INTRODUCTION

Collective mobility is delivered through many forms and systems, ranging from the traditional forms of rail and road vehicles in all designs and sizes, so-called unconventional systems (cable, monorails...), or even more personalized forms of shared mobility like taxis, car-sharing etc., each with its own operating features and performance levels.

As a promoter of sustainable mobility, UITP recognizes that all formats of transport do have a role to play in cities and regions and that only well-designed and seamless integration of all complementary modalities suited to the local requirements will offer citizens quality options to choose public transport over individual mobility.

HISTORY

In the 1950/70ies, many countries dismantled their tram lines to provide space for cars. A few cities modernised and upgraded them with newer vehicles and (partly) segregated tracks and Light Rail Transit (LRT) was born! Since the mid-80s, street rail systems have enjoyed a strong revival; many cities, where tramways had disappeared, started to build new LRT schemes: primarily in North America and in Europe, but since the beginning of the new Millennium they have also been introduced in the Middle East, Asia-Pacific and more recently in South-America and Africa.

As a result, light rail systems can now be found in 53 countries on all continents; they move 45 million people every day in 388 cities (Nov. 2015). Prospects are very promising, as around 80 cities are building or planning their first LRT line.

New LRT system openings - 1985-2015

![Graph showing new LRT system openings from 1985 to 2015.](image-url)
Light Rail covers a wide range of mainly surface rail systems with enhanced service quality such as frequency, speed and reliability; pleasant design for stations and vehicles; advanced IT (priority at traffic lights, operation control, real time information, smartcard etc.) as well as ample use of Park & Ride.

With its broad definition and wide-ranging scope of performance, LRT is suited to carry out various functions in the mobility pattern of cities. It can work as classical (modernised) tramways with extensive street-running sections and priority measures (e.g. Zurich, Milan, Vienna, Brussels, Dresden, Prague, Melbourne...), as a new largely segregated LRT (e.g. Nantes, Strasbourg, Zaragossa, Dublin, Portland...), as quasi-metro rapid transit (Stuttgart, Cologne, Porto, Istanbul...), or in specific cases as tram-train (e.g. Sarrebrucken, Karlsruhe, Alicante, Mulhouse...).

LRT can be the structuring public transport backbone of medium-sized cities (200,000-600,000 inhab.), but it can also serve as a feeder to higher capacity metros or commuter railways in larger conurbations; it can provide radial access from outskirts to CBD, or orbital connectivity between suburbs (e.g. Paris).

LRT has been successfully developed in the past 25 years because it delivers significant benefits for both customers and cities:

1. LRT has demonstrated the ability to offer passengers a positive travel experience, even among car-drivers because of the following service quality features:

- **Capacity**
  Investment costs are not negligible (20-30 m €/km in Western countries), and the challenge is to develop the LRT in response to the right transport need. With train composition ranging from 22 to 60 m in length, it is a good intermediate mode for capacity needs ranging between 3,000 and 11,000 passengers per hour per direction. Only metros, heavy rail and to some extent specific BRT offer similar or higher transport capacity.

- **Speed, reliability and regularity**
  To be successful, LRT calls for an effective alignment (e.g. avoid curvy routes) with a high level of segregation and priority at junction signals. Such design features can make light rail nearly congestion-free and result in good commercial speeds.
(20-30 km/h) and short journey times. Additional measures to reduce dwell times at stops (e.g. level boarding, wide doors, tickets sold off the train) also contribute to this result. With their good acceleration performance, light rail vehicles can attain good service speeds; they also continue to operate in adverse meteorological conditions when snow or ice affect road traffic.

- **Comfort, accessibility and ease of use**
  
  Modern vehicles as well as well-designed and maintained track ensure a smooth and comfortable ride. Low-floor vehicles and accessible surface stations can offer better services for all categories of passengers with step-less access in very close vicinity to shops, schools, housings, etc... Well-designed stations and stops, as well as dynamic passenger information can also contribute to passenger satisfaction. Finally, riding on the surface instead of underground is perceived by many as a more pleasant and secure travel experience.

- **Safety**
  
  Statistical evidence show that LRT is six times safer than car travel. Segregated rights-of-way and priority at traffic lights reduce the risks of collisions with road transport. Scientific research in the field of passive safety, have led to safer vehicle design, and professional operators investigate each incident to learn and make the system safer day after day. In addition, so-called Driver-Assistance-Systems are currently in early deployment and will help reduce further the risk of collision through early driver warning.

2. LRT has also established itself as a popular investment for cities because it can offer further benefits contributing to overall quality of life in cities:

- **Environmental-friendliness**
  
  LRT consumes on average seven times less energy per passenger than cars. Light rail produces no emissions at street level in sensitive areas and therefore contributes significantly to localised air quality improvement. Modern traction equipment allows regeneration of braking energy. Also, (on-)board or stationary energy storage device and modern power supply equipment such as reversible substations have reached maturity level to improve LRT energy-efficiency even more.

- **Adaptability**
  
  Light rail can operate in urban and suburban environments: on the streets (mixed traffic) or preferably on segregated rights-of-way; ideally at ground level but underground or elevated if necessary. It has proven to be a very flexible transport mode to serve pedestrian areas. Light rail vehicles can leave the city and run on railway track, even in mixed operation with heavy rail traffic.

- **Impact on urban life and positive image for the city**
  
  In the past decades LRT has demonstrated its ability to convey a strong positive image to the city. Light rail schemes are not only transport projects, but also urban upgrade projects: with per-
manent and highly visible infrastructure, they testify a strong, long-term political commitment to sustainability. LRT supports the creation of pedestrian zones with an overall facelift of the public space along the corridor and the introduction of new elements of aesthetic value (stations, bridges, monuments...). Light rail contributes thereby to the regeneration and modernisation of the areas it serves and to the development of new areas. It encourages the creation of new housing, offices and commerce along its corridor. It increases the value of existing real estate as well. LRT encourages the compact and dense development of towns and cities, and avoids unnecessary and resource-hungry urban sprawl.

- **Impact on mobility**

  LRT is highly visible, easy to understand and enjoys an image of quality and prestige among citizens. Customers’ massive enthusiastic response to LRT has become coined as the “LRT bonus”, in most places, ridership is reached much earlier than forecasted. Experience also shows that LRT is very conducive to attracting car-drivers. Therefore LRT helps reduce congestion and the need for parking. LRT is also often conducive to increased walking and cycling as a consequence of reduced road traffic pressure and nuisance.

  LRT’s success depends on a well-thought adaptation of the existing transport systems: public transport has to be re-designed with feeders around the major backbone (hierarchy), and LRT should get priority over roads: space segregation between junctions and time segregation at junctions. Better co-existence of private car and LRT can be increased by interchange stations and park-and-ride. This will make the structure more visible, integrated, understandable, user-friendly, and above all efficient and competitive.

  Light rail development has been very successful over the last three decades. The reasons for its success remain valid, however for the success story to continue, LRT needs to respond to some challenges.

  ![Well integrated boarding facilities (Portland, USA)](image)

  ![Several technical solutions allow to run LRVs without overhead wires (Orléans, France)](image)

3 Hue, LRT, the city and its people, UITP, 1997
Next to its many benefits, there are some challenges with LRT:

The main one is the **investment costs**. When LRT was “invented”, the philosophy was to deliver medium/high capacity for a fraction of the cost of a metro. This was achieved with great success, as LRT typically costs 5-8 times less than metro to build. However, Bus Rapid Transit (BRT) has since been developed to carry similar number of passengers for lower investment costs. Does this mean the end of LRT?

BRT in its many forms and performance regimes is a newer tool to serve mobility needs. The decision to develop a BRT or LRT system is a complex process determined not just by capacity and funding, but also - and equally importantly - by urban planning and environmental considerations, acceptance by users and non-users, political considerations and the socio-economics of the city.

**Noise and vibration** are also challenges for LRT: trains can create vibrations affecting adjacent buildings and generate so-called “squeal” noise in curves. These nuisances do not relate to the trains themselves, which are electric and very silent, but to the interaction between track and vehicles. State-of the art engineering allows design infrastructure to minimize noise and vibration: avoidance of tight curves, so called “whisper track”, use of absorbing elastomer elements in wheels and track components can mitigate these problems.

Another issue which was causing “sore eyes” for many decision-makers was the overhead power supply wires, which are sometimes perceived as visual pollution, especially in areas with heritage value. Many historic cities have LRT with carefully designed power wires which blend discreetly in their surroundings (Florence, Strasbourg, Ghent, Munich). In addition, state-of the art technologies make it also possible to design reliable LRT system without overhead wires, either along the full length of the line or in sensitive areas (Bordeaux, Saragossa, Orléans, Dubaï, Cuenta, Kaoshiung).

Finally, a drawback of LRT is the long planning, construction acceptance and commissioning process. In built-up, mature cities, it can take 8-10 years between the emergence of the first idea to the opening of a line. This long **time to market** requires political stability and enormous efforts to generate a high level of convergence and consensus among stakeholders. It takes very experienced project management expertise to conduct LRT projects within politically acceptable time frames.
RECOMMENDATIONS

Light rail has many positive attributes and can reduce the dependence on private car. Its development has been very successful over the last three decades, and there is every reason to expect that it will go on. It is obvious, however, that a minimum ridership (>3,000 pass/hour/direction) is necessary to ensure cost-effectiveness.

LRT can only be implemented successfully if it is integrated with other public transport modes.

To be successful, LRT must be designed in such a way to develop its full potential for speed and reliability; i.e. separate right-of-way wherever possible and priority at traffic lights to get rid of external disruption.

This is beyond the responsibility of operators. Authorities are also involved, and it is necessary to create a good partnership between all stakeholders. This includes a clear and solid urban development strategy to:

- make sure that the project is suited for longer term development,
- take advantage of light rail construction to carry out urban regeneration schemes and to fuel housing, job and public equipment developments along the line,
- exploit innovative financial instruments which take the future benefit of light rail into account to provide part of the initial capital,
- build coherent transport policies, by using mutually the benefits of each mode, developing network hubs, focusing on complementarily of each mode.

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This Knowledge Brief was prepared by Light Rail Committee.