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THE HIGHLIGHT OF GROWING LIGHT RAIL TRANSIT

Meral Bayraktar
Rahmi Guclu
Yildiz Technical University
Dept. of Mechanical Engineering,
34349 Besiktas, Istanbul, Turkiye

ABSTRACT
Light Rail Transit (LRT) is a kind of rail vehicle form which includes from modern tramcars to speed transport. These vehicles go on special road, underground, floor or specific altitude.
Today the number of active serving LRT systems in 50 countries is more than 400. Moreover, a forceful increase has been expected for next years. It is clear that this growing up has certain reasons. In this study, the reasons such as capacity, speed, safety, comfort, flexibility, environment friendly, adaptability, etc. for preferring LRT systems in the world and the advantages of these systems will be presented and alternative systems for the future will be explained.
Keywords: light rail transit,

1. LIGHT RAIL TRANSIT
Light rail transit (LRT), according to the Transportation Research Board's Committee on Light Rail Transit, is defined as "a metropolitan electric railway system characterized by its ability to operate single cars or short trains along exclusive rights of way at ground level, on aerial structures, in subways or, occasionally, in streets, and to board and discharge passengers at track or car-floor level". This definition allows for the inclusion of older streetcar-style systems as well as new LRT lines that have begun service in the past thirty years. It also separates LRT from systems that do not use electricity to power their vehicles and those that require full grade separation because a third rail is used.

2. WHAT ARE THE REASONS FOR USING LRT?
Light rail usually involves steel wheel vehicles operating on steel rails and collecting electrical power from an overhead wire. Diesel light rail is a concept that has been tried to a limited extent, and may have a role in future for low-cost starter lines. The steel rails can be grooved, so that they may lay flush with a street surface, or ballasted like normal railway track, making light rail the only system which can operate on both city streets and jointly with conventional rail services. It offers the possibility that regional rail services can be extended through to the city centre via transfer points from rail to street track, a concept that has been introduced with enormous success in Karlsruhe, Germany, using dual voltage light rail vehicles, and is now being built elsewhere [1].

2.1. Capacity
The first investment cost is too high for transportation so it is important to decide which system is the best. While a street tramway can operate from a bus capacity to 7000 passenger/hour, metro can operate from 40.000 passenger/hour to 80.000 passenger/hour. For 17000 passenger/hour capacity, a street tramway is inadequate and the metro is too expensive. Light rail vehicle is the best solution for the given capacity.

2.2. Speed, Comfort and Safety

LRT vehicles travel on average of 30 km/h speed which enables completing the travel in a short time. Low floor vehicles provide simplicity for passengers, especially older and handicapped person during getting in and out from the vehicle.

The already excellent safety standard of light rail is being further enhanced through the development stronger vehicles (which better protect passengers in the rare event of a collision) and the elimination of steps (through the use of low floor vehicles). Also adding to safety is the use CCTV cameras instead of mirrors and direct observation for vehicle operators to monitor the closing of doors and road traffic behind the vehicle.

The provision of safe and reliable services is a fundamental requirement of the railway. Comparing with highway, probability of die in a railway accident is 8 times and probability of injuring in a railway is 200 times fewer in railway.

In figure 1, it is possible to see that passengers prefer LRT over the other forms of transportation mainly for speed, comfort and safety.

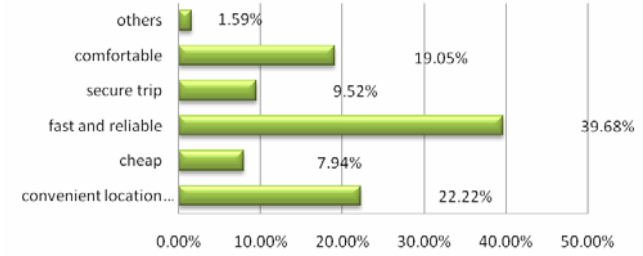

Figure1. A survey result: why ride LRT over the other forms of transportation [2].

2.3. Adaptability and Flexibility

Its ability to operate in a wide range of built environments demonstrates the flexibility of light rail. It can act as a tramway in the street, though if its advantages over the bus are to maximized, unsegregated street track should be kept to the minimum needed to pass particular pinch points. Within the street environment it is possible to segregate by white lines, low kerbs, and side or central reservation. Due to the operational and environmental requirements, tracks can be laid in tarmac, mass concrete, ballast or grass. Light rail can be built on former railway formations, or indeed track share with railways, whether little-used freight lines or those with a passenger service.

2.4. Costs

"External Cost" is a cost factor determining the damage to the environment by the transportation modes. It is stated that external costs are higher in the case of highway transportation than air and high speed rail and high speed rail transportation has the minimum external cost [3].

Table 1. Comparison of external cost of transportation modes

External Cost Category	Air System	High Speed Rail	Highways
Accidents	$0.0004	$0.0000	$0.0200
Congestion	$0.0017	$0.0000	$0.0046
Noise	$0.0043	$0.0020	$0.0045
Pollution	$0.0009	$0.0000	$0.0031
TOTAL	$0.0073	$0.0020	$0.0326

2.5. Energy Consumption and Environment Friendly

Although advances in diesel technology have radically improved bus emissions, LRT systems still produce less regional and urban emissions. Comparing with typically diesel powered bus rapid transit vehicle (BRT), LRT has a clear advantage over BRT for oxides of nitrogen (NO_x) (0,287 g/passenger-

km for LRT and 0,715 g/passenger-km for BRT) and carbon mono oxid (CO) (0,0240 g/passenger-km for LRT and 0,0713 g/passenger-km for BRT) emission results [4].

Light rail vehicles produce less noise than diesel buses and much less noise than the equivalent volume of automobile traffic. Smooth, welded rails and vibration absorbing fasteners eliminate much of the noise we associate with rail travel. Moreover, the noise level in DTA Hamburg vehicle is 57 [dB (A)] on 40 (km/h) travelling speed and 63 [dB (A)] on 60 (km/h) travelling speed while speech noise level is 60-65 [dB (A)] due to DIN standards. So, it is clear that the noise level in LRT is in undisturbed noise level for passengers.

3. ALTERNATIVE SYSTEMS

Rail systems are one of the most popular solution type for city traffic. It is still discussed how useful the alternative systems (bus rapid transit, ultra light rail, etc…) to LRT. In this part general alternative rail systems have been introduced.

3.1. Sky train

The Sky Train at Dortmund University campus is a driverless transit system. Each Sky Train vehicle consists of one or two passenger cabins, each hanging on two bogies. These driverless vehicles are moved by the automatic low noise propulsion system with four solid-rubber tired support wheels per bogie at speeds up to 50 km/h.

Figure2. Driverless sky train in Dortmund University Campus [5].

3.2. Monorail, Maglev, Aerotrain

Monorail is a single rail serving as a track for a wheeled vehicle; also, a vehicle traveling on such a track. It occupies minimal space for vertically and horizontally. It is quiet, up and out of traffic. Moreover, it is not physically capable of derailing. On the other hand, it can not be built at grade, making exit in an urgent case. It is very expensive and costs $80-300 million /mile.

Maglev (Magnetic Levitation) is a new mode of transport, in which high speed vehicles are magnetically levitated and propelled along elevated guide ways. Maglev can transport passengers and freight over long distances at speeds of hundreds of miles per hour. On the other hand, the goal of the Aerotrain was similar to that of the magnetic levitation train: to suspend the train above the tracks so the only resistance is that of air resistance. Consequently, the Aerotrain could travel at very high speeds with reasonable energy consumption and noise levels, but without the technical complexity and expensive tracks of magnetic levitation.

3.3. Dual-Mode Vehicles (DMV)

Figure 3. Dual-Mode Vehicles

Dual-mode vehicles have generally preferred for carrying cargo. The dual mode vehicle shown in figure 3 has four rubber tires for road use and four steel wheels for the rails, and it is possible to go from road to rail and back again in a 15 seconds. While it drives just like a

bus on the road, the tires are raised by a hydraulic system and then it lowers the steel wheels as the driver guides the vehicle onto the tracks [6] .

3.4. Personal Rail Transit (PRT) Systems (Innovative Systems)

ULTra personal podcar

Vectus

Megarail

The Aerospace Corporation PRT System

Cabintaxi

Figure 4. Examples for Personal Rapid Transit (PRT) Systems [7- 9].

In this part it is possible to see innovative systems such as personal systems. For example podcars seen from figure 4 which are extremely energy efficient and produce about 20% CO_2 of what normal vehicle would use. The four person vehicle itself is battery powered and centrally controlled. Some of these systems have been still developed according to needs.

6. CONCLUSION

In this paper, the advantages of LRT systems have been explained and the alternative rail systems have been illustrated. It can be concluded that railway transportation have many advantages, such as energy efficiency, low air pollutant emission level, less space consumption and safety considerations. Rail systems have been preferred as an efficient solution system for traffic due to the explained reasons.

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