



**POLITECNICO
MILANO 1863**

DolomitiBUS

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PUBLIC TRANSPORT MANAGEMENT

DESIGN OF URBAN BUS NETWORK IN BELLUNO MUNICIPALITY

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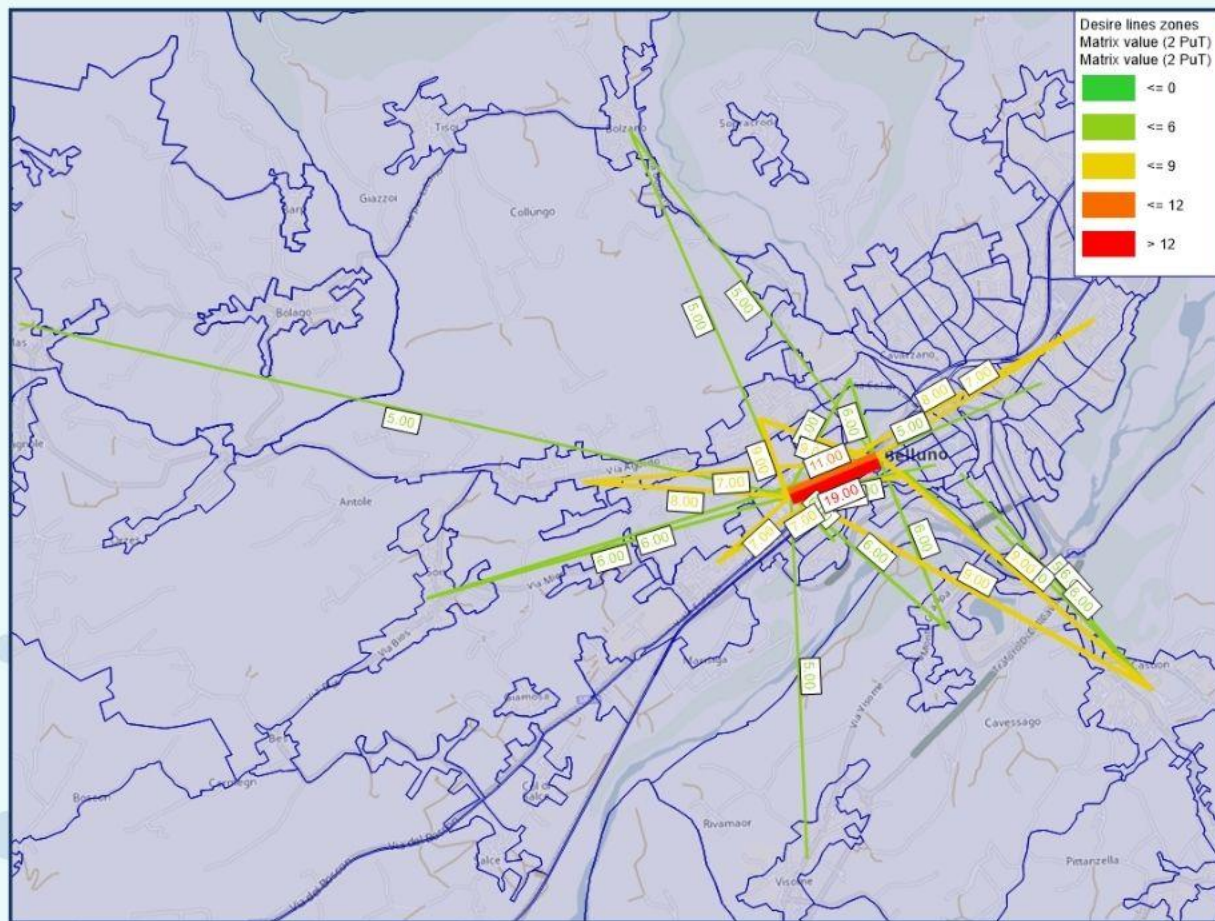
**ECONOMIC
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DESIGN OF THE LPT SERVICE



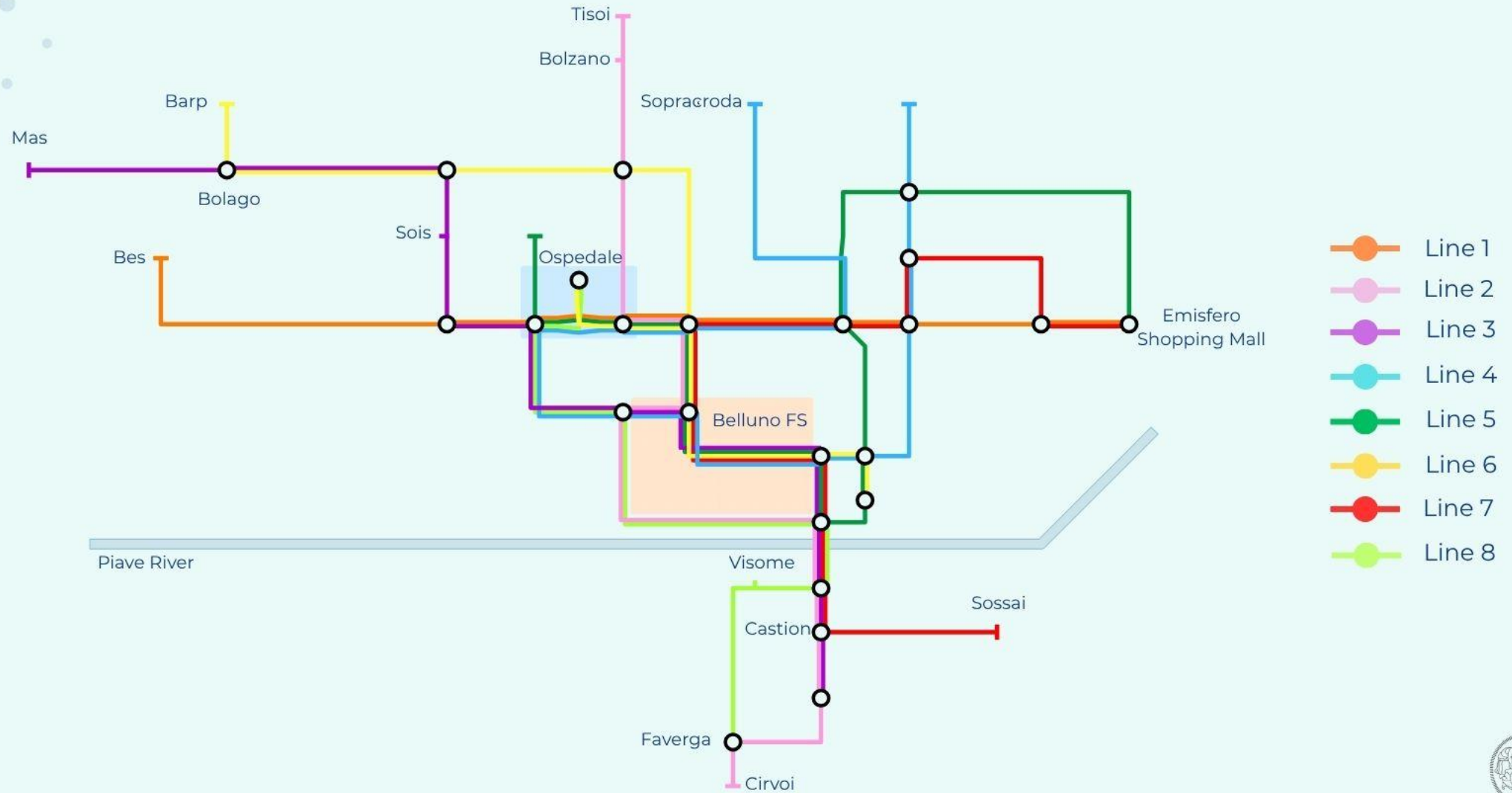
Improve the efficiency and satisfy the most relevant mobility **demand paths**, ensuring effective connections to key city destinations



From the observation of the **desire lines**, an high number of trips can be identified towards:

- **The hospital**
- Belluno **railway station** (connections with train lines and provincial buses)
- **Residential areas** surrounding Belluno: Castion, Visome, Mas, Bolzano

1 DESIGN OF THE LPT SERVICE



2 HEADWAY BASED SIMULATION

	Vehicles-km	OD served	Pax-km	Load Factor	JRT	IVT	ACT	NTR
Current service	501,37	100%	3277	23,73%	48,43	7,65	2,32	0,285
Headway based	516,41	100%	3773	29,01%	54,10	10,15	2,27	0,279



The limitations on vehicle-km have been met



The proposed solution shows significant improvements in the main KPIs



The calculated JRTs is higher due to the nature of the assignment (headway based)

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HEADWAY BASED SIMULATION

	Load Factor	RT journeys	N. of buses
Line 1	19%	2	1
Line 2	26%	2	1
Line 3	23%	3	2
Line 4	39%	3	1
Line 5	36%	3	2
Line 6	24%	2	1
Line 7	39%	3	2
Line 8	26%	2	1



The **load factor** shows different values based on the direction of the line, according to the morning demand

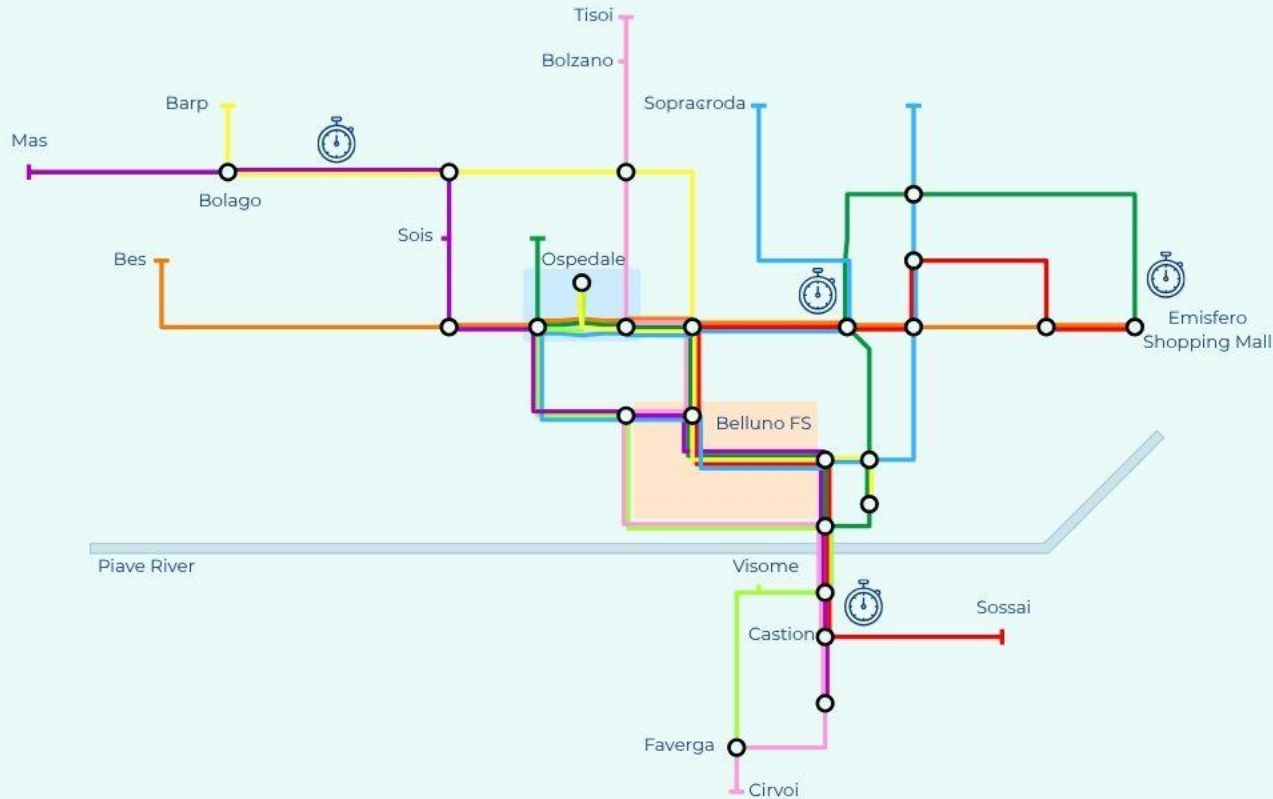


The **total number of buses** utilised is **11**:

- **4 small buses** (65 seats) have been allocated on lines 4, 7 and 8
- **7 bigger buses** (85 seats) are on the others

3 TIMETABLE BASED SIMULATION

Timetable Design Process



Same starting time at each hour of the day
(regular timetable)



Uniform headway in common sections of
different lines



Coordination of timing in key transfer nodes



Resource optimisation: fewer buses and less
waiting time for drivers at the terminus

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TIMETABLE BASED SIMULATION

	09:00	09:15	09:30	09:45	10:00	10:15	10:30	10:45	11:00	11:15	11:30	11:45	12:00	12:15
L1A		09:24		09:51						11:24		11:51		
L1R				09:59		10:27						11:59		12:27
L2A	09:11		09:44						11:11		11:44			
L2R				09:54		10:20						11:54		12:20
L3A			09:42		10:21	10:42				11:21	11:42			12:21
L3R				09:46		10:22		10:46		11:22		11:46		12:22
L4A	09:10		09:35		10:10		10:35		11:10		11:35			
L4R			09:40		10:05		10:40		11:05		11:40		12:05	
L5A			09:30	09:58			10:30	10:58			11:30	11:58		
L5R				09:54		10:22		10:54		11:22		11:54		12:22
L6A	09:14			09:46					11:14			11:46		
L6R				09:55		10:27						11:55		12:27
L7A	09:00		09:31		10:00	10:31			11:00		11:31			
L7R	09:05		09:36		10:05	10:36			11:05		11:36			
L8A				09:57		10:22		10:57		11:22				
L8R		09:26		09:53		10:26		10:53						

3 TIMETABLE BASED SIMULATION

	Vehicles-km	OD served	Pax-km	Load Factor	JRT	IVT	ACT	NTR
Headway based	516,41	100%	3773	29,01%	54,10	10,15	2,27	0,279
Timetable based	516,41	100%	3340	26,14%	19,96	9,00	2,33	0,125



Thanks to the timetable implementation it's possible to use **only 10 buses**, optimising resources



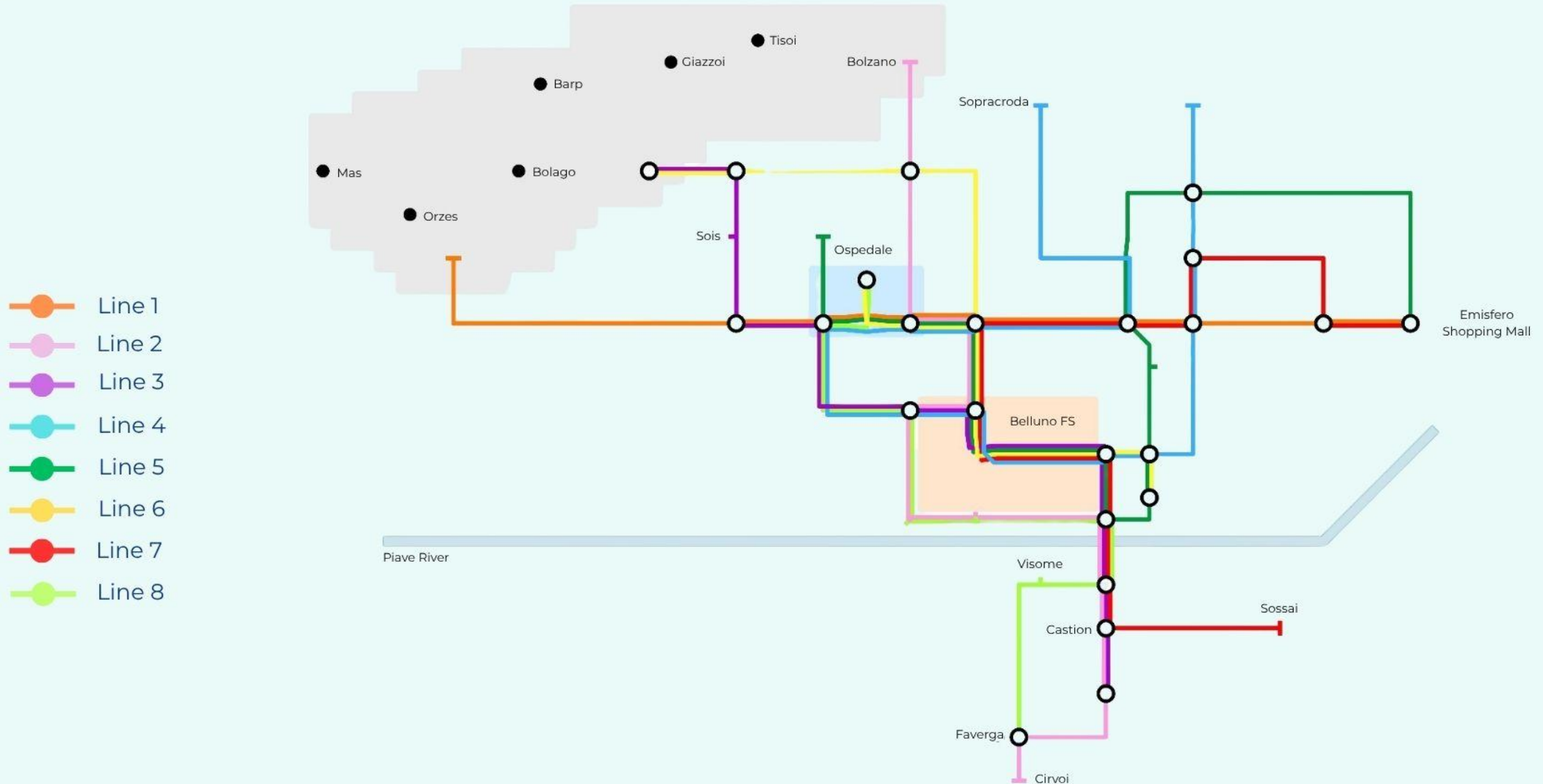
The **JRT** has drastically decreased compared to the headway based simulation



There is an **overall improvement** of the KPIs

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DRT SCENARIO SIMULATION



4

DRT SCENARIO SIMULATION

	OD served	Load Factor	JRT	IVT	ACT	NTR
Timetable based	100%	26,14%	19,96	9,00	2,33	0,125
DRT	100%	23,87%	19,71	7,82	2,26	0,168



One small DRT bus will replace a standard bus



The DRT allows users to **reach multiple terminals**, giving access to a wider range of lines, **reducing the JRT**



Multiple simulations were ran with more than 1 DRT bus, showing limited improvements due to **restricted DRT implementation area**

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ECONOMIC ANALYSIS

Main Assumptions



The **number of drivers** has been assessed considering:

- **daily shifts** of 7 h
- a maximum of **40 h/week** for each driver
- **220 working days/year** (250 days minus an average of 30 days/year between vacations and sick leave)
- 10 **buses circulating** for 14 hours/day



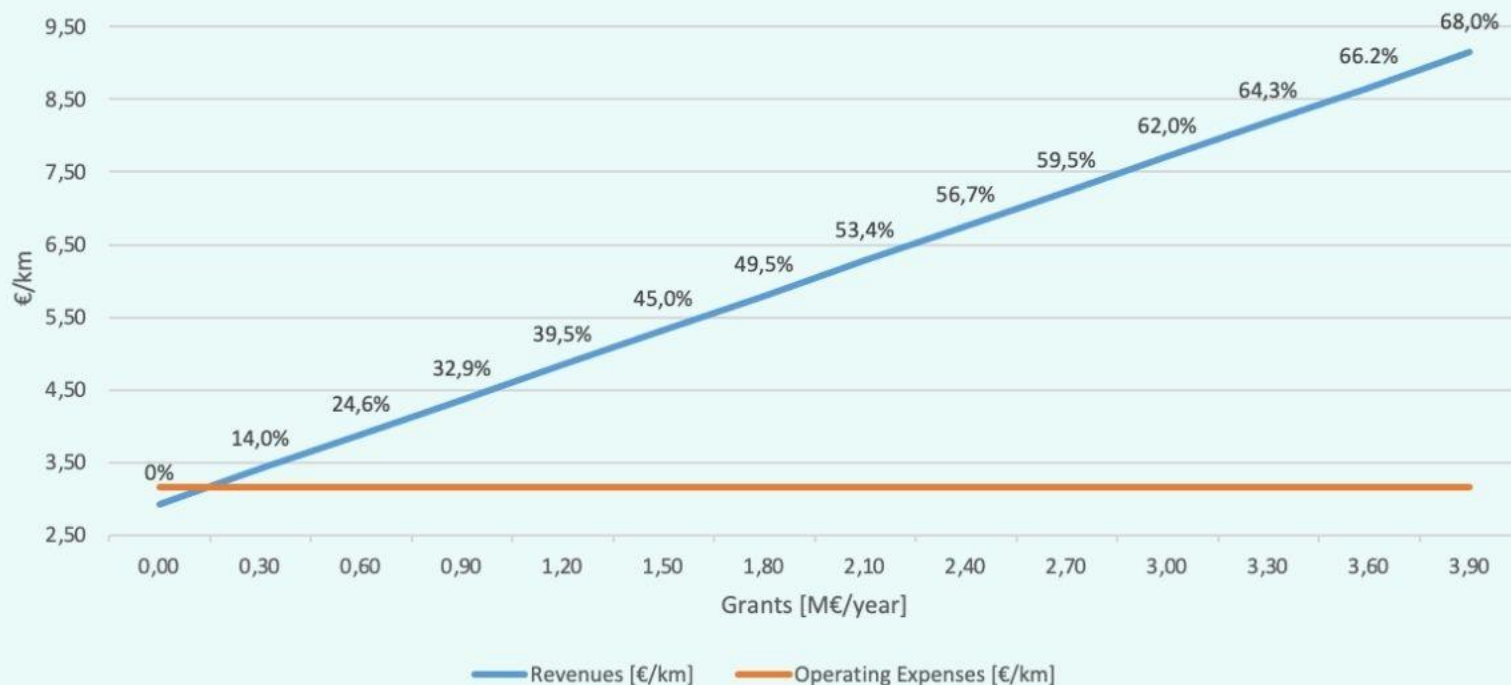
Resulting in:

- A total of **28 drivers**
- **10** operating bus + **3** backup buses

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ECONOMIC ANALYSIS

Revenues and Operating Expenses vs Grants



Fare revenues reach **1.8 M€/y**

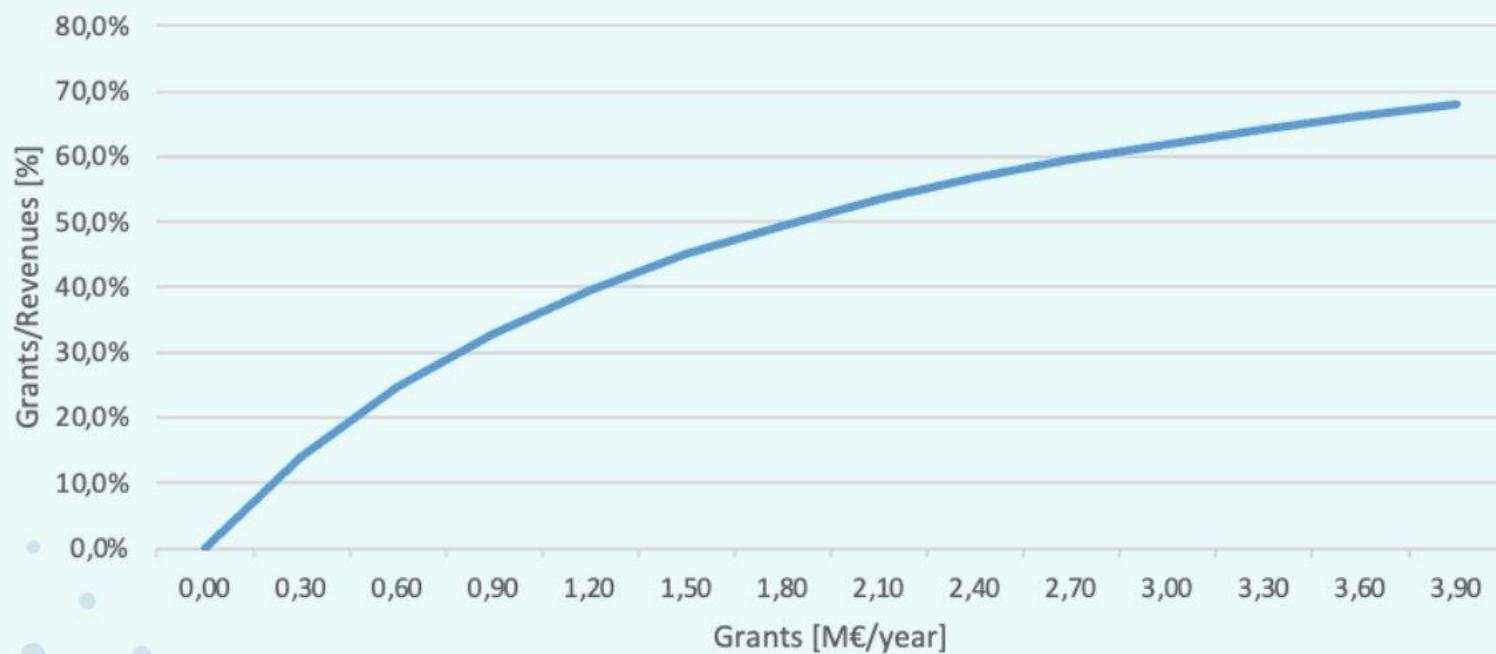


A **Yearly Grant of 250 k€** is already sufficient to **cover the Operating Expenses**

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ECONOMIC ANALYSIS

Grants/Revenues Rate vs Grants



A **Grant of 900k€** allows for a Grant/Revenues ratio **equal to 30%**



To reach a Grant/Revenues ratio of **50%**, **1.8 M€ of yearly Grant** is required

CONCLUSIONS AND LIMITATIONS



- The performance given by the **proposed service** are generally **higher** than the current one
- The **Timetable based assumption** has brought several **improvements** compared to the Headway Based Scenario
- The **DRT proposal** has proven to be a **valid alternative**, decreasing the operating costs satisfying all the demand



- The service has been set for the demand during the **off peak morning period** (9-12 AM)
- The **demand** has been assumed as **constant**
- The **Economic analysis** is based on simplified calculations which may not consider other **management issues**



THANK YOU FOR THE ATTENTION