TRAMS AT THE HEART OF THE 21ST CENTURY METROPOLIS

Comparative study of **32 trams systems** and **tram trends in 2019**

EUROGROUP CONSULTING

EUROGROUP CONSULTING

About Eurogroup Consulting

Eurogroup Consulting is a strategy, management and organization consultancy. Established in 1982, our firm is independent and European by nature, with 55 offices in 37 countries. Through our network Nextcontinent of 1,800 consultants and 400 employees in France, we have an established reputation for providing consulting expertise in every field of business in the private, public and social sectors. Eurogroup Consulting stands out from the crowd because we apply a unique approach to consulting: positive transformation. Our staff and our entire business ecosystem – including our digital business accelerator – work together to offer our clients effective solutions that are adapted to their employees and their corporate culture. Together, we turn each necessary change into a process that is understood and experienced as a useful and sustainable transformation. Through the Eurogroup Foundation, we work to reaffirm and deepen our commitment to society by helping to improve access to education.

Summary

Trams in the 21st century metropolis

Since the turn of the century, the tram has been in its next phase of growth, with **almost 200 cities launching a new tram network since 2000**.

Characteristics of this tram revival include:

- **the modernisation of several historic tram systems** including Swiss, German and Belgian networks, which have combined service redesign, improved commercial speed and the introduction of new generation rolling stock.
- **the reintroduction of trams along main city arteries,** often following retirement of the system in the 1950s and 60s in response to growing car ownership. This occurred in France in large cities like Paris, Lyon and Bordeaux as well as in mid-sized cities like Dijon and Tours.
- **the repurposing of former railway lines as tram or tram-train lines** to connect the town centre to outlying municipalities in response to metropolitan development. Examples include Manchester, Dublin and more recently Aarhus in Denmark where rapid tram services on dedicated tracks connect the city outskirts with the city centres over 20km away.
- **the development of trams as a feeder service** to the structuring metro and suburban train network. Shanghai's Songjiang tram, Dubai's Al-Sufouh tram in the Marina and Paris' T1 tram are all examples of this trend.

BERGEN, NORWAY

Trams belong in the 21st century city:

1. **As a common form of accessible mobility within a city**
   Trams are a vector of inclusion:
   - for people with reduced mobility, for whom the tram is often a valued mode of transport thanks to its ground-level accessibility and predictability
   - as a driver of stronger urban identities forged along the territories it connects.

2. **As an intermodal and sustainable transport mode**
   The development opportunities for the tram in sustainable and smart cities are numerous in terms of:
   - transforming and enhancing urban spaces
   - developing proximity services in mobility 'hubs'
   - offering a blueprint for the roll-out of other networks like fibre and electricity.

3. **As an aggregator of micro mobility solutions**
   As a structuring mode covering a wide range of uses from micro-commuting in the city centre to longer journeys, trams offer a junction role between 'traditional' networks (metro and bus) and new mobility solutions (bike, car sharing, etc.).

Trams deliver on their potential in several types of urban environments

Mid-sized cities looking to reinforce their structural axes

Large cities choosing a mass transit transport solution, in an open and widely accessible environment

Districts of major global cities to better connect to the mass transit network (metro, urban train)

Chapter 1
Comparative study of 32 tram systems

Tram network scoring method

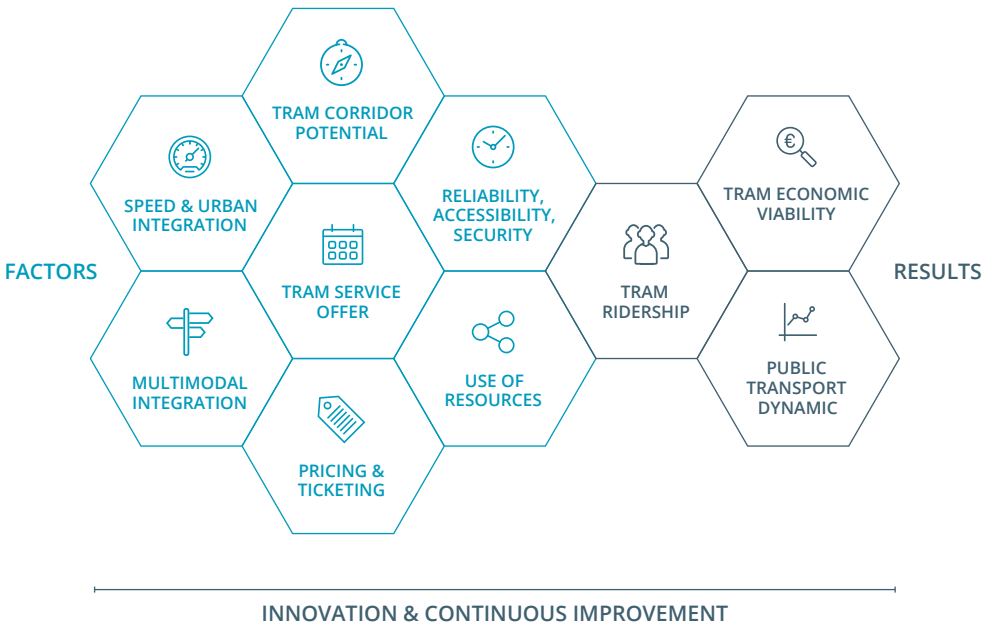
Sources

This study analyses the performance of **32 tram systems** for which information is considered **available**, **accessible** and **reliable**. This study is based on:

- A **range of documents from different sources**: the World Bank, UITP, activity reports of the networks concerned, baseline studies
- A **series of interviews** with key players in urban transport and subject matter experts: Tram Director at UITP, Tram Network Managers from Brussels, Stockholm, Helsinki, Bordeaux, tram-train experts TTK
- **Field observations** on the ground and online

Performance criteria

10 performance criteria were identified covering both **performance factors** (offer, quality of service, resources) and **performance results** (ridership, costs, modal share...).



Measurement indicators

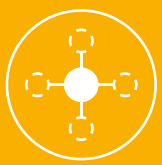
Analysis and measurement indicators were established for the 10 criteria in order to compare the 32 tram systems selected. The results of these indicators are distributed by deciles, allowing the attribution of a mark between 1 and 10 for each of the 10 criteria.

Performance criteria	Measurement indicators
Tram corridor potential	· % of stops serving activity centres of the urban area · Density of population along tram corridor
Speed & Urban integration	· Tram speed/degree of protection · Tram speed/distance between stops · Speed of trams in city centre
Tram service offer	· Opening time of tram network · Tram frequency during off-peak hours · Kilometre offer per resident
Pricing & Ticketing	· Quantity of payment solutions available · Level of ticket integration with other mobility solutions
Multimodal integration	· % stops with public transport connections (bus, metro, train) · % stops with connections to individual transport modes (P+R[1], BSS[2]...)
Reliability, Accessibility, Security	· Service punctuality rate · Level of accessibility at stations and in trams · Maturity of safety policy & communication
Use of resources	· Fleet use rate · Tracks use rate · Number of depots/number of tram lines
Tram economic viability	· Kilometre production cost (weighting PPP[3]) · Coverage rate for tram operating costs
Tram ridership	· Number of trips per tram kilometre · Number of trips per line kilometre
Public transport dynamic	· Coverage rate for transport network operating costs · Modal share of public transports · Tram ridership dynamic

(1) P+R : Park and Ride
(2) BSS : Bike-Sharing System
(3) PPP : Purchasing Power Parity

Three families of tram systems

Given that tram systems are characterised by a wide variety of infrastructure, design and use cases, one of the challenges of the study was to capture a representative and coherent sample of tram systems. **The choice was therefore made to define three tram system families** in order to allow for relevant system comparisons:



RECENT TRAM SYSTEMS IN LARGE CITIES

Tram systems at the heart of urban areas with more than 500,000 residents

Notable urban characteristics: metropolitan development, densification and connection with outlying municipalities

Many large cities, such as Bordeaux and Montpellier, are investing in trams as a **backbone of the public transport network**, linking it to the bus network.

Other cities use their tram **to complement their metro network**. It is the case of many German cities where the "Straßenbahn" complements the U-Bahn, or in cities with more than one million inhabitants such as Lyon or Barcelona.

Trams can also **connect outlying municipalities** located 15-20 km from the city centre, with fast lines going through less dense areas, like in Manchester, Dublin or Salt Lake City.

RECENT TRAM SYSTEMS IN MID-SIZED CITIES OR SERVING NEIGHBOURHOODS OF LARGE CITIES

Tram systems in mid-sized cities of under 500,000 residents or tram lines serving a specific neighbourhood of a major global city

Notable urban characteristics:
concentration and regulation of passenger flows via tram corridors.

Tram systems for cities of between 250,000 and 500,000 residents are generally composed of **one or two lines** that act as a network backbone, linking with a bus network to ensure greater service coverage.

This category also includes tram systems **providing services to certain neighbourhoods of major global cities**. Their role is to provide a feeder service to metro lines, or regional and suburban trains. These networks are being developed in cities including Dubai or Songjiang (Shanghai District).

Notable urban characteristics: secondary end link increasing population density

Historic tram networks like Vienna, Zürich, Berlin and Brussels that have been structured by finely tuned network meshing, often with m**ore than a dozen lines** and short distances between stops.

These networks face more challenges in **maintaining and modernizing** their rolling stock (often made up of several generations of vehicles) and their infrastructure, as seen with the Toronto Streetcars network.

HISTORIC TRAM SYSTEMS

Historic tram systems (late 19th/early 20th century), that have not been retired

The 32 tram systems studied

RECENT TRAM SYSTEMS IN LARGE CITIES

- Barcelona
- Bordeaux
- Dublin
- Grenoble
- Manchester
- Montpellier
- Nantes
- Lille
- Lyon
- Paris (T3)
- Salt Lake City
- Strasbourg

RECENT TRAM SYSTEMS IN MID-SIZED CITIES OR SERVING NEIGHBOURHOODS OF LARGE CITIES

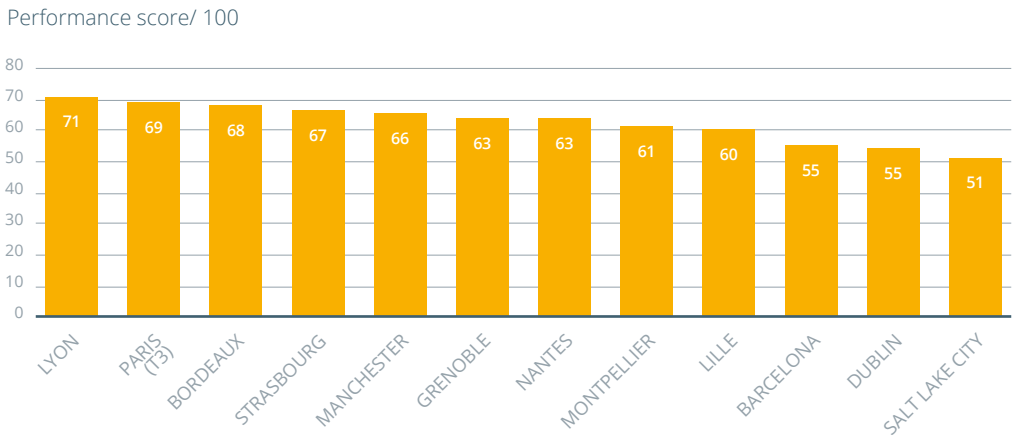
- Adelaide
- Bergen
- Brest
- Croydon (London)
- Dijon
- Dubai Marina
- Gold Coast
- Nottingham
- Sheffield
- Stockholm (22)
- Sydney
- Tours

HISTORIC TRAM SYSTEMS

- Berlin
- Brussels
- Helsinki
- Melbourne
- Oslo
- Toronto
- Vienna
- Zürich


Bergen
Oslo
Stockholm
Helsinki
Manchester
Sheffield
Dublin
Nottingham
Croydon
Brussels
Berlin
Lille
Paris
Dijon
Strasbourg
Brest
Zürich
Vienna
Nantes
Tours
Lyon
Bordeaux
Grenoble
Montpellier
Barcelona
Dubai
Gold Coast
Adelaide
Sydney
Melbourne

Large city tram systems



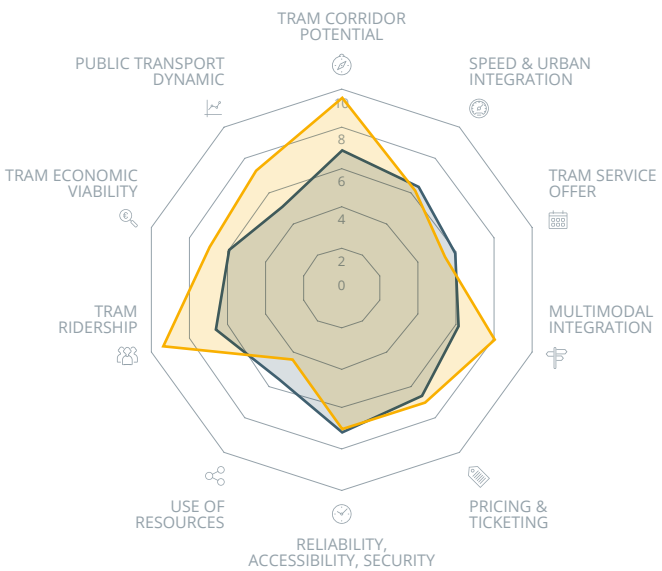
In large cities, trams can deliver on their full potential **by linking with metro and urban trains networks** in cities with more than 1 million inhabitants or **structuring public transport networks** in cities with less than 1 million inhabitants, total ridership can exceed **100,000 passengers per day**.

Paris, France
Opening date: **2006**
Network length: **22 km**
Operation: **Public, RATP**
Annual offer: **3.0 Mkm**
Annual ridership: **83 Mpax**

Lyon, France
Opening date: **2001**
Network length: **61 km**
Operation: **DSP, Keolis**
Annual offer: **5.2 Mkm**
Annual ridership: **93 MPax**

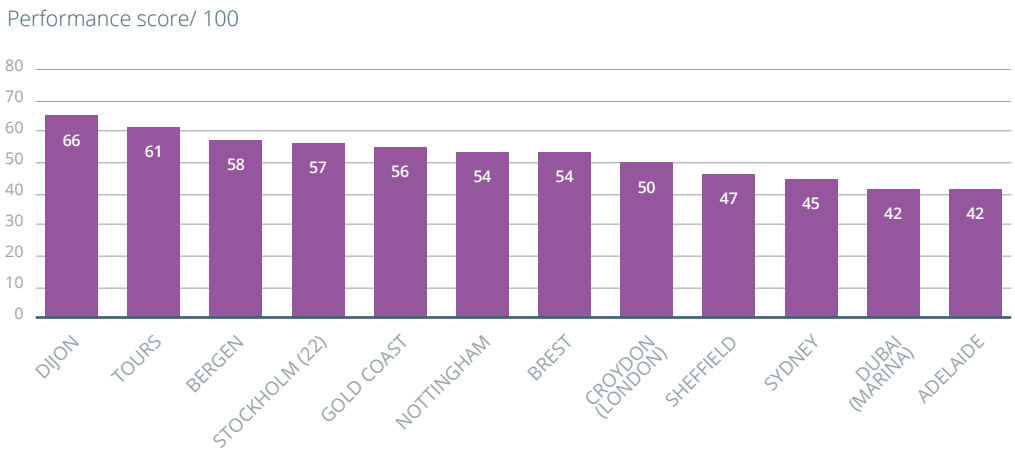
Bordeaux, France
Opening date: **2003**
Network length: **67 km**
Operation: **DSP, Keolis**
Annual offer: **6.9 Mkm**
Annual ridership: **106 Mpax**

Lyon tram network is growing in ridership and will soon have six lines.



- Three out of five lines transport more than 100,000 passengers per day, and with an 18+ trips per kilometre rate
- A rate of operating cost coverage by passenger revenues of over 60% thanks to a strong integration of maintenance and operation, and synergies between modes
- During rush hour reinforced services for universities to adapt to the dynamic of ridership

Mid-sized city tram systems



Tram systems in mid-sized cities, which have greatly expanded in the 2000s, are **modern** and designed to be **fully accessible**. **Network integration with buses and feeder systems** (P+R) is key to ensuring tram systems reach their full potential.

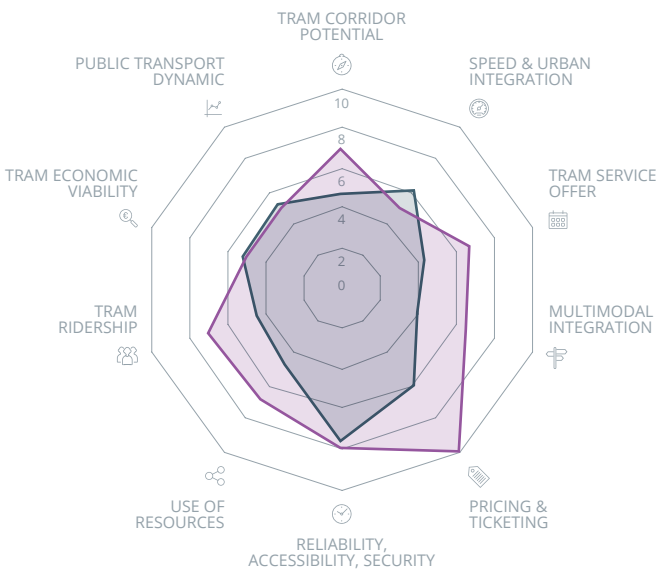
Tours, France
Opening date: **2013**
Network length: **15 km**
Operation: **DSP, Keolis**
Annual offer: **1.3 Mkm**
Annual ridership: **17 Mpax**

Dijon, France
Opening date: **2012**
Network length: **19 km**
Operation: **DSP, Keolis**
Annual offer: **2.1 Mkm**
Annual ridership: **24 MPax**

Bergen, Norway
Opening date: **2001**
Network length: **20 km**
Operation: **Operating contract, Keolis**
Annual offer: **2.1 Mkm**
Annual ridership: **15 Mpax**

DIJON, FRANCE

In operation since 2012, **Dijon tram has enhanced the appeal of its public transport.**

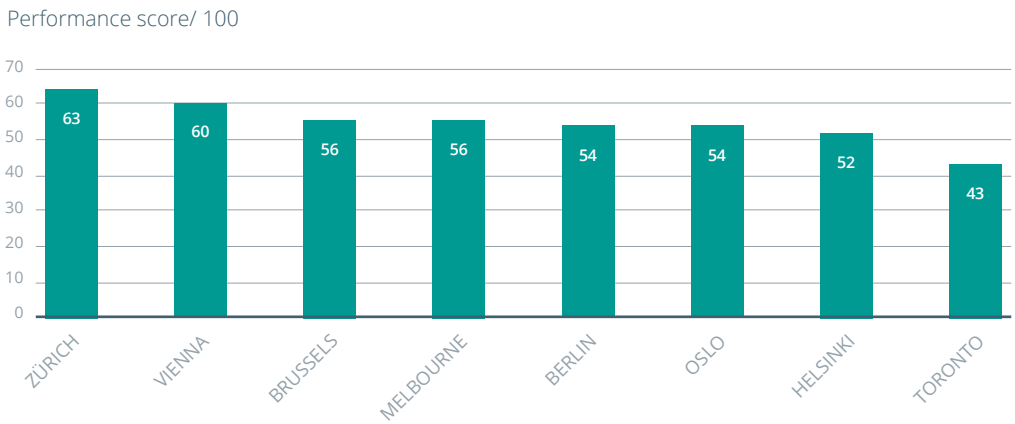


- With 34% of tram stations serving major activity poles of the city, the tram network is the backbone of Dijon
- The network is fully accessible for people with reduced mobility
- Dijon tops the ranking on ticketing thanks in part to the introduction of open payment on board allowing passengers to purchase, store and validate transport tickets using their contactless credit or debit cards
- The arrival of the tram has driven a 40% increase in Dijon's public transport ridership in just 3 years

Dijon

Average mid-sized cities

Historic tram systems



Some historic **tram systems have benefited from continuous modernisation investments**, and their performance is close to those observed on more recent networks. Thanks to its wide-reaching distribution network, **tram is the link between metro, urban trains and other soft modes of transport**.

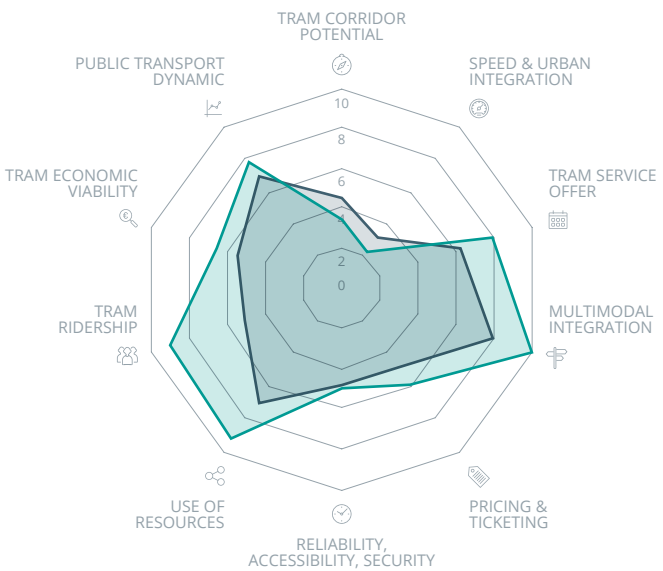
Vienne, Austria
Opening date: **1897**
Network length: **178 km**
Operation: **Public, WL**
Annual offer: **28 Mkm**
Annual ridership: **363 Mpax**

Zürich, Switzerland
Opening date: **1894**
Network length: **73 km**
Operation: **Public, VBZ**
Annual offer: **18 Mkm**
Annual ridership: **205 MPax**

Brussels, Belgium
Opening date: **1894**
Network length: **141 km**
Operation: **Public, STIB**
Annual offer: **15 Mkm**
Annual ridership: **149 Mpax**

ZÜRICH, SWITZERLAND

Thanks to a committed tram-friendly public transport policy,
Zürich's tram tops the ranking of historic trams.



- The bus and urban train networks were built around the tram network, ensuring effective multimodal integration
- The complete public transport offer has led to a good balance in the economic performance of the overall network and a public transport modal share of 32%
- The 16 lines feature numerous shared tracks and high tram frequencies all day, especially in the city centre

Five takeaways from the ranking

1. The tram effect: a new lease of life for public transport

Dijon example : + 40% public transport ridership in 3 years after tram opening

The arrival or revival of a tram in a city drives ridership.

Thanks to benefits like comfort, capacity and ease of use, the **tram attracts new customers** and converts people who were previously rare public transport users.

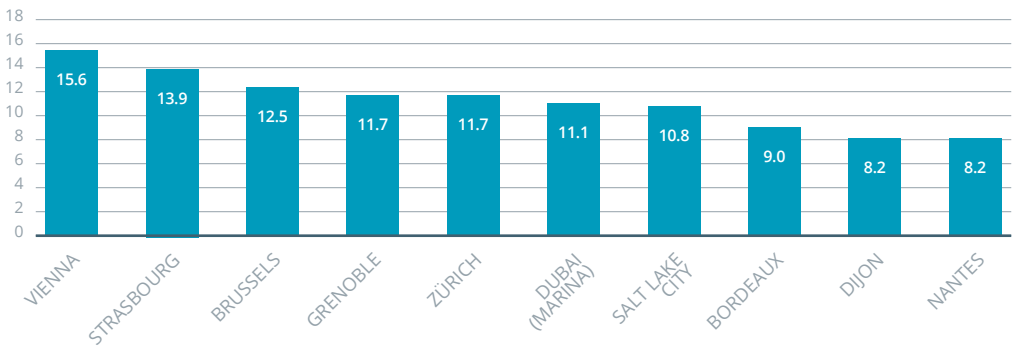
To take full advantage of the tram, its introduction is usually accompanied by a **restructuring of the bus network:**

- Some bus lines follow tram standards with similar frequency levels and quality standards to form the public transport network backbone
- Other bus lines provide local services and feeder services for the principal arteries of the network

VIENNA, AUSTRIA

2. The offer at the heart of the tram attractivity

Annual tram km offer per inhabitant

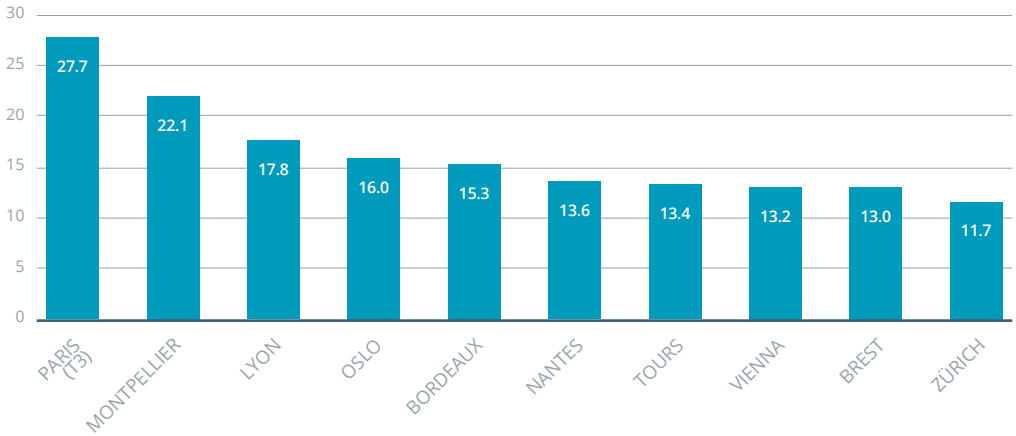


Historic tram networks, with more local services, have a higher km offer per inhabitant than the average of the networks., as demonstrated by Vienna, Brussels and Zürich.
Some cities like Strasbourg or Grenoble also use the tram to serve both their structural arteries and most of the neighbourhoods of the municipalities.

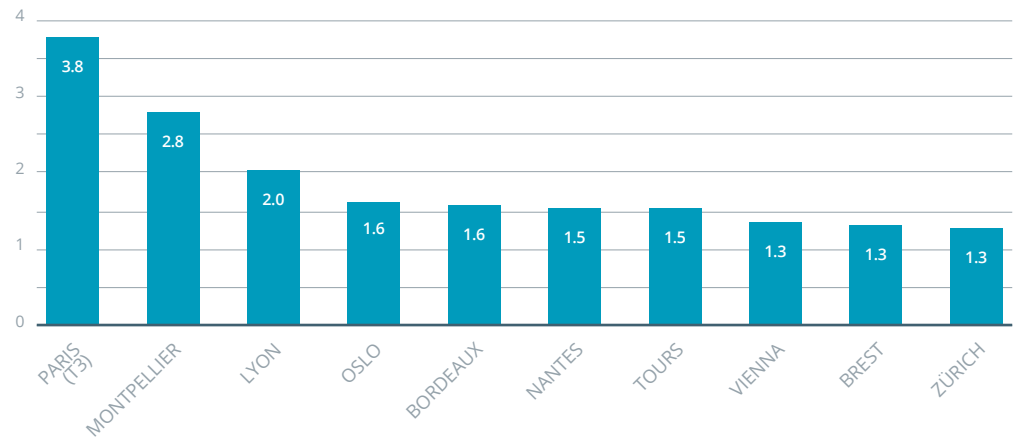
Cities equipped with a metro, like Barcelona or Lyon, appear lower in the ranking.
Mid-sized cities (<500,000 inhabitants) have a slightly lower km offer per inhabitant due to a slightly reduced offer, especially in the evening.

3. Tram ridership varying between regions

Trips per km produced (V/K ratio)



Million trips per km of tracks



The number of trips per tram km or km of tracks gives a good indication of tram ridership and infrastructure usage.

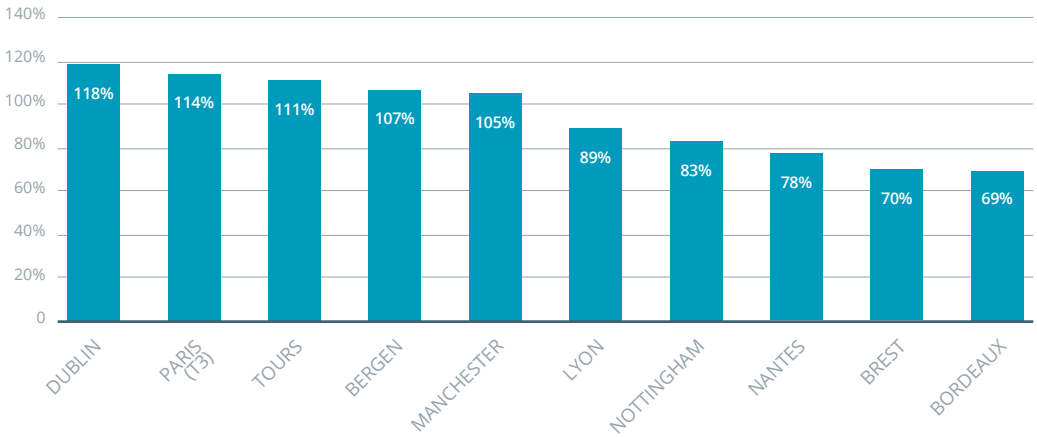
Globally, large cities with the densest populations achieve the highest ridership rates.

- **Tram systems in France** with lines following structural arteries enjoyed above average levels of ridership. The T3 line in Paris, which runs parallel to the Périphérique ring road, enjoys daily ridership of over 280,000 passengers. It is mainly used on short distances as a feeder to the Parisian metro.
- In **Zürich**, several lines share the same tracks which generates a high number of trips per km of tracks.
- Trams in **Australia** and the **United States**, where the car culture and urban sprawl are common characteristics, achieve lower levels of ridership.
- In the **United Kingdom**, where trams often run along former railway tracks, travelled distances are longer which impacts these ratios.

PARIS, FRANCE

4. Operating costs largely covered

Rate of tram operating cost recovery by revenues



When trams reach **high ridership levels** (>50,000 trips per line a day), operating costs are largely covered by passenger revenues. Five of the tram networks studied have their operating costs covered by passenger revenues.

Dublin's tram system features a high ticket price (€2.10 single trip ticket) and ridership on the red and green lines reaching 75,000 trips per day. The inferior operating costs to the passenger revenues **allows investment of the surplus** generated in the modernisation and development of the network.

Tours tram also covers its operating costs with a ridership reaching 70,000 trips on certain days.

Certain tram systems like Nantes, Lyon and Manchester achieve a high operating cost recovery by revenue rate whilst maintaining a high frequency rate outside of rush hour.

5. Performance works as a virtuous circle

The 32 tram systems studied have different levels of maturity.

The challenge for **new systems** such as Dubai or Gold Coast is to drive ridership by winning the loyalty of current customers and converting new ones by demonstrating the tram's benefits.

For **5-10 year old tram systems**, with growing ridership, optimising operating costs becomes a major challenge.

Networks **older than 10 years** face challenges in growing capacity and investing in a heritage tram systems to maintain their appeal. Swiss and German systems modernised their systems with continued investment and enjoy trams which are still efficient despite their age.

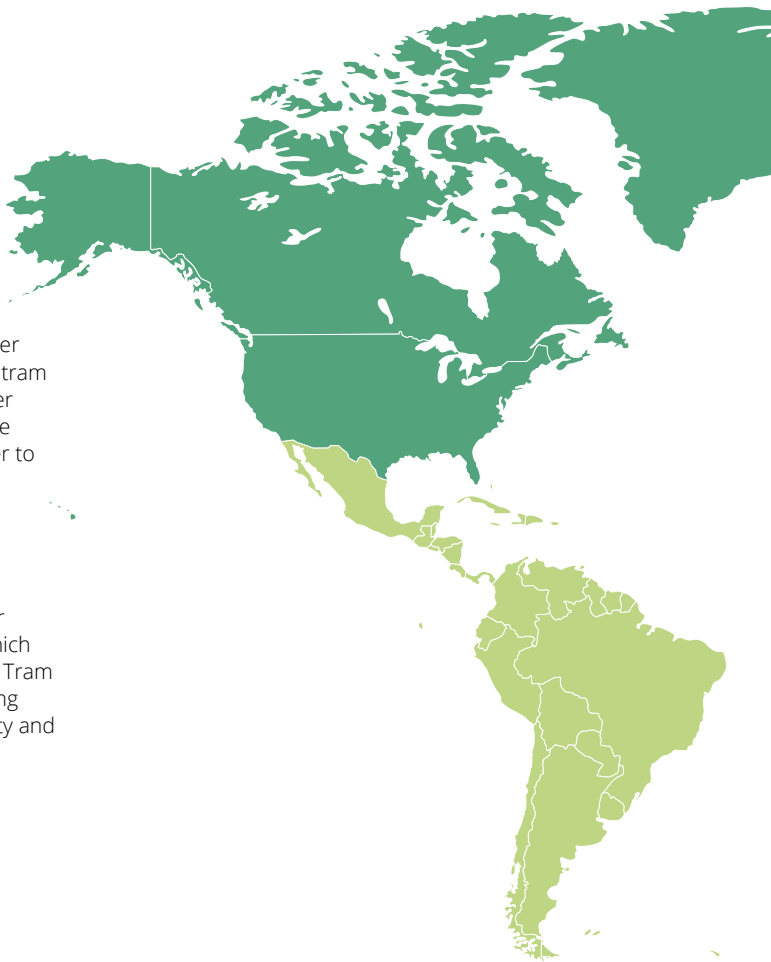
Chapter 2
Tram trends in 2019

Regional trends

The **tram is strengthening its position** in a number of regions

In **North America**, the **United States** is experiencing a modest tram revival with 30 'modern' networks in operation, but ridership levels remain low. In **Canada**, streetcars are concentrated in Alberta (Calgary, Edmonton) and Ontario (Toronto, Ottawa). New projects are often funded through Public Private Partnerships (PPPs) (Edmonton, Waterloo, Hurontario). The Toronto Street Car is also receiving significant investment for its modernisation.

Russia is focusing on its historic tram networks rather than on creating new networks. It is gradually upgrading its trams (120 new low-floor trains ordered in Moscow) but it is also closing some lines as it rethinks its multimodality.



In **South America**, the tram remains under developed with a few exceptions (the Rio tram in Brazil, launched in 2016 for the summer Olympics). South American cities are more reliant on BRT systems, which are cheaper to create and quicker to put into operation.

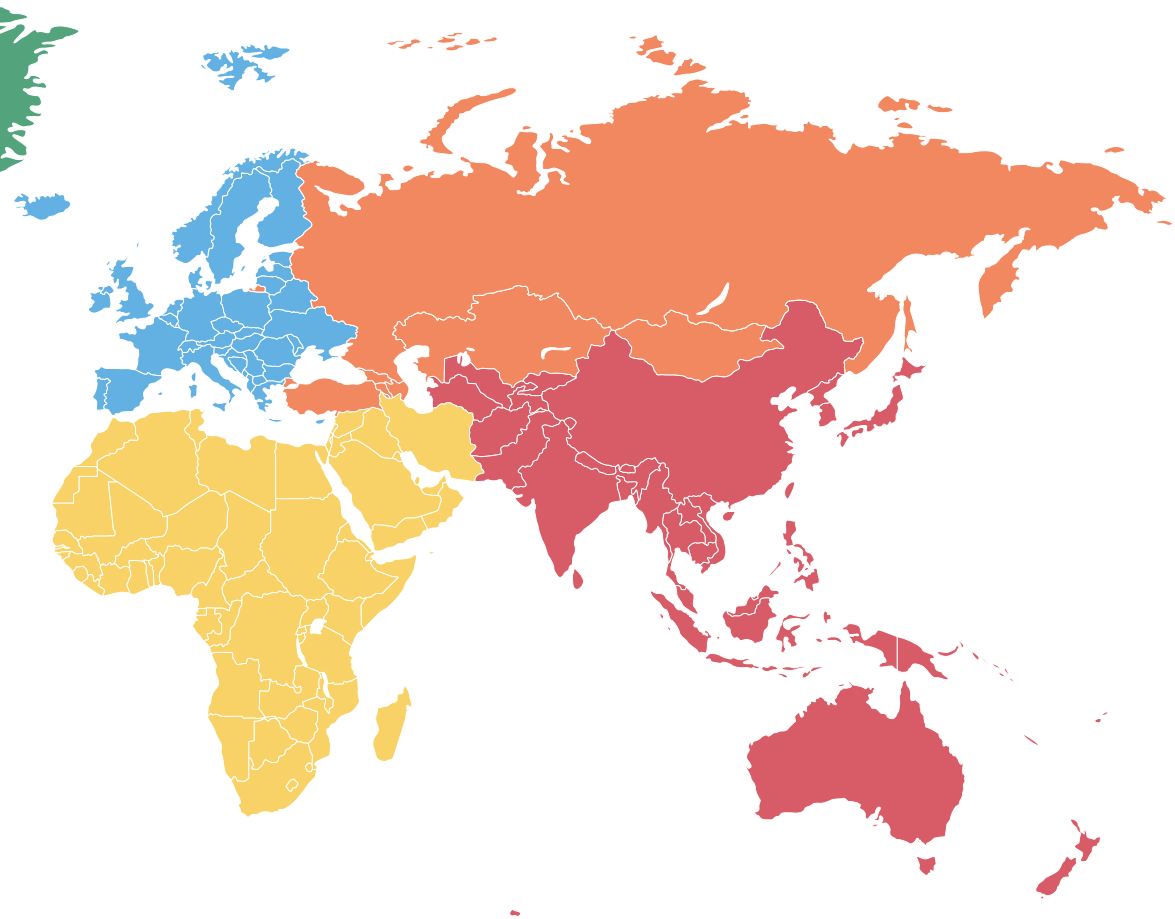
Europe is now a mature market with over 210 tram networks, more than 30% of which have been reintroduced since the 1990s. Tram investments are now focused on extending existing networks, increasing their capacity and ensuring their longevity.

The **Middle East** sees the tram as a strong vector of the image and modernity of a city. Dubai was the first Middle Eastern city to incorporate a tram into its marina. Doha, followed by Bahrain, will also soon have modern and comfortable tram systems.

In **Africa**, the tram is enjoying increasing success in **Maghreb** countries, mainly in Algeria and Morocco. The tram market is slowly expanding in sub-Saharan Africa, particularly in Nigeria (Lagos, Abuja).

China is committed to an ambitious tram policy, with plans for more than 800 kms of tram lines to complement metro networks. The opening of the Songjiang tram system in Shanghai in late 2018 is already proving a success.
India is defining its tram development model with trams being considered for new reorganised and pedestrianised neighbourhoods.

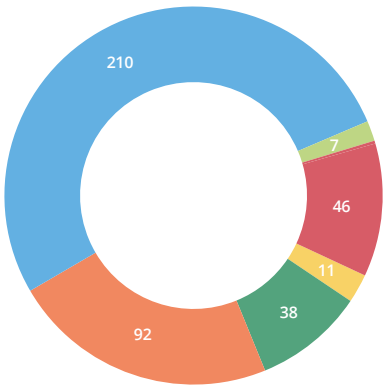
Australia has been investing heavily in trams over the past decade, notably through PPPs (the Gold Coast in 2014 and soon in Canberra). Also of note is Australia's first multimodal bus and tram network operated by Keolis Downer in Newcastle since 2018.



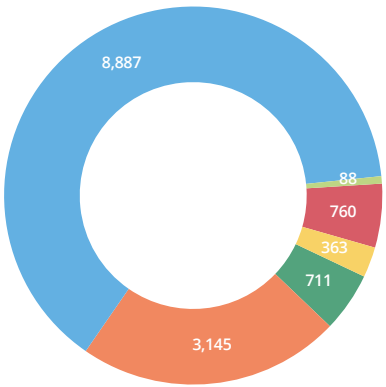
Regional trends

Tram systems remain concentrated in Europe

404 tram systems in the world
Divided by region



14 billion passenger journeys per year
Divided by region



Source UITP

Half of the world's tram systems and almost two thirds of annual passenger journeys are concentrated in Europe. This illustrates the importance of tram use in European culture as well as the scale of the offer.

The second largest region for trams is **Eurasia**, with many historic networks in Russia.

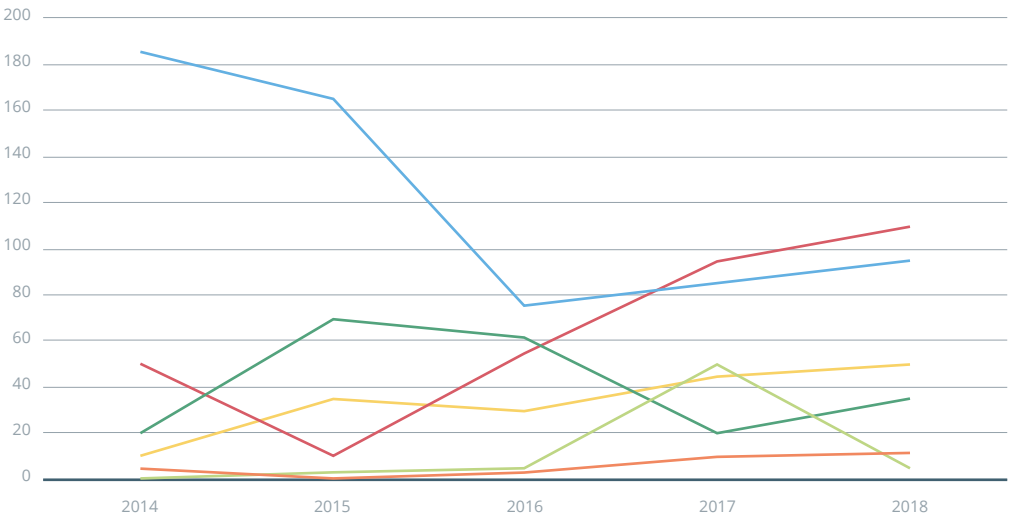
North America and **Asia Pacific** follow in terms of number of systems but their passenger journeys are proportionally lower.

- Eurasia
- Europe
- North America
- South America
- Middle-East & Africa
- Asia Pacific

Growth drivers are increasing and Europe remains a strong development ground for the tram

Evolution of tram development (km per year) Divided by region

Source UITP



Trams are emerging in new regions like **Asia** where **China** leads the field in terms of tram tracks built in 2018. The **Middle East** and **Africa** are seeing slower but steady growth with Casablanca in Morocco and Setif in Algeria which have opened 15 km long tram systems.

Despite a decrease in tram development between 2015 and 2016, **Europe** maintains strong growth. By way of example, 32 km of new tram lines were introduced in Aarhus, Denmark.

Management trends

The different management models

Although the **public management model** remains the most widespread, an increasing number of **Public Transport Authorities (PTAs)** are delegating the operational management of trams or public transport networks **to private operators** through different types of contracts. The length of these contracts largely depends on the level of responsibility and risk entrusted to the operator.

Characteristics of contracts	Increasing delegation of responsibility to the operator		
Contract length	Short < 7 years	Medium ≈ 10 years	Long > 15 years
Performance target	Limited to quality of services		Integration of customer satisfaction indicators
Ridership and revenue risks	Entirely borne by the PTA		Partially borne by the operator
Modal interface (*)	Entirely borne by the PTA	Partially borne by the operator	Entirely borne by the multimodal operator
Scope entrusted to the operator	Operation of tram only (1)	(1) + Tram and infrastructure maintenance (2)	(1) + (2) + Project management support

(*) passenger info, continuation of services in degraded mode of operation

BUDAPEST, HUNGARY

The role of equipment manufacturers

Some equipment manufacturers offer **a maintenance contract associated with their supply contract.** This offers a support solution as the system performance ramps up during the first years of operation. After a few years, maintenance is usually integrated within operations to enhance reactivity and optimise operating costs and client service. In the long term, equipment manufacturers' involvement is focused on **heavy and specific engineering projects.**

Funding methods

While tram operating costs are often covered by **passenger revenues**, investment costs (line construction, purchase of rolling stock, major fleet overhauls, etc.) require **additional sources of income:**

- In Australia and Canada, cities are increasingly using **Public-Private Partnerships (PPPs)** to finance tram infrastructure. This approach makes it possible to transfer many construction-related risks (delays, extra costs, underperformance) to the private sector, and to reduce the burden on the community (via an operating subsidy).
- In France, companies and administrations with more than 11 employees pay a **transport tax** which finances about one third of public transport.
- In Germany, the tram systems are financed in part by electricity suppliers, as trams are a major consumer of this energy.

Urban development trends

Driving the modernisation of a city

Trams **enhance the urban landscape** and **modernise neighbourhoods** by transforming public space as shown in Bordeaux where the tram revitalised the city centre. Trams contribute to neighbourhood cohesion and reassure investors by illustrating an area's investment appeal. Trams can also reflect the image and **identity of the city**; in Tours, for example, the system's stations and trams were designed and decorated by the artist Daniel Buren.

The opening of a tram system involves restructuring the public transport offer with the bus lines, but also integrating soft modes of transport within the development and creation of the new infrastructures

Supporting the development of sustainable and smart cities

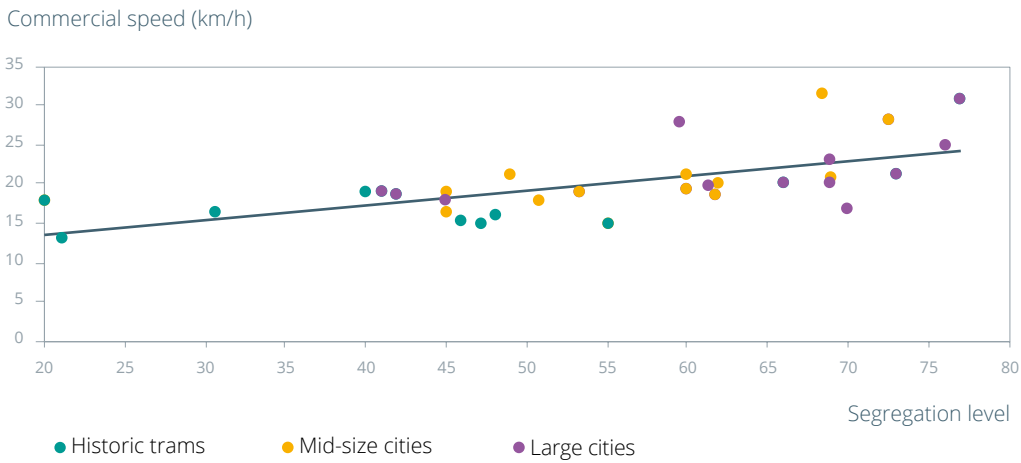
100% electric, trams emit no emissions and are perfectly adapted to sustainable smart cities. Characteristics include their capacity to:

- run on tracks surrounded by grass
- make full use of fibre optic infrastructure
- interconnect with autonomous vehicle services
- integrate public services around the stations

Putting a tram in place requires removing certain obstacles

- The introduction of trams can disrupt the habits of motorists and pedestrians. It should therefore be accompanied by awareness campaigns to ensure the safety of all road users.
- Construction of a tram line has a short-term impact on residents and neighbouring businesses. Alternative means of transport need to be offered from the beginning, and be well communicated, in order to limit this impact.

BORDEAUX, FRANCE



Commercial speed depends on how the tram is inserted into the existing infrastructure and notably how isolated the tram tracks are from other transport modes. The right balance has to be found for the area the tram integrates:

- In a lot of historic systems **tracks are shared** with traffic which impacts both speed and punctuality.
- In the city centre, trams like those in Tours or Zürich go through **pedestrian areas** which requires reduced speed limits and entails the hazards intrinsic to shared transport zones.
- **Tracks surrounded by grass** is a deterrent to cars and bikes, thereby freeing space for the tram and enhancing a neighborhood's appeal.
- The tram-train model often **re-uses former rail lines** which facilitates higher speeds. The challenge is then to integrate the infrastructure within the neighbourhoods without creating pronounced boundaries.

Industrial and technological trends

The tram rolling stock market is increasingly open

Globally, the tram industry accounts for **€3.7 billion** in sales, **50% of which is in Europe**. It is seeing **annual growth rate of 10%**.

The market is dynamic and is seeing several companies take significant market shares, like Stadler or CAF. The emergence of the Chinese tram market could call into question this distribution, as is already the case for heavy rail.

The trend towards standardisation

Since the end of the 1990s, the construction of tram systems has been based on the following core elements: low floor trams, dedicated track infrastructure, iron wheel trams, 1.435m track gauge, 30 to 50 metre long trams.

For rolling stock, PTAs were used to ordering 'tailor-made' models based on the specificities of the network.

Due to the cost involved in having such a diversity of rolling stock, manufacturers are now trying to **standardise** their offer whilst maintaining a certain **level of customisation** for their clients. Alstom has joined this trend by developing the Citadis, a modular tram dividing the number of part references by two (from 5,000 to 2,500).

Driver Assistance Systems making rapid progress

Tram systems are gradually being equipped with automation systems, initially developed for metro, to meet **security and capacity challenges**:

- Automatic Train Protection (ATO) like in Dubai
- Anticollision Systems (ATP) like in Frankfurt with Bombardier's Driver Assistance System

Automating some functions may:

- Improve commercial speed and regularity of trams
- Increase capacity with better regulation
- Reduce energy consumption
- Improve security

Depending on the network's profile, results will differ when assessing the efficiencies. They will be less impactful for tram systems since, unlike metros, they run in an open environment.

First steps of automated tram

During the "Innotrans" Summit in Berlin, operator Potsdam VIP and Siemens Mobility presented in September 2018 a fully automated tram and organised a full-scale test in a closed network.

Tram automation might be first used in protected areas like depots: this would enable tracking the whole cleaning process, as well as sandblasting, inspection, and storage without a driver.

The high-growth of green trams

- Several networks are experimenting with the recovery of a tram's braking energy and its reinjection into the electric traction network
- Manufacturers are innovating e.g. carbon fiber trains to lighten the weight of the rolling stock and make it more energy efficient, 'eco-driving' modes such as in Caen
- Operators are also working on the air-conditioning and heating of trams to reduce their energy consumption

The development of 'zero impact' trams also involves the reduction of noise pollution with manufacturers working on limiting the noise linked to the rail-wheel contact in track curves.


DUBAI, UAE

BERLIN, GERMANY

SALT LAKE CITY, USA

MELBOURNE, AUSTRALIA

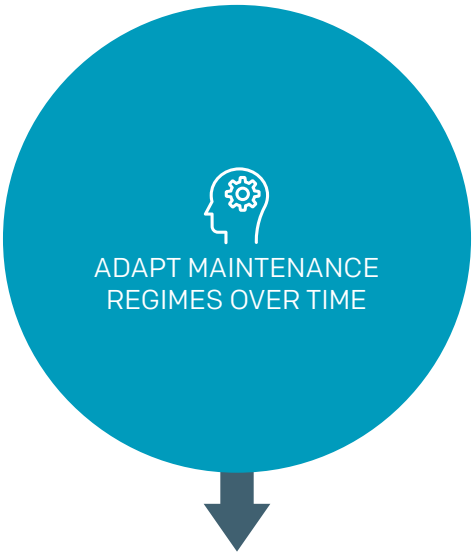
Heritage trends

Maintaining tram networks constitutes a major challenge for their longevity

Tram networks are often a PTA's foremost asset. Maintaining good operating conditions and its quality of service are essential to it remaining an attractive network. The main heritage issues facing authorities are:

Heritage trends

Heritage strategies to optimise overall costs and keep an appealing network.

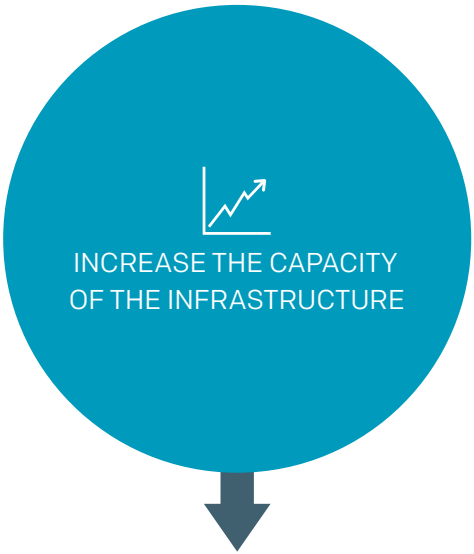


- Continuously monitor the performance of the network via data collection (big data, IOT)
- Develop preventative maintenance and monitoring of critical infrastructure

E.g. In **Vienna**, the maintenance plan is associated with the continuous collection of data in order to budget and plan maintenance operations.

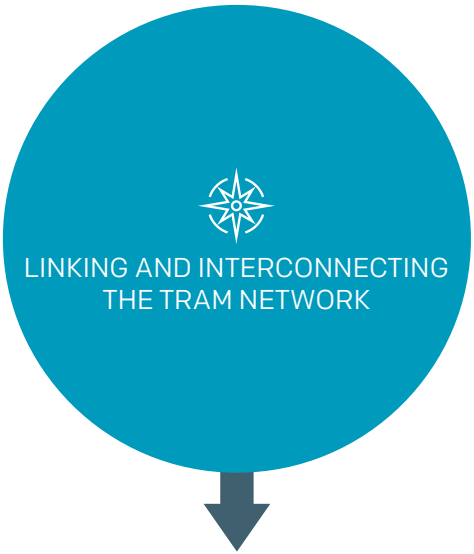
- Extend tram lifespan and increase capacity with mid-life upgrades
- Move the lower capacity trams to lines with the lowest ridership

E.g. In **Melbourne**, seven generations of trains coexist, the oldest and lowest capacity ones operate on the less popular tourist lines



- After 15-20 years, extend the platforms and increase network power to allow for the use of more high-capacity and efficient trains
- Invest in track and signalling equipment to increase capacity

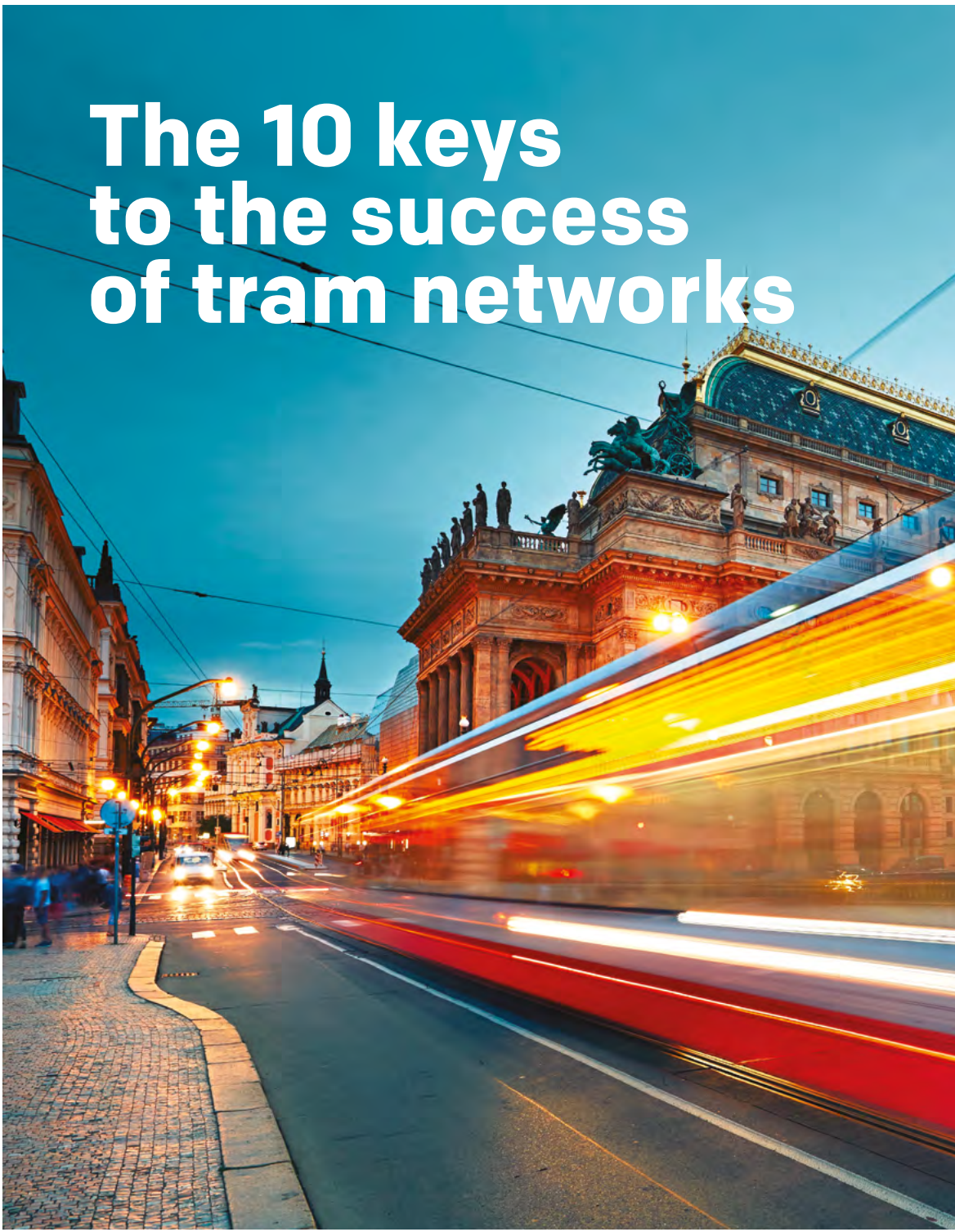
E.g.: Since 2017, the platforms of tram stops in **Lyon** have been extended to increase the capacity of some lines by 30%



- Develop the linking of the network to interconnect the depots with some dedicated to ongoing maintenance and others to larger operations
- Develop interoperability of the fleet between lines for more flexibility in daily operations

E.g. In **Stockholm** tram lines, which remain very fragmented today, are being connected to enhance flexibility and efficiency.

The 10 keys to the success of tram networks



PRAGUE, CZECH REPUBLIC

01
Lines serving the main neighbourhood and traffic generators allow for high ridership throughout the year

02
Achieving optimal commercial speed offering benefits over cars on a given transport corridor

03
A network design incorporating the possibility of increasing the **capacity of lines** (length of platforms, electric power)

04
The **involvement of the future operator** from the design phase of the tram network

05
An **integrated operation and maintenance system** to support changes in ridership and provide quick response times

06
Changes to service frequency based on the time of day or year, while keeping a continuously attractive offer

07
Successful integration with the bus network, other heavy modes, soft modes, P+R, and walking to promote multimodality

08
An **integrated and connected tram network** for increased day-to-day flexibility and economic efficiency

09
Regular investment in the infrastructure and rolling stock to maintain an attractive service offering

10
A **holistic approach** that includes urban planning, transport and sustainable development

Creation iLemon • Photos Credits Gettyimages / Envato / Shutterstock / Keolis

EurogroupFR
Eurogroup Consulting

EUROGROUP
CONSULTING

www.**eurogroupconsulting**.com