castagnaro	Badia Polesine	0:14
Badia Polesine	Lendinara	0:08
Lendinara	Fratta	0:07
Fratta	Costa	0:05
Costa	Rovigo	0:09
Verona P.N.	Rovigo	01:41

Table 4 – Travel times of the Verona-Rovigo Regionale trains

Departure Station	Arrival station	Time [h:min]
Verona P.N.	Isola della Scala	0:15

Isola della Scala	Cerea	0:23
Cerea	Legnago	0:09
Legnago	Badia Polesine	0:18
Badia Polesine	Rovigo	0:25
Verona P.N.	Rovigo	1:30

Table 5 - Travel times of the Verona-Rovigo Regionale veloce trains

In the section between Rovigo and Chioggia only Regional trains run, which stop at each station. Travel times are shown in Table 6.

Departure Station	Arrival station	Time [h:min]
Rovigo	Ceregnano	0:09
Ceregnano	Lama	0:05
Lama	Baricetta	0:07
Baricetta	Adria	0:06
Adria	Loreo	0:18
Loreo	Rosolina	0:05
Rosolina	Cavanella d'Adige	0:06
Cavanella d'Adige	Sant'Anna di Chioggia	0:05
Sant'Anna di Chioggia	Chioggia	0:09
Rovigo	Chioggia	1:10

Table 6 - Travel times of the Rovigo-Chioggia Regionale trains

4 ROLLING STOCK

The rolling stock fleet carrying the service on the Rovigo - Chioggia and Rovigo-Verona lines consists of 26 vehicles; more than half is made up of Fiat Ad 668 models, manufactured in 1979 and powered by diesel engines. Only three newer vehicles were put into operation from the 2000s.

Descrizione	Model	Year	Traction	Units	Maximum speed (Km/h)	Brake	Length (m)	Mass (tonn)	Seated seats	Standing seats
Motor coach	Stadler ATR 110	2007	diesel electric	2	140	automatic continuous	39.5	83	111	106
Motor coach	Stadler ATR 116	2012	diesel electric	1	140	automatic continuous	39.5	83	111	84
Motor coach	Fiat Ad 668	1979	diesel	11	110	automatic continuous	23.54	44.7	68	32
Motor coach	Fiat Ad 668	1979	diesel	4	85	automatic continuous	23.54	44.7	68	32
Motor coach	Fiat Ad 663	1991-1993	diesel	5	90	automatic continuous	23.54	45.7	68	32
Control car	Fiat Bp 663	1993	diesel	3	90	automatic continuous	23.54	37	68	32

Table 7 - Composition of the rolling stock that operates on Chioggia -Rovigo and Rovigo-Verona

As it is possible to evaluate from Figure 11, the fleet has a very high average age, it is over 30 years old, with very different performances compared to more recent trains. The trains operating characteristics are lower than the railway infrastructure ones. Only three vehicles allow to reach the maximum speed at which it is possible to run some sections of the network, while 12 trains out of 26 do not exceed 90 Km/h. This involves a marked under-use of the line potentiality of the line and a consequent increase in travel times.

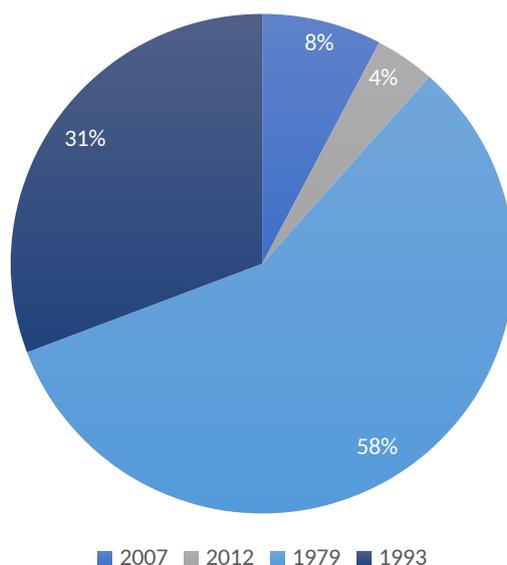


Figure 11 – Percentage of the year that rolling stock enters into service

5 RAILWAY CONNECTIONS

The line focused on this study allows railway interchanges with other lines in the stations of Verona Porta Nuova, Legnago and Rovigo.

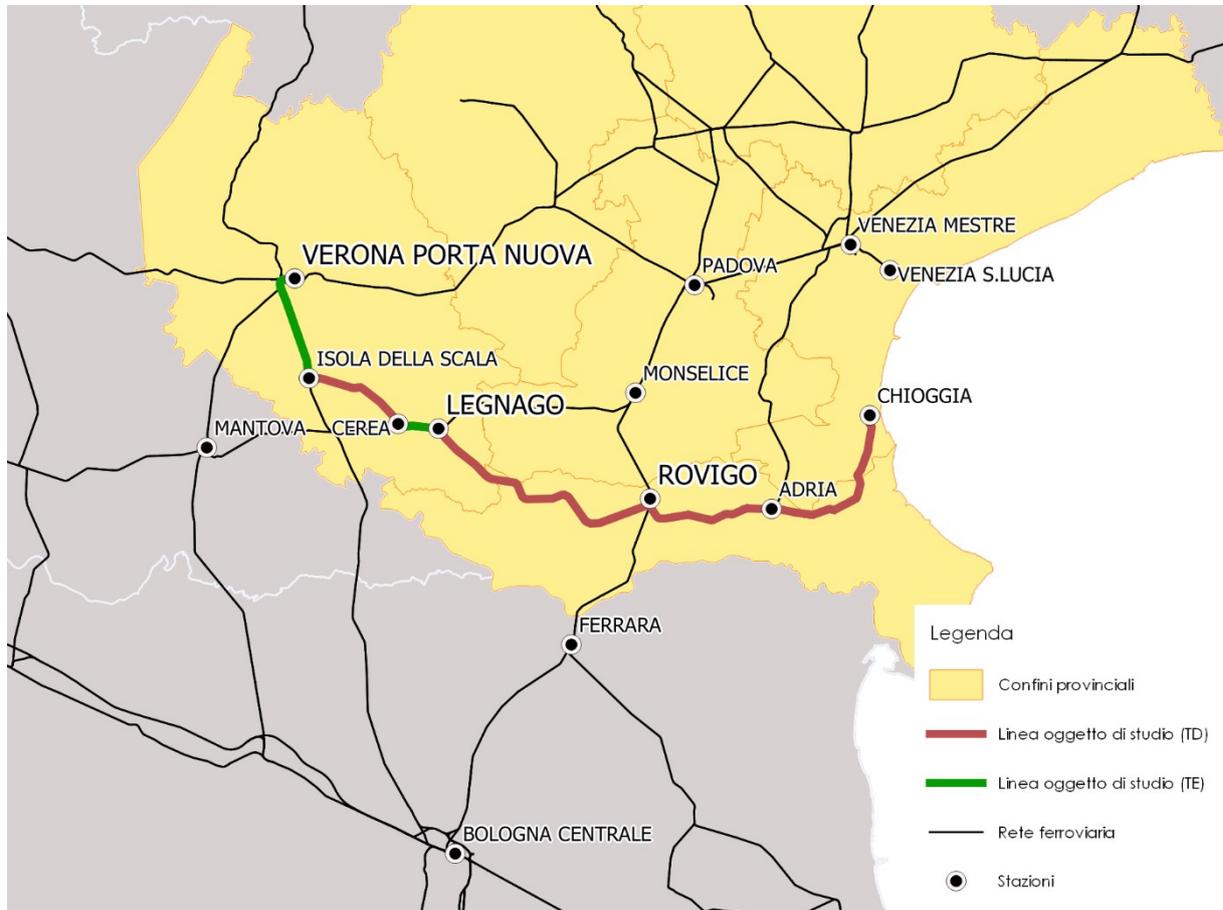


Figure 12 – Railway interchange at Legnago railway station

The following tables show, at the Legnago, Rovigo and Verona Porta Nuova stations, the complete departure and arrival times on a working day, during the period from 9th December 2018 to 8th June 2019 (source: RFI scheduled timetable)

Destination	Departure hour																	
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		21
	minute																	
Mantova		22	22		22				22		22		22	22	22		8	
Monselice			34		34			34	34	34	34	34	34	34		34	10	
Padova	46	56															2	
Rovigo		42	42	42	42			42	42	42	42	42	42	42	42	31	14	
Venezia Mestre		34															1	
Verona Porta Nuova	42	29	29	29	29	29		29	29	29	29	29	29	29	29		14	

Table 8 – Departures from Legnago station

Origin	Arrival hour	Total number
--------	--------------	--------------

	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21		
	minute																		
Mantova		33	33		33				33	33	33		33			33			8
Monselice		21	21		21				21	22	21	22	21	21		22			10
Padova				22		22													2
Rovigo	41	28	28	28	28	28			28	28	28	28	28	28	28	30			14
Venezia Mestre															21		22		2
Verona Porta Nuova			41	41	41			41	41	41	41	41	41	41	41	41	27		13

Table 9 - Arrivals to Legnago station

Destination	Category	Departure hour																					
		1	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22			
		minute																					
Adria	R																	55				1	
Bologna Centrale	R			57	18																		2
	RV				51	53	51	51		51	51	51	51	51	54	51	51	54	51				14
Chioggia	R				15	15	15	15				15	15		15	15	15	15					10
Ferrara	R					30							35			35	35						4
Fiumicino Aeroporto	FR				13																		1
Lecce	FB					48								46									2
Legnago	R																			39			1
Napoli Centrale	Italo						47																1
	FA														25								1
Roma Termini	IC								22						1								2
	ICN		19																				1
	Italo											47								47			2
Trieste Centrale	IC													32							53		2
	ICN			56																			1
Udine	FR																				46		1
	FA									32													1
	FB													0								2	2
Venezia S. Lucia	Italo										14					14							2
	R			34	34	34	38		32		26	36		36	36	33	36	36					12
	RV				11	8	8	8	8	8	8		8	8		8	8	7	8	8		14	14
Verona Porta Nuova	R			47	47	39	39	39				39	39	39	39	39	39						14

Table 10 - Departures from Rovigo station

Origin	Arrival hour	Total number
--------	--------------	--------------

Origin	Category	Arrival hour																			Total number of trains			
		0	1	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		23		
																					2	2	2	
																						1	2	3
		minute																						

6 TICKETING

Tickets can be purchased both in paper and electronic format.

The former can be bought at the Trenitalia ticket offices and in some retailers near the railway stations of the lines focused, a list of which is available on Sistemi Territoriali website.

The E-ticketing service is available: tickets can be purchased on the Trenitalia website and on other online booking platforms connected to the Trenitalia booking system.

Finally, it is possible to take advantage of the UNICA Veneto Card, an electronic wallet on which travel tickets can be loaded.

In the near future, for this type of ticketing, an integration with other transport companies serving the urban areas of Rovigo and Verona may be available.

7 OTHER COSTUMER SERVICES

On the web platform, PuntualTreno, customers can check the exact position of the trains and their punctuality. The PuntualTreno App application is also available, which can be downloaded from the Sistemi Territoriali website.

Among the services offered to the costumers there is also "Servizio SMS per informare", which sends a warning message to users if their train is delayed by ten minutes or more. Passengers can register up to four trains to be checked. In addition, the service informs whenever the delay is further increased, or the train is cancelled.



SERVIZIO SMS PER INFORMARE

 Iscriviti al servizio "SMS per informare" per essere tempestivamente avvisato in caso di ritardo dei nostri treni.

 Seleziona fino a quattro treni di interesse (esempio: due per l'andata, due per il ritorno), inserisci nome e numero di cellulare e riceverai, via SMS, le notifiche di eventuali ritardi superiori ai 10 minuti (con nuovo SMS per l'accumulo di ulteriori 5 minuti di ritardo) ed eventuali soppressioni del treno stesso.

 Il servizio è fornito gratuitamente ed il ricevimento dei messaggi può essere interrotto in qualsiasi momento. Qualora desiderassi modificare le corse selezionate o interrompere il servizio, è sufficiente indicare le nuove preferenze o la richiesta di disiscrizione scrivendo a sms@sistemiterritorialispa.it, specificando nome e numero di telefono utilizzati per la registrazione al servizio.

Cellulare (*): +39

Nome (*):

Cognome:

E-mail:

Linee (*): Adria - Mestre (Venezia S.L.) [Tabella oraria](#) Rovigo - Chioggia [Tabella oraria](#) Verona P.N. - Rovigo [Tabella oraria](#)

Consulta le tabelle orarie di ciascuna linea, per aiutarti ad identificare le corse alle quali sei interessato. Ricorda che possono essere selezionate al più 4 corse in totale.

Treni di interesse (*): Per Venezia S.L.:

<input type="checkbox"/> 91560	<input type="checkbox"/> 91570	<input type="checkbox"/> 91582	<input type="checkbox"/> 91594
<input type="checkbox"/> 91562	<input type="checkbox"/> 91572	<input type="checkbox"/> 91584	<input type="checkbox"/> 91596
<input type="checkbox"/> 91564	<input type="checkbox"/> 91576	<input type="checkbox"/> 91588	<input type="checkbox"/> 91598
<input type="checkbox"/> 91566	<input type="checkbox"/> 91578	<input type="checkbox"/> 91590	
<input type="checkbox"/> 91568	<input type="checkbox"/> 91580	<input type="checkbox"/> 91592	

Per Adria:

<input type="checkbox"/> 91565	<input type="checkbox"/> 91577	<input type="checkbox"/> 91589	<input type="checkbox"/> 91599
<input type="checkbox"/> 91567	<input type="checkbox"/> 91579	<input type="checkbox"/> 91591	<input type="checkbox"/> 99999
<input type="checkbox"/> 91569	<input type="checkbox"/> 91583	<input type="checkbox"/> 91593	
<input type="checkbox"/> 91571	<input type="checkbox"/> 91585	<input type="checkbox"/> 91595	
<input type="checkbox"/> 91575	<input type="checkbox"/> 91587	<input type="checkbox"/> 91597	

Figure 13 – "Servizio SMS per informare"

Transport of bicycles on board is only available on trains specially marked in the timetable. This service is limited because there is a little space on board to accommodate bicycles. It is

possible to reserve the space for bicycles by sending an email in advance to Sistemi Territoriali.

8 PLANNING SOLUTIONS

8.1 Analysis of the potential of the line

The line potentiality can be evaluated by the performance simulation, which shows the best theoretical hourly chart, assuming that the trains stop at each station.

The theoretical travel time can be estimated from the description of the current infrastructure in the Line Files provided by the Infrastructure Manager (RFI).

Two different types of rolling stock have been considered:

- Minuetto N, diesel train;
- E464, electric train.

Figure 14 and Figure 15 show the traction curves of two selected rail vehicles.

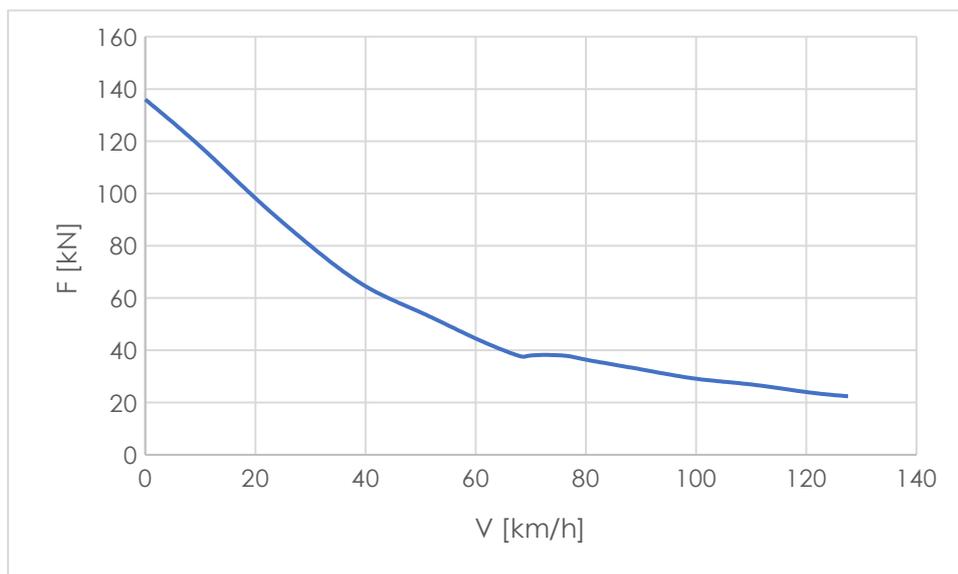


Figure 14 - Traction curve of Minuetto N

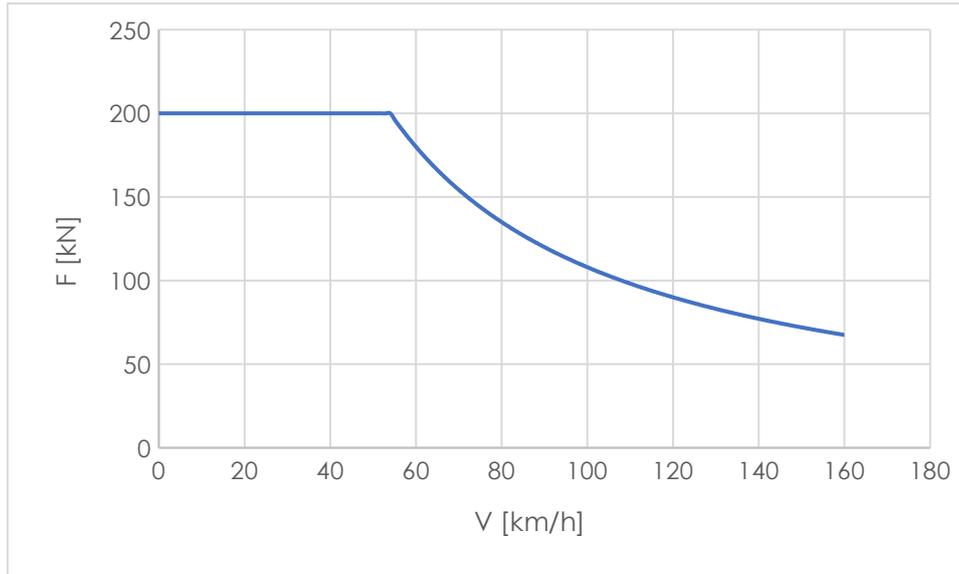


Figure 15 - Traction curve of E 464

A maximum jerk limited to 0.5 m/s^3 has been assumed; even the maximum acceleration has been maintained at 0.5 m/s^2 despite the characteristics of the selected rail vehicles could allow more performing values.

The following figures show the graphic result of the performance simulation on both lines: Verona-Rovigo and Rovigo-Chioggia.

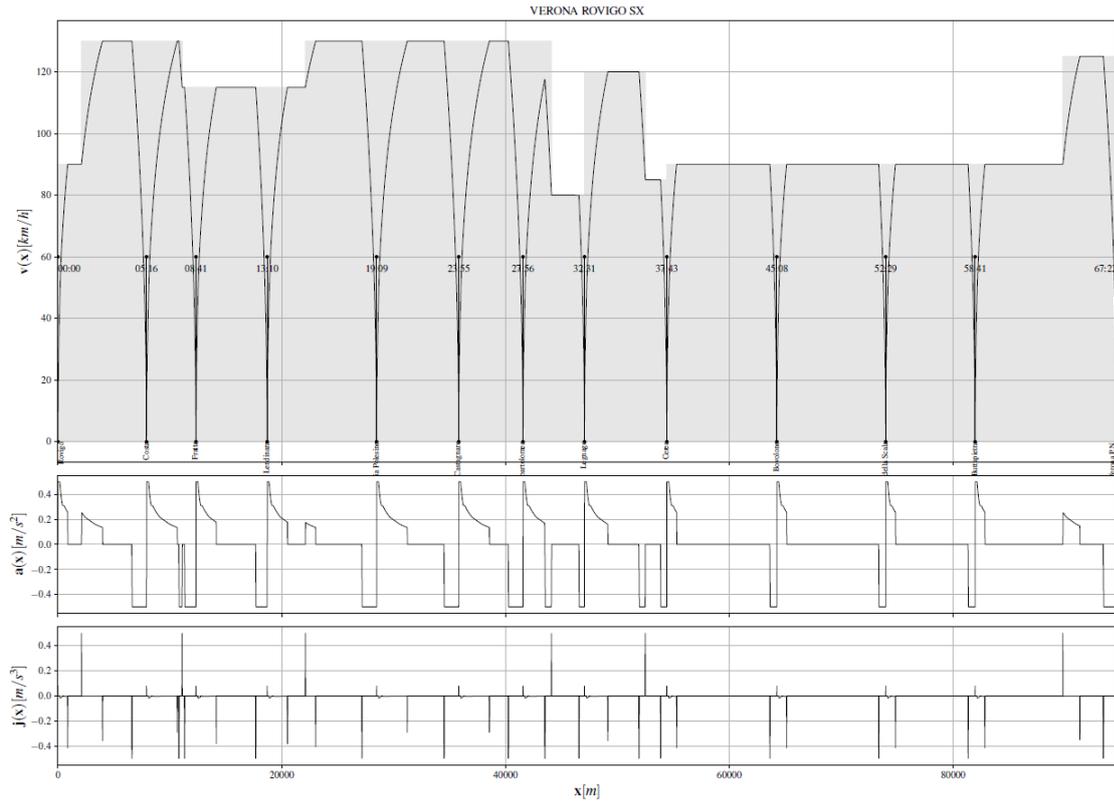


Figure 16 – Performance simulation between Verona and Rovigo, rank B, Minuetto N

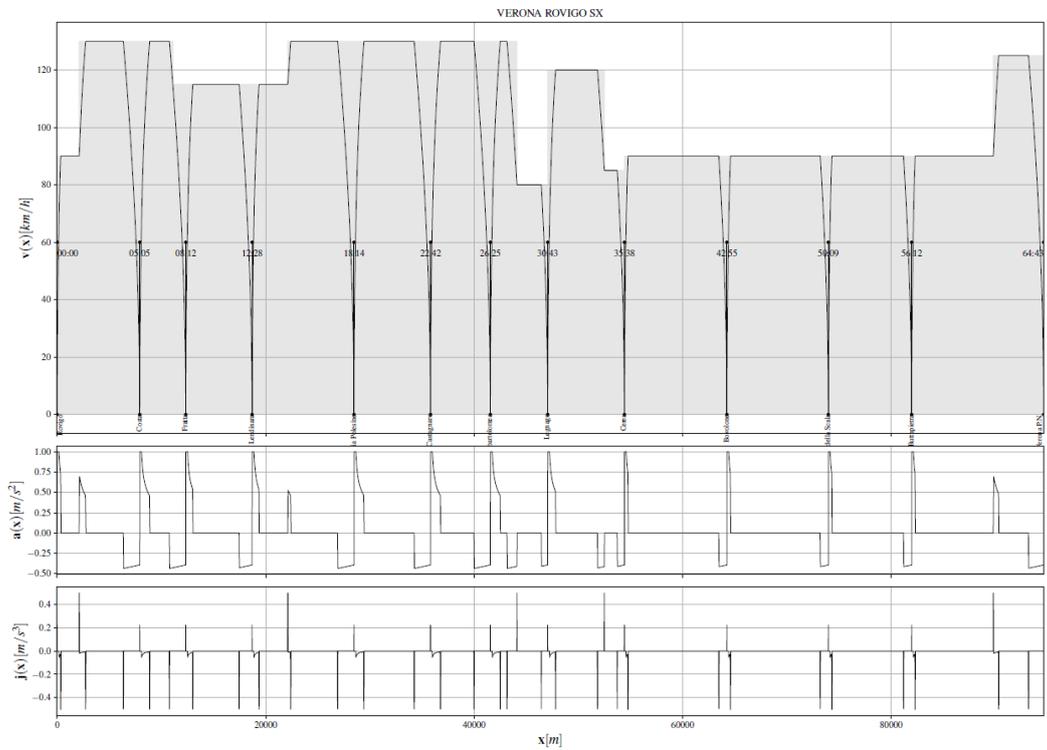


Figure 17 - Performance simulation between Verona and Rovigo, rank B, E464

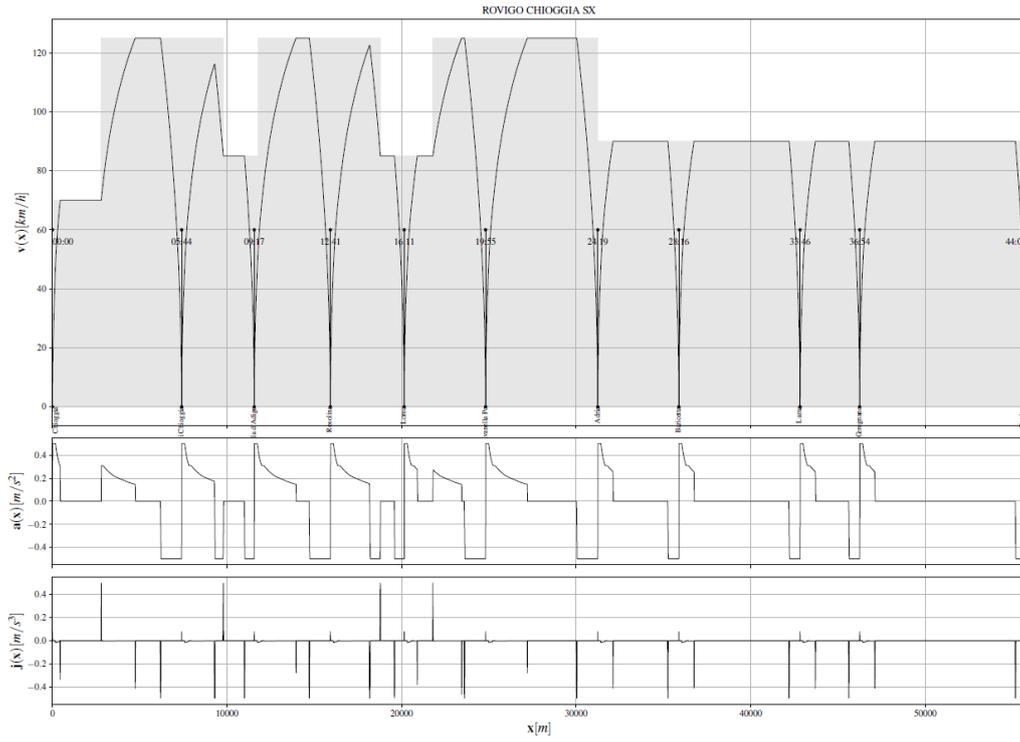


Figure 18 - Performance simulation between Rovigo e Chioggia, rank B, Minuetto N

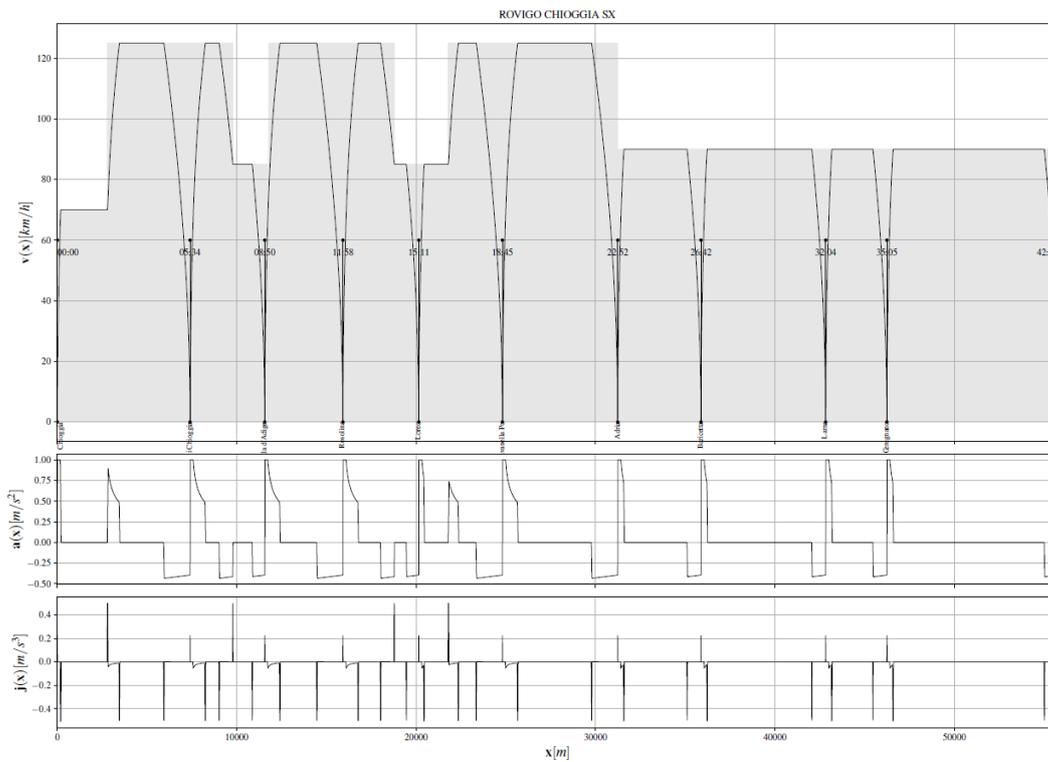


Figure 19 - Performance simulation between Rovigo e Chioggia, rank B, E464

The theoretical travel times obtained with Minuetto N are shown on Table 14 and Table 15.

Station	Prg [m]	Time [HH:MM:SS]
Rovigo	0	00:00:00
Costa	7920	00:05:17
Fratta	12340	00:08:42
Lendinara	18700	00:13:11
Badia Polesine	28480	00:19:10
Castagnaro	35820	00:23:55
Villabartolomea	41560	00:27:56
Legnago	47060	00:32:32
Cerea	54420	00:37:43
Bovolone	64250	00:45:08
Isola della Scala	73980	00:52:30
Buttapietra	81970	00:58:41
Verona P.N.	94640	01:07:22

Table 14 – Theoretical travel times on Rovigo-Verona, Minuetto N

Station	Prg [m]	Time [HH:MM:SS]
Chioggia	0	00:00:00
S. Anna di Chioggia	7400	00:05:44
Cavanella d'Adige	11560	00:09:18
Rosolina	15920	00:12:41
Loreo	20150	00:16:12
Cavanella Po	24810	00:19:56
Adria	31240	00:24:19
Baricetta	35880	00:28:17
Lama	42830	00:33:47
Ceregnano	46240	00:36:55
Rovigo	55790	00:44:09

Table 15 - Theoretical travel times on Chioggia-Rovigo, Minuetto N

8.2 Proposed solution

The proposed planning solution consists in the electrification of Isola della Scala and Cerea section, roughly 20 km long: this allows to homogenize the traction system between Verona and Legnago. The other part of the line, from Legnago to Rovigo, doesn't changed. So it is possible to consider the service organized in two parts: the electrified one between Verona and Legnago and the not electrified one between Legnago and Rovigo, with interchange in Legnago station for passengers travelling from Verona to Rovigo and vice versa. This solution makes possible to optimize journey times on the entire line and even on the intermediate sections.

Figure 20 shows the current and planned travel time graphs respectively. The sections of double-track line are highlighted in blue.

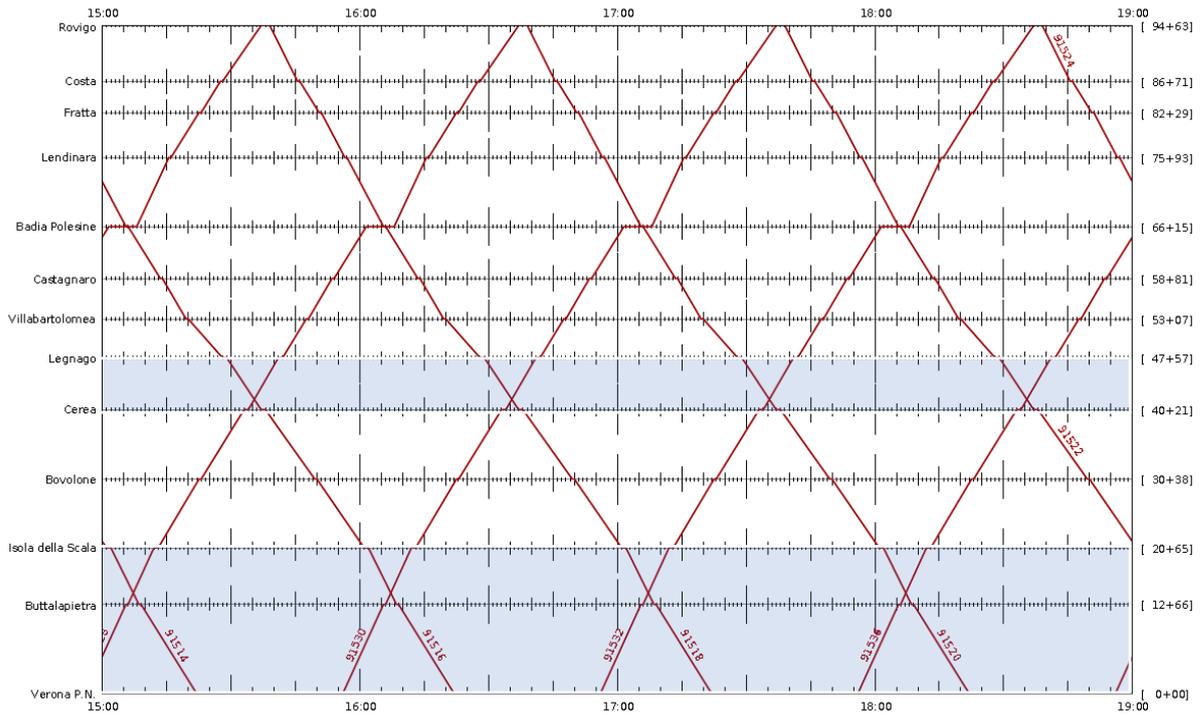


Figure 20 -Actual schedule chart

Considering the complexity of the Verona Porta Nuova node, the substantial changes on the timetable have shifted towards Legnago and Rovigo, keeping the arrivals and departures at Verona Porta Nuova unchanged: in this way the proposed timetable is already compatible with the complexity of the node.

In the Legnago- Rovigo section , it is important that, in the event of delays, the train heading towards Legnago takes precedence over the other, having a much more limited margin of recovery.

Verona-Rovigo-Adria-Chioggia

04-02-2019

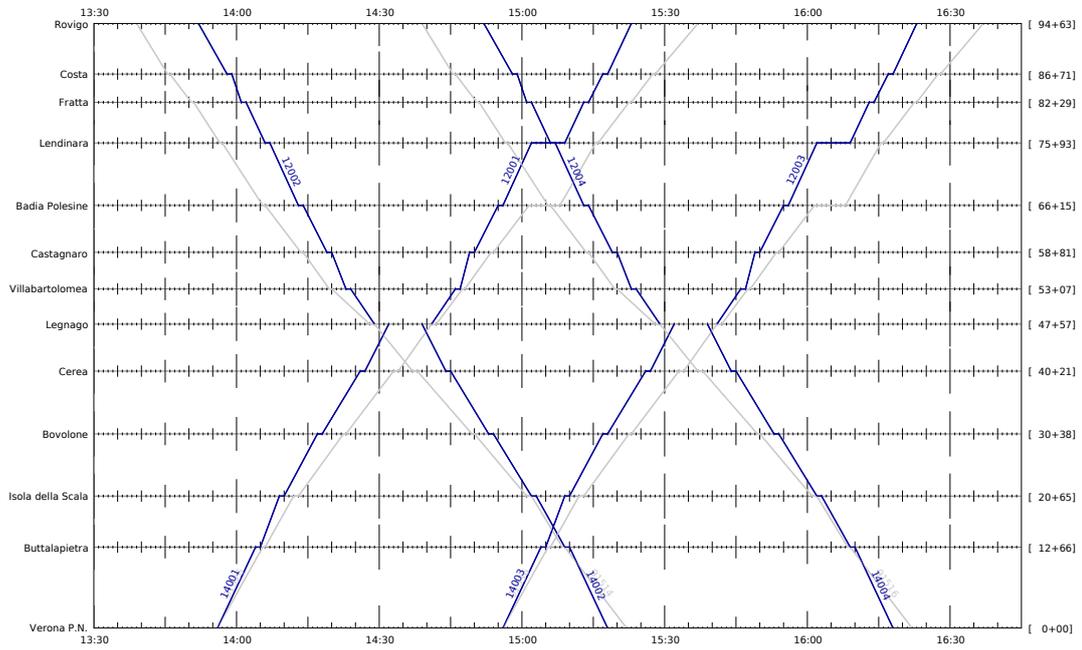


Figure 21 shows the characteristics of the line in the planned scenario.

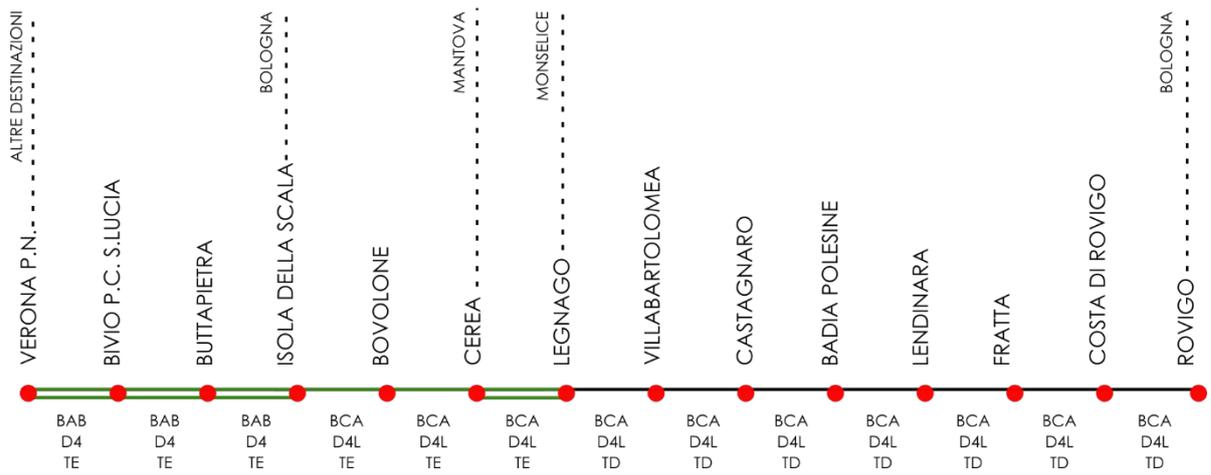


Figure 21 – Planned features of the Verona

LEGEND

CIRCULATION SYSTEM	BAB	Bi-directional automatic electric block
	BCA	Axle counter block
AXIAL MASS CATEGORY	C3	Axleload 20 tonn Load per meter 7.2 tonn/m Axleload 22.5 tonn
	D4	Load per meter 8 tonn/m Without speed limits Axleload 22.5 tonn
	D4L	Load per meter 8 tonn/m With speed limits (PGOS – art. 118 and art. 119)
TRACTION SYSTEM		Non electrified line (TD)
		Electrified line 3Kv (TE)
NUMBER OF TRACKS		Single track
		Double track

In the following figures, it is possible to compare current and planned station clocks in the stations of Legnago, Rovigo and Verona Porta Nuova: they refer to a selected standard hour which repeats itself regularly during the day.

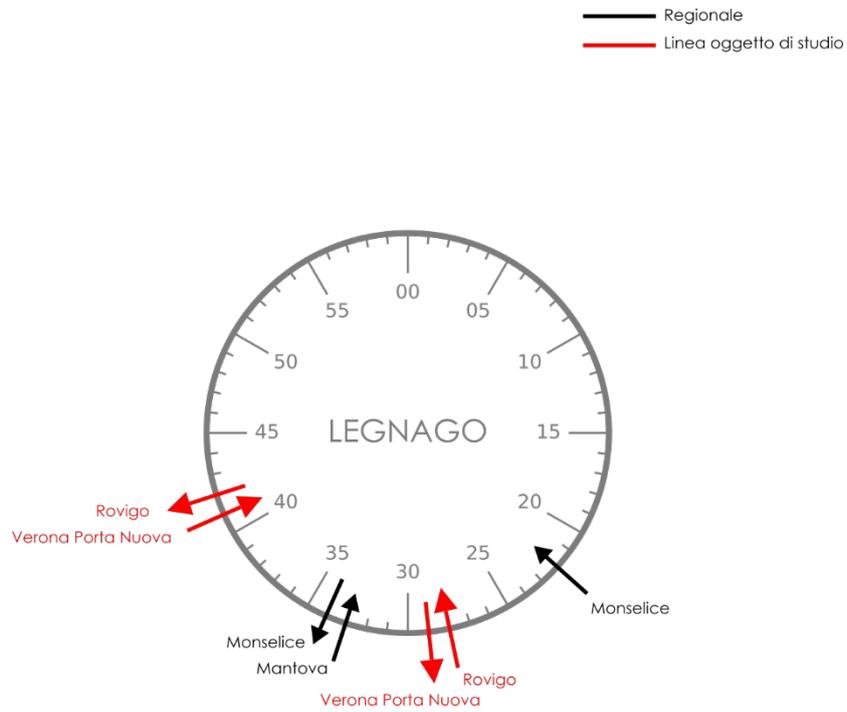


Figure 22 – Current station clock, Legnago

— Regionale
— Linea oggetto di studio

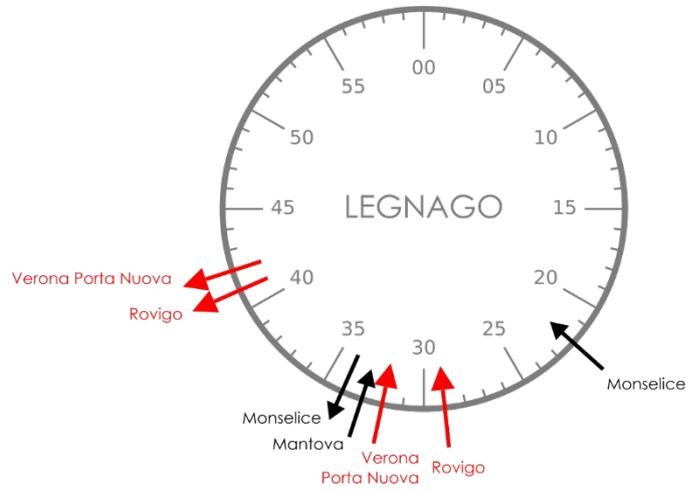


Figura 23 – Planned station clock, Legnago

— Regionale
— Linea oggetto di studio

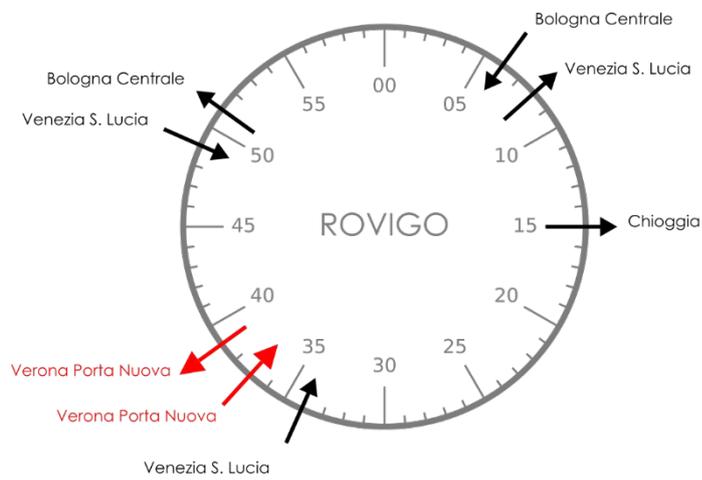


Figure 24 – Current station clock, Rovigo

— Regionale
— Linea oggetto di studio

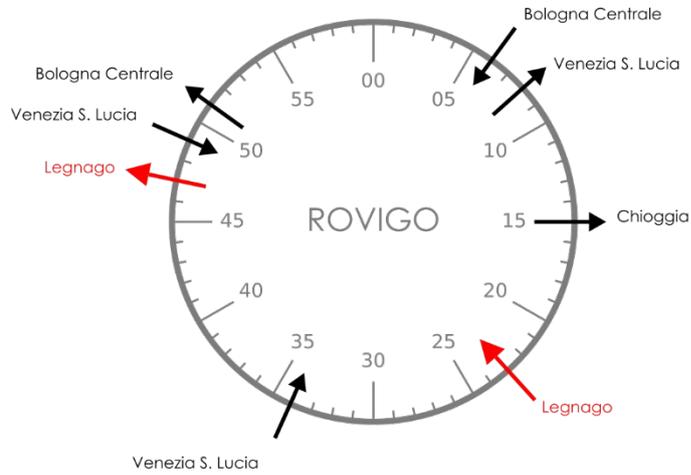


Figure 25 – Planned station clock, Rovigo

— Regionale
— Regionale (Trenord)
— Frecciarossa
— Italo
— Linea oggetto di studio

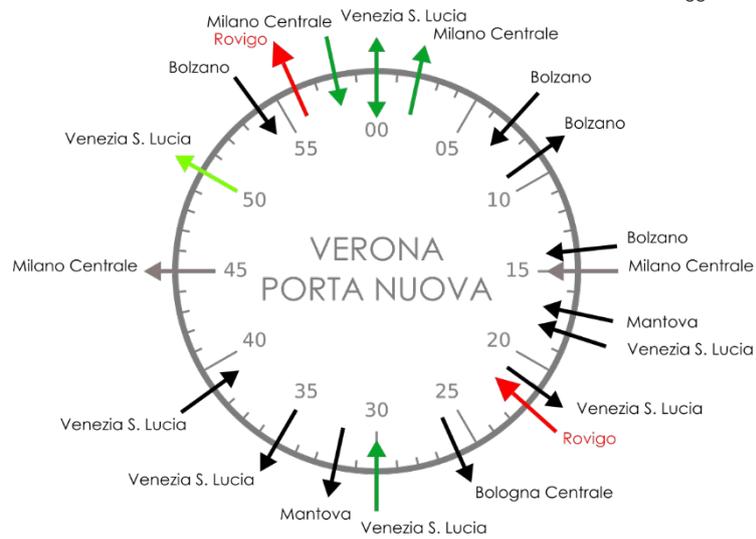


Figure 26 - Current station clock, Verona Porta Nuova

9 ConclusionS

As reported in the previous paragraphs, the current travel time on the lines studied depends mainly on two factors:

- the state of maintenance and the technological characteristics of the railway infrastructure;
- the performance of rolling stock.

The first conducted analysis was therefore aimed to define the potential of improving the efficiency of railway services linked to the renewal of rolling stock. This study used a simulation model that starting from the geometrical characteristics of the infrastructure, the features of the rolling stock and the stations of the studied service, allows to simulate the speed/distance diagram of the trains and the hypothetical travel time without any restrictions from priorities. Using rail vehicles able to make the most of the characteristics of the network, it is possible to recover 12% of the travel time.

Travel times can be reduced on both Rovigo-Legnago and Verona-Legnago sections, and on the entire Verona-Rovigo line, despite the interchange. The comparison of travel times is shown in Figure 28.

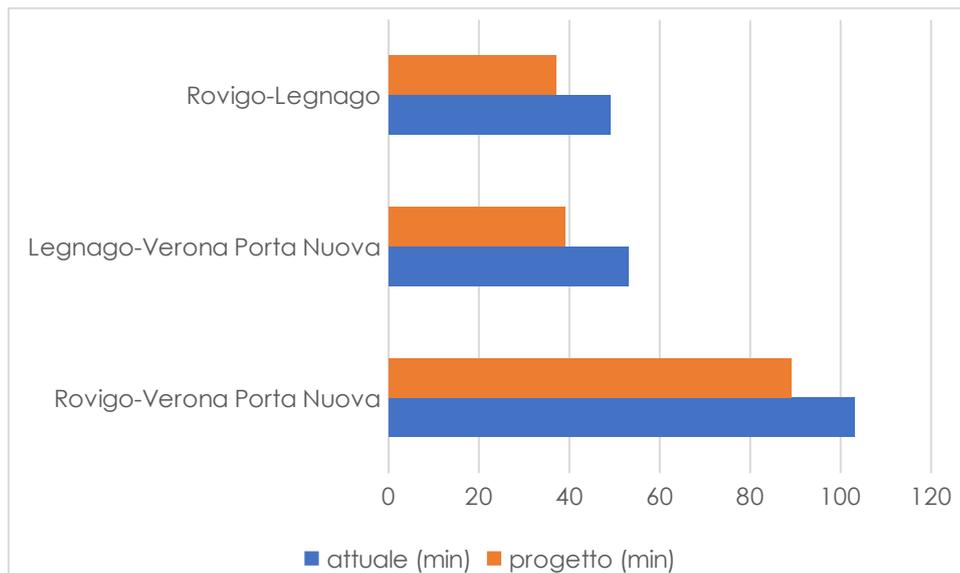


Figure 28 -Comparison between actual and planned travel times

The other focused theme has been the implementation of the infrastructure and the management of services. Assuming the electrification of the entire section between Verona and Legnago, it would be convenient to organize two separate services: Verona-Legnago, to be completely electrified, and Legnago-Rovigo. The subdivision of the services on sections with homogeneous characteristics would allow to achieve important results in terms of:

- improvement of the regularity;
- reduction of regularity extensions.

The activation of this new management requires four vehicles, two for each segment, to be deployed simultaneously.

Some improvements are possible also for the Chioggia-Rovigo line, however the demand on this line does not justify substantial investments. In this case, the offer could be improved with new services made by buses during off-peak hours.