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PERCEPTION OF TRANSPORT-TERRITORY AND TRANSPORT-CITY ANALYSIS: STRATEGIES FOR MEDITERRANEAN CITIES IN ALGERIA AND ITALY

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Summary. The transport sector is a crucial lever for economic, social, and territorial development, playing a key role in regional integration and population mobility. In Algeria, significant efforts are underway to modernize transport infrastructure. These initiatives address the challenges of rapid urbanization and growing demand for mobility, while promoting ecological and sustainable solutions. At the same time, Italy, with its advanced infrastructure, is focusing on sustainability and innovation to modernize an already well-developed transport network, including metros, streetcars, high-speed trains, and freeways. The two countries illustrate complementary dynamics: Algeria is undertaking ambitious projects to address existing gaps, while Italy is adapting its infrastructure to contemporary challenges such as managing urban congestion and upgrading aging assets. Finally, sustainability and social equity lie at the core of transport policies in both Algeria and Italy, with accessible and environmentally friendly solutions aimed at reducing social inequalities and promoting more livable cities. These efforts reflect a transition toward transport systems that support a resilient and environmentally sustainable future.

Keywords: Mediterranean, sustainable development, transport/territory, city, tramway

1. INTRODUCTION

Transportation plays a fundamental role in a country's development, as it is closely linked to economic growth, mobility, trade dynamism, and regional integration. An efficient and well-developed transport system – including roads, railways, ports, and airports – stimulates trade, reduces regional disparities, improves access to essential services such as healthcare and education, and attracts foreign investment.

By facilitating the rapid movement of goods and raw materials, transport supports production and connects local, regional, and global markets. Investment in this sector generates both direct employment (construction and infrastructure management) and indirect jobs (trade and tourism), thereby contributing to economic expansion and local business development, particularly in rural areas. Moreover, well-structured networks connect producers to markets, enhance exports, ease the import of raw materials, and ensure reliable distribution nationwide. Seaports and airports play a strategic role in global trade, while rail and road systems strengthen domestic connectivity and territorial cohesion.

Beyond its economic impact, transport enhances citizens' mobility by improving access to employment, education, healthcare, and other essential services. This contributes to higher productivity, poverty reduction, improved quality of life, and overall well-being. Modern and sustainable transport networks also help reduce pollution and promote more livable cities. Furthermore, efficient logistics corridors, modern airports, and high-speed rail systems strengthen a country's attractiveness to investors and tourists, reinforcing its position in the global economy.

Within the broader framework of sustainable development, transportation has become a key strategic sector. However, mobility policies vary according to available resources and institutional capacity. This article presents a comparative analysis of two Mediterranean countries – Algeria and Italy – with particular attention to urban public transport.

The study adopts a mixed qualitative and quantitative approach to examine urban transport systems in both countries, highlighting their similarities, differences, challenges, and opportunities. It assesses the impact of public transport policies – especially tramway systems – while identifying country-specific dynamics. Through thematic analysis, quantitative data evaluation, and comparative assessment, the research identifies convergences and divergences and proposes strategic recommendations for more effective and sustainable transport policies.

The analysis first reviews national transport strategies, then compares Algeria and Italy through planning documents addressing governmental approaches, urban development policies, public transport systems, and the urban planning – transport relationship. A focused case study on tramway policies is subsequently presented, followed by concluding remarks contributing to the broader academic discussion.

2. DATA AND METHODS

The study employs a mixed-methods approach, combining quantitative and qualitative analyses to compare urban transport systems in Algeria and Italy, with a focus on tramways.
Collected data:

- Quantitative: urban population, density, registered vehicles, tramway network characteristics (length, number of lines, vehicles, capacity), annual public transport ridership.
- Qualitative: urban and transport policy documents, mobility plans, feasibility studies, and academic literature on sustainable mobility, equity, and smart cities.

Processing and normalization:

- Indicators standardized for comparison (network km per inhabitant, inhabitant-to-tram ratios, passengers per year).
- Geographical verification using Google Earth for network accuracy and extensions.

Analyses performed:

- Descriptive statistics and ratios to compare network scale and efficiency.
- Comparative analysis between Algeria and Italy on coverage, fleet size, and tramway usage.
- Case study approach on tramway development, integrating policy, technological innovations (ITS, electronic ticketing), and sustainability aspects.
- Mapping and visualization for spatial analysis.

This methodology allows the evaluation of both the quantitative performance of transport systems and the political, social, and technological context shaping their development.

3. GENERAL TRANSPORT/TERRITORY STRATEGIES. URBAN MOBILITY.

Urban development policies in many cities have increasingly emphasized urban regeneration (UR) initiatives over the past few decades. These initiatives aim to rehabilitate more or less extensive sectors of urban areas, including run-down neighborhoods, disused industrial zones, anonymous suburbs, and areas characterized by dilapidated buildings and infrastructure.

Mobility issues play a crucial role in this context, as redefining cities involves making choices that facilitate social interaction, improve accessibility for all citizens – particularly people with reduced mobility – and limit the negative impacts of traffic congestion. However,

transport planning and urban planning are often treated separately, which can lead to suboptimal outcomes.

Consequently, there is a growing tendency to promote integrated land-use and transport planning, drawing on advanced urban governance practices and innovative solutions such as Intelligent Transport Systems (ITS), active mobility, public transport (PT) technologies, and shared mobility.

Over time, cities have faced profound social and economic changes that have led to the redevelopment or regeneration of existing urban areas in order to adapt the built environment to contemporary community needs. Following the post-war reconstruction period (1939-1945), urban development often proceeded in an uncontrolled manner, resulting in the extensive expansion of the urban fabric across territories. From the 1970s onward, however, a new planning vision began to emerge.

During the 1980s, a perspective of sustainable and intelligent development took shape. Sustainable development was formally defined in the 1987 Brundtland Report of the World Commission on Environment and Development, *Our Common Future*, as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Since then, sustainable development has become an increasingly influential paradigm, aiming to balance economic growth with social equity and environmental protection. In 2001, the European Union adopted a strategy for sustainable development, which was revised in 2006 and "sets out a long-term vision of sustainability, in which economic growth, social cohesion, and environmental protection go hand in hand and are mutually supportive."

Around 2010, it was increasingly recognized that sustainable urban development could be supported by the diffusion of digital technologies and technological innovation, particularly Internet of Things (IoT) technologies. This recognition gave rise to the Smart City concept, defined as a city capable of ensuring a high quality of life for its citizens through the use of integrated and connected technological solutions, while remaining sustainable, high-performing, and innovative [1-18].

In 2017, the International WELL Building Institute introduced a protocol aimed at identifying levels of collective well-being, known as the WELL Community Standard. This benchmark seeks to improve the quality of life through construction practices, urban design, and the regeneration of the urban fabric at the neighborhood scale. It defines strategies addressing specific aspects of community health and well-being, with mobility identified as one of the ten action areas, placing particular emphasis on local relationships.

In recent years, alongside environmental sustainability, the concept of social equity has gained increasing attention. Litman provided an overview of key equity concepts in transport and proposed a methodological framework for integrating equity objectives and evaluating their impacts [13]. He distinguished between different types of equity, notably horizontal equity – where individuals with similar needs and abilities are treated similarly – and vertical equity, which requires more favorable treatment for disadvantaged groups.

Sustainable mobility refers to all modes of transport that meet current travel needs while minimizing their environmental, social, and economic impacts.

Strengthening public transport services remains one of the most critical measures for promoting sustainable mobility. This applies particularly to transport modes with dedicated or protected lanes, such as high-service-level buses, tramways, metros, and cable transport systems, as well as innovative technologies including Intelligent Transport Systems (ITS), assisted and autonomous driving, information systems, and artificial intelligence.

4. URBAN TRANSPORT DEVELOPMENT STRATEGIES. COMPARISON ALGERIA/ITALY.

Algeria and Italy lie on opposite sides of the Mediterranean and present distinct contexts in terms of urban development, road infrastructure, and economic dynamism. Urban transport development strategies differ considerably between Algeria, a developing country, and Italy, an industrialized European nation. These differences reflect variations in economic priorities, existing infrastructure, population needs, and environmental constraints.

Algeria's road network spans approximately 130,000 km, including the East-West Freeway, a flagship project linking the country's main regions and facilitating economic exchanges [5, 12-25]. Nevertheless, some infrastructures still suffer from inadequate maintenance, and rural areas remain relatively isolated. The state is striving to address these disparities through substantial investments in roads, rail networks, and public transport projects, such as tramways and the Algiers metro, aimed at decongesting urban centers and reducing pollution [4].

Italy, by contrast, has a mature economy and a rich historical heritage. Its road infrastructure and urban development are among the most advanced in Europe. Major cities such as Milan, Rome, and Naples feature sophisticated transport networks, including metros, streetcars, and electric buses. Italy's motorway network, approximately 7,000 km long, is densely interconnected and well-maintained, promoting both national and international connectivity. The country also has an extensive railroad network and has developed high-speed train services. However, challenges remain, including the management of aging infrastructure – particularly in southern regions – and urban congestion in major cities. Italy is increasingly focusing on smart and sustainable solutions to address environmental challenges while maintaining the attractiveness of its cities for both residents and tourists.

These two countries illustrate complementary approaches to infrastructure development and urban management: Algeria is focusing on filling its gaps through modern and ambitious projects, while Italy relies on a well-established network that it continues to adapt to contemporary challenges.

Several relevant research questions arise:

- What specific challenges do Algeria and Italy face in modernizing their transport networks?
- What lessons can Algeria and Italy learn from each other in the development and management of modern transport systems?
- To what extent do sustainability policies and technological innovations (such as electric buses or electronic ticketing systems) contribute to reducing social inequalities and promoting environmentally friendly modes of transport?

These questions explore how a rethought and modernized transport sector can act as a driver of positive change. By fostering an ecological transition, it not only reduces negative impacts but also actively builds a cleaner, fairer, and more resilient future for generations to come. Placing sustainability at the core of transport policies can simultaneously strengthen social equity. Accessible solutions, such as electric buses or car-sharing schemes, enable all citizens – including disadvantaged populations – to benefit from reliable and affordable transportation.

4.1. Historical notes on the development of cities and transport

In the late 19th and early 20th centuries, Algeria's transport networks were modernized with the introduction of electric tramways, notably in Algiers in 1898, making it one of the first cities in Africa to adopt this innovative mode of transport [17]. The system was gradually extended

to other major cities such as Oran and Constantine, improving urban mobility but primarily serving European districts, while areas inhabited by the local population remained underprovided. After independence, Algeria experienced rapid urbanization: from an urban population of 2.5 million in 1954, largely concentrated in coastal cities, the country progressively shifted toward an urban majority driven by rural exodus, agrarian reforms, and industrialization (Fig. 1).

Since the early 2000s, sustained demographic growth and the sharp increase in the vehicle fleet have profoundly reshaped Algerian cities, intensifying congestion and pressure on infrastructure [9]. For decades, urban transport was not treated as a national priority, but around the turn of the century authorities began recognizing its strategic importance. With the urban population reaching approximately 35 million by 2024 – around 75% of the total population – major modernization efforts have been undertaken, including the reintroduction of tramways, the expansion of the Algiers metro, the development of cable cars, and improvements to bus networks [16]. These initiatives mark a significant phase in the transformation of urban mobility in Algeria.

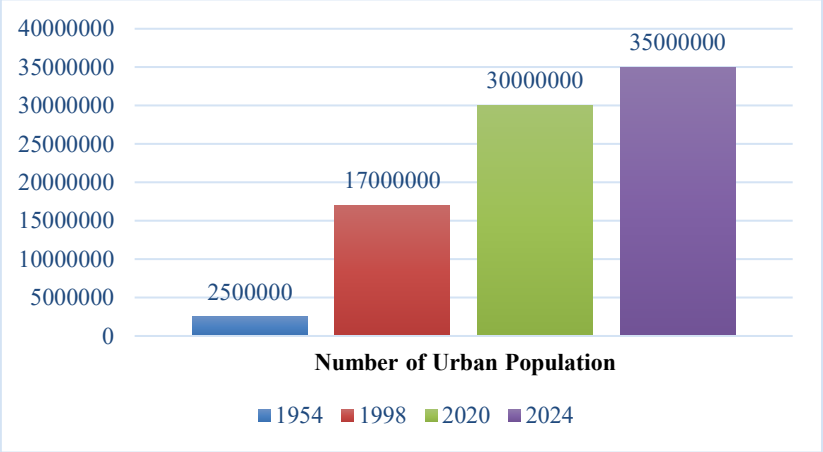

Fig. 1. Urbanization rate in Algeria, 1954-2024 [2]

Rapid urbanization in Algeria has deepened disparities between major metropolitan areas, equipped with relatively modern infrastructure, and secondary cities that struggle to meet growing demand. At the same time, massive motorization has generated severe congestion, as outdated road networks are unable to absorb rising traffic volumes, leading to chronic delays and declining quality of life. For nearly four decades after independence, the absence of major mass transit projects such as metros or tramways – despite sustained demographic growth – worsened urban mobility challenges, particularly in large cities like Algiers. This inertia, shaped by economic priorities and financial and organizational constraints, ultimately underscored the urgent need to rethink mobility policies, prompting ambitious transport modernization initiatives from the 2000s onward, including the launch of the Algiers metro and the introduction of tramway systems in several major cities [4].

From the 1970s onward, Italy – like other Western European countries – experienced a crisis of the Fordist model based on mass industrial production, which weakened the traditional link between industrialization and urbanization. This transformation led to productive decentralization, with the rise of small and medium-sized enterprises and industrial districts across the country, reorganizing Italy into a system of widespread and interconnected urban networks – often described as the “Italy of 100 cities.” Intermediate towns regained economic

vitality, contributing to territorial balance and the global success of Made in Italy [2-15]. By the 1990s, tertiarization accelerated as employment shifted from manufacturing to services, and urban development became increasingly defined by flows of goods, people, and information, reinforcing the role of cities as dynamic nodes within national and global networks.

Italy's settlement system is highly diversified across its 7,919 municipalities and can be grouped into four main categories: a large number of small communes with fewer than 5,000 inhabitants; a limited number of expanding metropolitan areas such as Rome, Milan, Turin, Naples, Florence and Bologna; around 100 medium-sized provincial capitals (50,000-200,000 inhabitants), often facing demographic decline; and approximately 3,000 communes with 5,000-20,000 inhabitants, many integrated into dynamic industrial and tertiary districts. Medium-sized towns differ in structure and function, ranging from compact urban centers that act as territorial hubs to multipolar systems forming conurbations, where networks of services and economic activities extend across interconnected urban areas.

In contrast, Italy's inland and mountainous areas have experienced long-term demographic decline and socio-economic weakening since the mid-20th century, marked by population aging, reduced public services, limited accessibility, and infrastructure deterioration.

4.2. Urban transport development

Urban mobility has become a critical issue in Algeria due to rapid urbanization and a population projected to reach 35 million by 2024, placing growing pressure on cities like Algiers, Oran, and Constantine. Rising traffic congestion, inadequate infrastructure, and sometimes inefficient transport systems are impacting both citizens' quality of life and the economic competitiveness of urban areas. In response, the government has increasingly prioritized the development of sustainable, modern, and inclusive mobility, investing since the 2000s in major projects such as the Algiers metro, tramway networks across several cities, and expanded urban bus services managed by public operators like the Establishment of Urban and Suburban Transport in Algeria and Constantine.

As of December 2020, Algeria's motorization had reached 7.7 million registered vehicles, reflecting the country's rapid urbanization, growing mobility needs, and expanding economic activities [17]. The market is dominated by used vehicles, preferred due to high costs and import restrictions, while only 140,000 new vehicles were registered in 2020. This situation highlights critical challenges, including the need to modernize the vehicle fleet, improve road infrastructure, regulate the automotive market, and develop sustainable public transport solutions to reduce congestion and environmental impacts. Without restrictions, the national car fleet could have reached an estimated 20 million vehicles by 2025, illustrating the rising demand for individual mobility among an increasingly urbanized population [19].

In response, Algeria has invested heavily in public transport modernization, particularly in major cities such as Algiers, Oran, and Constantine. Initiatives include the construction of new metro lines, the extension of tramway networks, and the renovation of cable car and gondola systems. Since the inauguration of the first tramways between 2011 and 2013, numerous expansion projects have been planned to connect more districts and improve urban mobility. These efforts aim not only to alleviate congestion but also to promote environmentally friendly transport, reduce dependence on private cars, and enhance the quality of urban life.

In Italy, despite policies supporting public transport, smart working, and non-motorized mobility, travel remains costly, with households spending an average of 3,000 euros per year on mobility in 2021, about 10% of total expenditures [14]. The car remains the dominant mode

of transport, accounting for over half of intra-municipal trips and up to 85% of extra-urban journeys, while walking and cycling cover just under 40% of local trips. Italy also has the highest car ownership rate in the EU, with 694 cars per 1,000 inhabitants in 2023, though Italians drive fewer kilometers annually (around 11,000 km) and tend to keep older vehicles, leading to environmental and social challenges related to an aging fleet [20].

European and national authorities have prioritized three main strategies for sustainable urban mobility: promoting active mobility through cycle paths, pedestrian zones, and green spaces; encouraging low-pollution and shared private mobility, including car-sharing, bike-sharing, car-pooling, micro-electric vehicles, and personal mobility devices; and strengthening public transport by modernizing fleets with eco-friendly vehicles, expanding networks – especially exclusive right-of-way lines – and upgrading infrastructure to meet advanced European standards, supported by sufficient funding European [10, 11].

4.3. Urban public transport development

Urban transport in Algeria has developed dynamically over the past decade to meet growing mobility demands amid rapid urbanization, with major cities diversifying public transport options to improve traffic flow and reduce congestion. Algiers is the only city with a modern metro, inaugurated in 2011, providing a fast and efficient alternative to heavy traffic, while tramways – also introduced in 2011 and now operating in seven cities – offer sustainable, structured mobility that reduces congestion and emissions. Buses remain the most widely used mode, though often criticized for irregularity and aging fleets. Despite these advances, Algeria's metro and tramway networks remain limited compared with regional and international standards, highlighting the need for further infrastructure expansion to meet urban transport demands effectively.

Despite having a relatively developed rail network, Algeria lags behind its North African neighbors in passenger transport, with 5 billion passenger-kilometers in 2023 compared to 9 billion in Morocco and 6 billion in Tunisia. Urban mobility is dominated by buses, which account for over 65% of trips, while tramways across major cities cover 94 km and carry about 40 million passengers annually. The Algiers metro, with 18.2 km of track, serves around 40,000 passengers per day, demonstrating both the potential and the current limitations of rail-based transport in meeting the country's urban mobility needs.

Italy's urban public transport network, while extensive, remains smaller than those of major European countries [22]. The metro spans about 240 km, tramways 342 km, and suburban railroads 672 km, all below the lengths found in Germany, France, the UK, and Spain. Rail accounts for only 36.4% of passenger-kilometers, compared with over 50% in leading European nations. Despite being the fourth largest public transport sector in Europe, with sales exceeding 12 billion euros, Italy still lags behind Germany, France, and the UK, both in network size and in passenger usage.

The sector is highly fragmented, comprising around 930 companies employing 124,000 people, with public operators dominating services and market share. Publicly owned companies, though only 12% of the total, account for 83% of passenger journeys and 85% of sales. Revenues from traffic cover only a minority of income, while public subsidies remain the primary source, averaging 55% of production value.

5. CASE STUDY: TRAMWAYS

The rapid and extensive introduction of tramways in Algeria is part of a dynamic similar to that observed in many other countries over the last three decades. This phenomenon reflects a desire to modernize urban transport systems in response to major challenges such as decongesting city centers, reducing pollutant emissions, and improving citizens' quality of life.

Following the inauguration of the first tramway lines in the country's three main cities – Algiers, Oran, and Constantine – between 2011 and 2013, the development of Algeria's tramway network has gained considerable momentum. These initial projects marked a key milestone, illustrating the authorities' determination to transform urban mobility systems over the long term. Building on this early success, no fewer than 15 new projects have been studied nationwide, reflecting the ambition to make this modern, environmentally friendly mode of transport widely available and adapted to the challenges of large conurbations. These studies target cities with high population growth or urban density, aiming to relieve congestion on road networks, enhance citizens' quality of life, and meet rising mobility needs while reducing the environmental footprint (Tab. 1). This dynamic positions Algeria among developing countries rapidly adopting modern infrastructures to meet the demands of the 21st century.

Tab. 1

Provision of tramway networks in Algeria by 2023

CITIES	Population (inhab.)	Surface Area (km²)	Density (inhab/km²)	Network L. (km)	Allocation km/10000	Vehicles (N.)	Allocation inhab/veh
Algiers	3,500,000	363	9,642	23.2	0.07	48	72,917
Oran	1,500,000	250	6,000	18.7	0.12	30	50,000
Constantine	450,000	231	1,948	18.5	0.41	27	16,667
Sétif	300,000	127	2,362	22.4	0.75	47	6,383
Sidi Bel Abbès	210,000	49	4,285	13.8	0.66	30	7,000
Mostaganem	160,000	100	1,600	14.2	0.89	25	6,400
Ouargla	150,000	133	1,127	9.7	0.65	23	6,522
TOTAL	**6,270,000**	**1,253**	**5,004**	**120.5**	**0.19**	**230**	**27,260**

By 2023, Algeria will have seven fully operational urban tramway networks across several major cities. These modern infrastructures represent a significant step forward in transforming the public transport landscape, addressing the growing need for mobility in the context of rapid urbanization. The networks, located in Algiers, Oran, Constantine, Sidi Bel Abbès, Ouargla, Mostaganem, and Sétif, reflect the authorities' commitment to diversifying transport options while promoting sustainable and environmentally friendly solutions.

By 2023, Algeria will have seven operational urban tramway networks across several major cities (Tab. 2 and Fig. 2). These modern infrastructures represent a significant step forward in transforming the public transport landscape, addressing the growing need for mobility in a context of rapid urbanization. The modern tramway lines already in operation include:

- Algiers (May 2011): The capital was the first city to reintroduce the tramway, a flagship project designed to relieve urban traffic congestion and provide a modern, environmentally friendly alternative for getting around the city.
- Oran (May 2011): The country's second-largest city launched its own tramway network in 2011, linking the main residential and commercial areas. It will be Algeria's longest tramway, with nearly 50 km of tracks and 75 stations.

- Constantine (July 2013): The historic city of Constantine inaugurated its tramway in 2013, improving traffic flow in a city with complex topography.
- Sidi Bel Abbès (July 2017): This northwestern city launched its tramway network in 2017, strengthening the region's transport infrastructure.
- Ouargla (March 2018): Located in the south of the country, Ouargla integrated a tramway into its urban infrastructure in 2018, marking a major step in the city's development.
- Sétif (May 2018): The city of Sétif inaugurated its tramway in May 2018, providing a modern mobility solution amid rapid demographic growth.
- Mostaganem (February 2023): The tramway network was recently extended to Mostaganem in February 2023, demonstrating the government's ongoing commitment to modernizing public transport infrastructure in Algerian cities.

Tab. 2

Tramway networks in Algeria, 2024 [3-7]

CITIES	Commissioning	Length (km)	Stations N.	Rames N.	Capacity (steps/day)	Extensions (dates)	Length (km)
Alger	05-2011	7,2	38	48+4	185 000	2012, 2015	23,2
Oran	05-2013	18,7	32	30+4	120 000		
Constantine	07-2013	8,1	15	27+20	80 000	2019, 2021	14,7
Sidi-Bel-Abbès	07-2017	13,7	22	30	70 000		
Sétif	05-2018	22,4	26	34	75 000		
Ouargla	03-2018	9,7	16	23	45 000		
Mostaganem	2021	14,2	24	25	60 000		
TOTAL		**94,0**	**173**	**245**			**37,9**

By 2023, the Algerian tramway fleet will total 221 units, all built to the standard 2.65 m gauge (Fig. 3). This gauge ensures technical uniformity and facilitates interoperability, as well as maintenance of the vehicles. The fleet serves several cities across the country, reflecting Algeria's efforts to modernize and expand public transport networks to meet the growing demand for urban mobility. This development also demonstrates the country's commitment to sustainable and environmentally friendly transport solutions.

The trainsets were produced by the Algerian Industrial Transport Company, a joint venture between Alstom, the National Railway Transport Company, Ferrovial, and the Algiers Metro Company, with the exception of some units manufactured at Alstom's Spanish plant near Barcelona. The Algerian Industrial Transport Company assembles the components supplied by Alstom at its European Citadis production sites (Tab. 3).

Tab. 3

Characteristics of trams in Algerian cities

CITIES	Nb Lines	Type of line	Operator	Opening	Length (km)	Gauge (mm)	Site Type
Alger	1	Tram	SETRAM*	2011	23.2	1,435	Dedicated site
Oran	1	Tram	SETRAM	2013	18.7	1,435	Dedicated site
Constantine	1	Tram	SETRAM	2013	14.7	1,435	Dedicated site
Sidi Bel Abbès	1	Tram	SETRAM	2017	13.7	1,435	Dedicated site
Sétif	2	Tram	SETRAM	2018	22.4	1,435	Dedicated site

Ouargla	1	Tram	SETRAM	2018	9.7	1,435	Dedicated site
Mostaganem	2	Tram	SETRAM	2023	14.2	1,435	Dedicated site
TOTAL	**9**				**116.6**		

*SETRAM: Tramway Exploitation Company

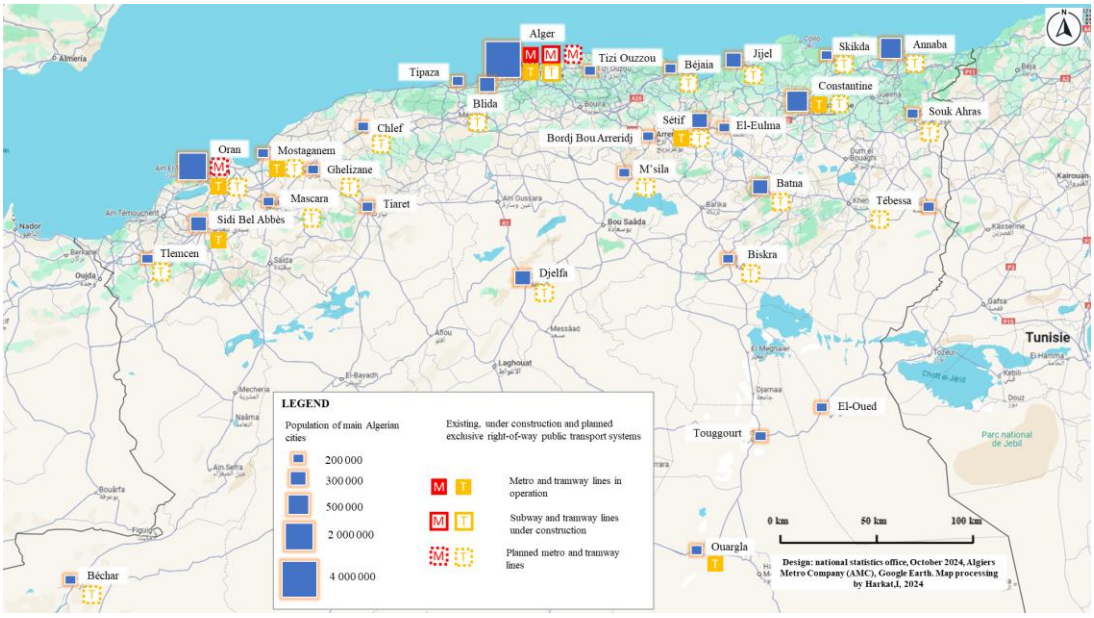

Fig. 2. Development of metro and tramway lines in Algeria [3], Google Earth, Map processing by author

Building on this initial success, no fewer than 15 new projects have been studied across the country, reflecting the national ambition to make this modern, environmentally friendly mode of transport widely available and adapted to the challenges of major conurbations.

Feasibility studies were launched in 2024 for the construction of tramway lines in 12 towns: Béchar, Béjaïa, Biskra, Blida, Chlef, Djelfa, Jijel, Mascara, M'Sila, Relizane, Skikda, and Souk-Ahras. In addition, two projects originally launched in 2015 and suspended in 2020 – Batna and Annaba – were relaunched in 2024. Nevertheless, there is often a gap between intentions and reality. Expansion and modernization projects are ongoing to improve the efficiency and sustainability of the transport system.

Italy currently has 48 tramway lines in operation, with a total length of 386.6 km. Overall, the construction of urban rail networks for mass rapid transit (trams and metros) has largely been at a standstill since 2015, with the exception of a few short new sections [24]. Table 4 presents data on tram infrastructure in Italian cities. The information below is drawn from various sources, notably the Mobility Maps of operating companies and the Urban Travel Plans of the cities concerned.

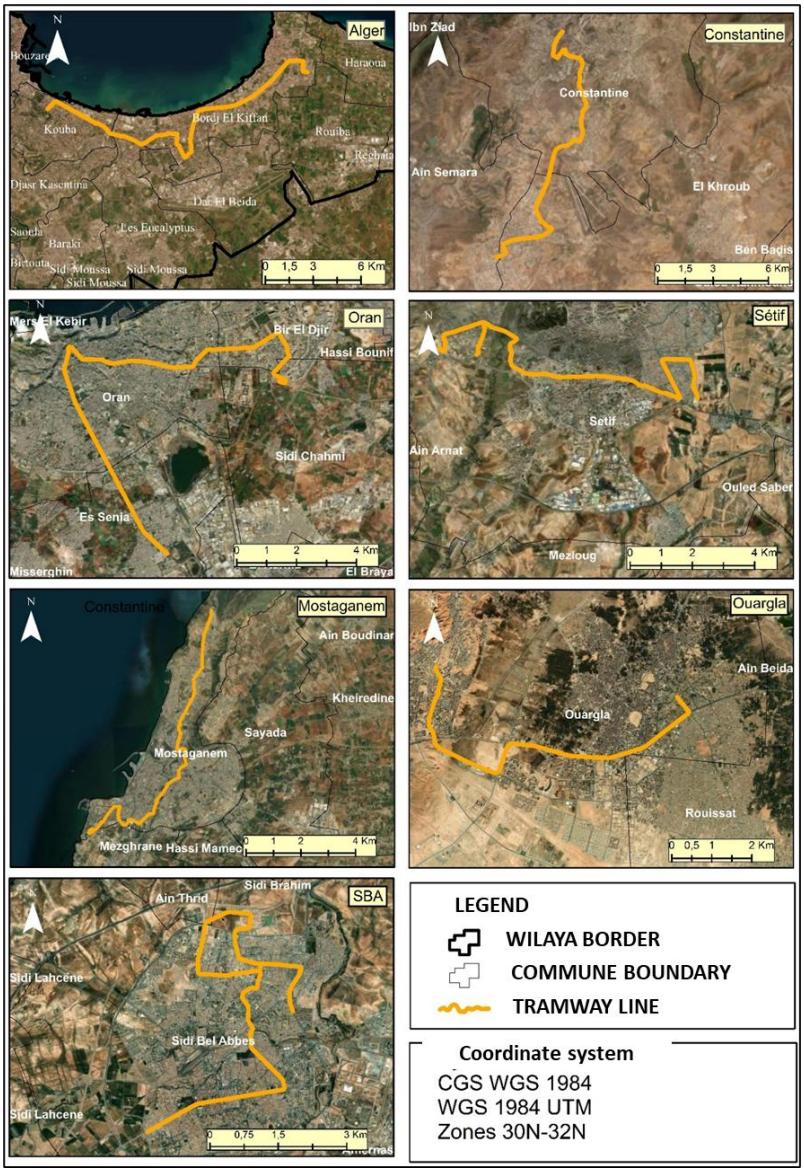

Fig. 3. Existing Tramway Lines in Algeria by 2024 [6]

Tab. 4

Characteristics of trams in Italian cities

CITIES	Nb Lines	Type of line	Operator[1]	Opening	Length (km)	Gauge (mm)	Location
Milan	17	Tram	ATM	1881	157,0	1.445	Clean site
Turin	8	Tram	GTT	1871	84,0	1.445	Clean site
Rome	6	Tram	ATAC	1887	32,0	1.445	Clean site
Palermo	4	Tram	AMAT	2015	18,3	1.435	Reserved site
Venice	2	Tyre-Guided tram	ACTV	2010	20,0	-	Clean site
Florence	2	Tram	GEST	2010	17,0	1.435	Reserved site

Bergamo	1	Metro / Fast tram	TEB	2009	12,5	1.435	Reserved site
Cagliari	2	Metro / Fast tram	ARST	2008	12,0	950	Reserved site
Naples	3	Tram	ANM	1875	11,8	1.435	Clean site
Padova	1	Tyre-Guided tram	Busitalia V.	2007	10,0	-	Clean site
Messina	1	Tram	ATM	2003	7,7	1.445	Reserved site
Sassari	1	Tram	ARST	2006	4,3	950	Clean site
TOTAL	**48**				**386,6**		

Note (Operator) Abbreviat Explanation	**Full Name**	
ATM	Azienda Trasporti Milanesi	Milan Transport Company
GTT	Gruppo Torinese Trasporti	Turin Transport Group
ATAC	Azienda per la mobilità di Roma Capitale	Rome Capital Mobility Company
AMAT	Azienda Municipalizzata Auto Trasporti	Municipal Transport Company (Palermo)
ACTV	Azienda del Consorzio Trasporti Veneziano	Venice Transport Consortium Company
GEST	Gestione Servizi Trasporti	Transport Services Management (Trieste)
TEB	Tranvie Elettriche Biellesi	Biella Electric Tramways
ARST	Azienda Regionale Sarda Trasporti	Sardinian Regional Transport Company
ANM	Azienda Napoletana Mobilità	Naples Mobility Company
Busitalia V. (part of the FS Group)	Busitalia Veneto	Veneto Busitalia

Figure 5 shows the existing tramway networks in six Italian cities in 2023. Table 5 presents data on the average equipment of these cities in terms of tramway network length and the number of operational vehicles. The total length of each tram network is calculated as the sum of all active lines. In the case of Milan, where some lines extend into surrounding municipalities (Rozzano, line 15; Cinisello B. and Sesto S.G., line 31), these extensions are included in the calculations.

Fig. 4. Italian cities planned to be equipped with tramways by 2026

Tab. 5

Provision of tramway networks in Italy by 2023

CITIES	Population (inhab)	Surface area (km^2)	Density (inhab/km2)	NetworkL (km)	Allocations km/10000 average	Medium km/Km^2	Vehicles N.	Allocation inhab/veh
Milan	1.488.132	206,6	10.921	157,0	1,10	0,76	477	3.120
Turin	846.926	130,1	6.509	84,0	0,99	0,65	189	4.481
Rome	2.754.719	1.286,7	2.141	32,0	0,12	0,03	164	16.797
Palermo	628.894	160,1	3.927	18,3	0,37	0,15	17	36.994
Venice	250.369	417,6	600	20,0	0,79	0,05	20	12.518
Florence	363.837	102,2	3.560	17,0	0,46	0,17	46	7.910
Bergamo	120.504	40,2	2.995	12,5	1,00	0,31	14	8.607
Cagliari	147.378	83,6	1.764	12,0	0,81	0,14	12	12.282
Naples	911.697	116,7	7.811	11,8	0,13	0,10	37	24.640
Padova	207.301	93,0	2.229	10,5	0,51	0,11	22	9.423
Messina	217.895	212,2	1.027	7,7	0,35	0,04	15	14.526
Sassari	120.875	546,6	221	4,3	0,36	0,01	4	30.219
TOTAL	**8.058.527**	**3.396**	**2.373**	**386,6**	**0,48**	**0,12**	**1.017**	**7.923**

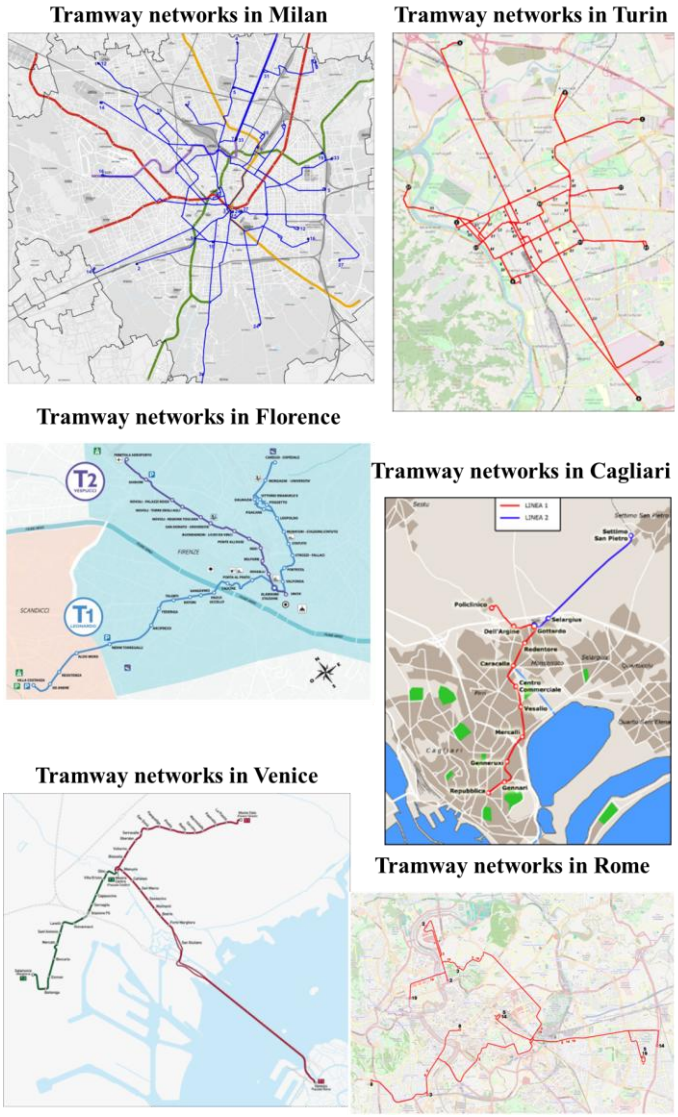

Fig. 5. Map of the tramway networks in Milan, Turin, Florence, Cagliari, Venice and Rome

Italy's tramway network spans 386.6 km across 12 cities, with 58 urban lines and 1,170 stations served by 1,017 vehicles. Ten lines are rail-based, and two are rubber-tyred, with about 10% operating on exclusive right-of-way (Tab. 6). Track gauges vary from 950 to 1,445 mm, and average commercial speeds range from 9 to 18 km/h. Service frequency typically reaches 4-8 vehicles per hour during peak times and 2-6 vehicles per hour off-peak, while line capacity varies widely, from 360 passengers per hour on low-demand lines to 3,600 on heavily used routes.

Tram Stadler Rail

Tram Hitachi Rail

Tram Bombardier Cityrunner

Tram Light Rail Type 4

Tram AB Sirio

Tram Škoda 06 T ForCity

Tram CAF Urbos

Tram Peter Witt Serie 2800

Tram FIAT Cityway

Tram Light Rail Vehicle Standard Type 3

Fig. 6. Tram vehicles in Italy

Tab. 6

Tram vehicles in Italy. 2022

Cities	Lines	Number of stops	Capacity (passengers/vehicle)	Frequency (trams per hour)	Line capacity (passengers/hour)
Milan	1	35	130	8	1.040
	2	29	175	15	2.625
	3	25	262	6	1.572
	4	22	285	6	1.710
	5	29	130	7	910
	7	21	285	4	1.140
	9	27	206	3	618
	10	35	130	3	390
	12	37	270	2	540
	14	46	285	2	570
	15	32	270	10	2.700
	16	37	270	2	540
	19	43	130	8	1.040

	24	18	270	5	1.350
	27	23	270	5	1.350
	31	27	285	4	1.140
	33	23	130	7	910
Turin	3	26	200	3	600
	4	33	200	12	2.400
	9	26	200	7	1.400
	10	24	200	10	2.000
	13	20	200	7	1.400
	15	39	200	8	1.600
	16CD	26	200	7	1.400
	16CS	15	200	7	1.400
Rome	2	29	240	12	2.880
	3L	21	240	15	3.600
	5	24	240	10	2.400
	8	31	240	15	960
	14	22	240	8	1.920
	19L	20	240	12	2.880
Palermo	1	15	188	12	2.256
	2	13	188	6	1.128
	3	12	188	6	1.128
	4	22	188	5	940
Venice	1	23	282	12	3.384
	2	17	282	8	2.256
Florence	T1	24	188	15	2.820
	T2	26	188	15	2.820
Bergamo	T1	16	188	4	752
Cagliari	1	11	266	6	1.596
	2	5	266	3	798
Naples	412	22	188	3	564
	421	32	188	3	564
	422	16	188	3	564
Padova	SIR1	25	164	10	1.640
Messina	1	18	180	2	360
Sassari	1	8	200	3	600
GLOBAL	48	1.170	191	-	-

The number of passengers on the public transport network was increasing before the COVID-19 period; it declined during the pandemic years, but the trend has resumed (Tab. 7), and significant growth is expected following the network expansion and improvements in service provision.

Italian authorities are planning a major expansion of tramway networks and public transport to modernize infrastructure and reduce the gap with leading European countries [20]. As of October 2024, projects include new and extended lines in cities such as Bologna, Milan, Bergamo, Padua, Florence, and Cagliari, supported by roughly 1.9 billion euros from the National Recovery and Resilience Plan (Tab. 8). The national tramway network is expected to grow from 386.6 km to 475.6 km, with long-term plans targeting around 800 km within ten years. Rome is a focal point, where seven new lines will expand the network from 32 km to 101.2 km.

Tab. 7
Public Transport Passengers per Year (in millions), 2017-2022

Cities	2017	2018	2019	2020	2021	2022
Milan	652.350	685.150	747.915	301.162	354.231	490.696
Turin	283.196	280.867	287.000	194.581	143.330	224.000
Rome	952.861	911.000	895.415	427.000	444.000	607.359
Palermo	28.400	27.000	25.162	9.436	6.462	28.000
Venice	215.200	215.630	218.900	125.500	145.790	171.080
Florence	94.000	114.634	112.371	87.700	91.208	92.149
Bergamo	21.087	21.500	27.964	21.611	21.162	22.700
Cagliari	24.402	25.000	32.000	25.787	22.469	23.730
Naples	109.000	130.158	114.092	35.900	42.920	59.600
Padova	26.663	27.383	27.913	15.501	14.475	18.872
Messina	10.956	11.417	12.523	7.864	2.280	5.318
Sassari	12.150	11.241	12.000	8.695	12.018	15.122
TOTAL	**2.430.265**	**2.460.980**	**2.513.255**	**1.260.737**	**1.300.345**	**1.758.626**

Tab. 8
New projects financed by the National Recovery and Resilience Plan

CITIES	New actions	L (km)	National Recovery and Resilience Plan (M€)
Bergamo	Line T2	9.8	50.0
Bologna	Red line	15.0	151.02
	Green line	6.2	222.1
Florence	Line 3 extension	5.0	222.5
	Line 4 extension	7.2	150.0
Milan	Express tram (northern districts)	3.0	50.3
	Line 7 extension	1.2	36.0
Naples	Network extension	1.3	5.7
	Tram line S.Giovanni-Piazza Sannazaro	2.8	17.0
Padova	Line SIR 2	17.5	238.1
Palermo	Network extensions and purchase of trains	19.7	504.4
Rome	Termini-Vaticano-Aurelio line (1st section)	2.2	120.0
	Togliatti line	8.0	100.0
Total		89.0	1,867.12

6. DISCUSSION AND CONCLUSION

Traffic issues in Algeria's and Italy's fast-growing cities call for innovative and sustainable mobility strategies to address the challenges of rapid urbanization, population growth, and economic development. Existing transport infrastructures are under considerable pressure, resulting in severe road congestion, extended travel times, frequent delays, and increased air pollution, all of which negatively impact citizens' quality of life and hinder economic and social activities. Addressing these issues requires a transition toward more sustainable and innovative mobility solutions, including the reconfiguration of transport modes to meet rising demand while minimizing environmental impacts.

A priority approach involves the strengthening and expansion of public transport networks, such as metros, streetcars, high-speed trains, cable cars, and gondolas, which provide efficient, rapid, and less-polluting alternatives for urban mobility. The integration of advanced

technologies, including electronic ticketing systems and mobile transport applications, enhances efficiency by managing passenger flows, offering real-time information, and facilitating seamless multimodal journeys. Complementary strategies, such as promoting active mobility through walking and cycling and providing safe, accessible infrastructure, further reduce dependence on private vehicles while encouraging environmentally friendly transport habits.

Coordination and integration between different transport modes are essential to an efficient urban mobility system. Well-designed multimodal networks connecting buses, trams, metros, and active mobility options optimize existing infrastructure, reduce congestion, and lower pollutant emissions, creating healthier and more livable urban environments. Public policy plays a central role in supporting these measures, requiring substantial investment in modernizing infrastructure, extending transport networks, adopting innovative technologies, and implementing incentive schemes, such as subsidies for electric bicycles or discounts on public transport. Awareness campaigns are also crucial to foster a culture of sustainable mobility among citizens.

In conclusion, both Algeria and Italy face urgent challenges in urban mobility that necessitate sustainable and innovative solutions. Expansion of public transport, adoption of multimodal approaches, integration of advanced technologies, and promotion of active mobility provide viable strategies to improve efficiency, reduce environmental impact, and enhance urban quality of life. While Algeria focuses on modernizing and expanding its infrastructure, Italy emphasizes sustainability and technological innovation; cooperation between the two could enable Algeria to benefit from Italian experience while adapting solutions to its own context. By investing in resilient, inclusive, and environmentally sustainable transport systems, both countries can address current congestion and pollution issues while laying the foundation for greener, more connected, and economically competitive urban futures.

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