

# The purpose of long-distance passenger trains in public passenger transport system

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**Abstract:** Current economical trends create new requirements to population mobility. People always travel for many reasons and they are very dependent on the system of passenger transport. There are several modes of transport, but passengers mostly use road and rail transport. Passenger transport system is influenced by many qualitative factors with various impacts. Long-distance passenger trains have got significant position on the transport market, what represents demand and offer in the passenger transport system. These trains connects far places therefore transport accessibility in the region or country is better and passenger railway transport is more attractive for traveling public. This article is focused on main purpose of these trains from operational and economical point of view.

**Keywords:** railway transport, passenger transportation, long-distance trains

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## 1. Introduction

Passenger transport is generally considered as an activity, which arises as the consequence of spatial division of places, where people are in exact time and their need to move. Requirements for transport of passengers originate in their need to move, while the passenger transport is dependent on the willingness of travelling [1]. In passenger transport, there are mostly individual passengers, so it is difficult to determine all transport requirements. Passenger transport is divided into individual and public. Individual passenger transport includes walking, cycling and car transport. Public passenger transport includes railway, road, water, air, city and unconventional transport. From spatial point of view, passenger transport is divided into local, regional and long-haul, which is then divided into interregional transport (in one country) or international transport (among two or more countries) [2]. From economical point of view, passenger transport is classified into tertiary sphere – services. It means that there are not any material production values, but it is reflected in costs. In general, passenger transport has got a great social and political importance. Primary function of the transport system is providing transport for passengers on regional, national-interregional and international level [3].

## 2. Railway Passenger Transport in General

Key element in railway passenger transport is a customer – traveller, who requires the transport from one place to another. A basic precondition for accomplishing the main requirement – transport, is making the complete offer which provides not only transport, but also other associated services. Motivators for moving could be commuting – job or education, dealing with personal or working matters, traveling for vacation – hiking, sport, health, cultural and social facilities, visiting relatives and friends. From operational point of view, passenger transport is the sum of acts for providing mass transport of passengers which includes boarding, selling and checking the travel tickets, transfer of passengers' luggage, ensure all individual needs of passengers and organizing of other complementary services [4].

One of the most important roles of the railway passenger transport is providing transport services for passengers, who travel for long distances. There are various types of long-haul passenger trains, which jointly create integrated transport system. Quality of this transport system depends on train routes topology, timetable of trains, number and location of all stations, where these trains stop. Primary function of the transport system is providing transport for passengers on regional, national-interregional and international level [5].

### 3. Passenger Transport Quality Criteria

Practically, there are many associated criteria with passenger transport, for example safety, duration, price, reliability, comfort and complementary services. Safety is the dominant criterion and it is guaranteed normative by licences, permissions, certificates and verifications. Safety is measured by indicator of accidents per one billion passenger-kilometres [6].

Another criterion is transport duration, what means the exact time of passenger moves from one place to another and it is closely related with speed. It does not mean the speed of the transport vehicle, there are other periods, such as time to go from home to the station, time to buy the travel ticket, boarding time, transport time, time to get off the train and time to reach the destination point. In case, where the traveller combines the trains, time for waiting to another train is also counted. Very important criterion is transport price. It is dependent mostly on economic indicators. In market economy, there are three factors: costs, demand and competition. Other factors with significant impact are reliability, offer of travel possibilities, vehicle occupation and coherence of passenger transport system [5].

Travel comfort is also very important for passengers, especially nowadays. It consists of vehicle construction, interior hygiene, physiological and psychological influences. Subjective feelings and experiences has also great impact along with current mood of each passenger. Overall subjective feeling is the result of different conditions with different seriousness. Other complementary services with some impact to quality of traveling are services provided on board or in stationary facilities [6].

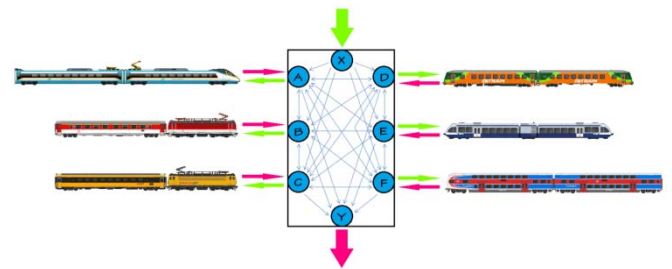
Entire quality is defined as an ability to satisfy all requirements of customers. Specific signs for services in transport are insubstantiality, impossibility to store, inseparability, variability, complexity and uniqueness. Level of service quality can be perceived as a disharmony among expectation and perception. Customers - passengers have got different priorities which are connected with quality of service. They usually remember low quality and high quality is a standard for them. The main challenge is to identify the passengers' needs and satisfy them in all cases because every transport is realized in different conditions [7].

### 4. The Importance of Different Types of Trains Connectivity

Long-haul passenger trains are intended to transport passengers mainly for long distances. Their routes usually connect regional centres with higher population. Regional passenger trains are adjusted to long-haul passenger trains transport system, therefore people from smaller towns and villages can also use long-haul passenger trains, which do not stop in their town or village.

According to long-haul railway passenger transport, the transport attendance in some area is dependent on accessibility of long-haul passenger trains in the centre of the area, and other transport hubs in this area. Transport hub is a place,

where passengers enter, change or exit the transport system. Considering to long-haul railway passenger trains, transport hubs are all stations and stops, where these trains usually stop. The route of the train consists of exact number of transport hubs. All transport hubs are characterized by localization and discesion. Localization is variability of transport hubs on the route, which means the exact number of stations and stops, where long-haul passenger trains stops. Discesion is mutual layout of transport hubs on the route to each other. Railway passenger station is some kind of transport hub – a starting and finishing point for flows of passengers. Passengers have the opportunity to change the train type from long-haul train to regional train or contrariwise or simply enter or leave the system of railway transport.



**Figure 1.** Simple scheme of railway passenger station with marked passenger flows there.

In the picture, there are illustrated flows of passengers between train types which arrive from different directions and depart to different destinations. Points A, B, C, D, E and F represent trains whereas point X represents input to the transport system and point Y represents output from the transport system where passengers use another mode of transport instead of railway transport.

In central Europe, there is a modern trend of establishing integrated passenger transport systems in selected regions. Cores of these systems are terminals, where passengers can change vehicle and also the mode of transport, for example get off the bus and get on the train. These terminals are hubs, whence all routes and lines from some region or district are connected. Building these new terminals will improve transport accessibility in the selected region. Operators, who participate in the integrated passenger transport system, are more effective and notice increased demand for transport services.



**Figure 2.** Integrated passenger transport terminal in Moldava nad Bodvou mesto, Slovakia [8].

Current trend is to optimize connectivity in railway passenger transport by reduction of transfer time – starting at home and finishing in the transport destination. It is important to synchronize arrivals and departures of all connected trains in all points, where passengers can get on, get off and change the vehicle. Minimizing of waiting time will increase quality of passenger transport in general. Particular emphasis must be put on reliability of all included vehicles, because delays could have serious consequences to the whole system. Preconditions for optimization of train connectivity in railway passenger transport are: dominance of passenger, timetable dependent on passengers' needs, synchronized arrivals and departures in all point in the transport system, harmonised conditions for all operators in the transport system, high reliability and punctuality [6].

## 5. Economic Impacts in Railway Passenger Transport

Railway passenger transport has to be evaluated from economical point of view. Basic evaluation method is operating costs calculation. Costs are financial representation of company sources consumption for realizing services per time. Internal costs of the transport company arise from operation of trains on railways. Thanks to calculation, the exact amount of these costs is known. In railway passenger transport, the calculation unit is the service – transporting of passengers. It can be defined by quantity (number of trains, vehicles), time (staff working time, time of traveling) or other way (passenger-kilometers, train-kilometers) [3].

In general, there are these costs: vehicle costs (price for vehicle, repairs and maintenance, insurance, operational cleaning), railway infrastructure access, staff costs (wages of vehicle-drivers and stewards), traction energy consumption and other indirect costs (management, marketing, travel ticket selling system, information system etc.). Sum of all costs, which are converted to one typified train on the route, is the base for making the tariff charges [7].

Railway vehicle costs are calculated this way:

$$r_{trkm}^{RV} \frac{D_Y + \Sigma RM_Y + OC_Y + INS_Y}{\emptyset \text{ annual vehicle kilometrage}}$$

where:  $r_{trkm}^{RV}$  – railway vehicle costs rate for train-kilometre [€/trkm];  $D_Y$  – depreciation of vehicle per year [€];  $\Sigma RM_Y$  – entire costs for repairs and maintenance of vehicle per year [€];  $OC_Y$  – entire costs for operational cleaning of vehicle per year [€];  $INS_Y$  – entire costs for vehicle insurance per year [€];  $\emptyset$  annual vehicle kilometrage – average kilometrage of railway vehicle per year [km].

$$C_{RV} = \Sigma trkm \cdot r_{trkm}^{RV} \cdot NRV_{tr} \quad (2)$$

where:  $C_{RV}$  – entire railway vehicle costs per route [€];  $\Sigma trkm$  – sum of train-kilometres per route;  $r_{trkm}^{RV}$  – railway vehicle costs rate for train-kilometre [€/trkm];  $NRV_{tr}$  –

number of railway vehicles in the train on the route [vehicles].

Staff costs are calculated this way:

$$r_{emph}^S = \frac{\text{price for working + equipment}}{\Sigma \text{ work time}} \quad (3)$$

where:  $r_{emph}^S$  – staff costs rate for employee-hour [€/emph] price for working – all month company's costs for the employee [€]; equipment – month costs for equipment of employee [€];  $\Sigma$  work time – entire month work time of employee [hours].

$$C_S = t_r \cdot CR_S \cdot S_{emph}^S \quad (4)$$

where:  $C_S$  – staff costs per route [€];  $t_r$  – train ride time [hours];  $CR_S$  – conversion ratio: train ride time  $\rightarrow$  employee-hour;  $r_{emph}^S$  – staff costs rate for employee-hour [€/emph]

Traction energy consumption costs are calculated this way:

$$C_{TEC} = \frac{\Sigma gtkm \cdot mc_{TE} \cdot S_{TE}}{1000} \quad (5)$$

where:  $C_{TEC}$  – entire traction energy consumption costs per route [€];  $\Sigma gtkm$  – gross-tons-kilometres per route;  $mc_{TE}$  – measurable consumption of traction energy per thousand gross-tons-kilometres;  $r_{TE}$  – traction energy rate [€]

From operating costs calculation, tariff rates can be appointed. The tariff reflects valuable relations among the operator and passengers. These rates have to include internal goals of the operator (increasing profit, decreasing costs, market share etc.), social sphere (quality and offer of public transport, reducing regional gaps etc.) and environmental aspects. Current transport demand and complementary transport offer are also important part of setting tariff rates.

## 6. Conclusions

The purpose of long-haul passenger trains is transporting passengers for long-distances. Together with regional passenger trains, they form the railway passenger transport system – basic part of the whole passenger transport system. This purpose of long-haul trains is influenced and evaluated from many points of view. According to passengers' will, transportation in long-haul trains should be safe, fast, cheap and comfortable. A great emphasis is put on connectivity with other types of trains to eliminate waiting time in stations or terminals, where passengers have to change the vehicle. It would also influence transport accessibility in some region. Economic aspects are stated operating costs calculation, what is necessary for operation of long-haul passenger trains in each route worldwide. Quality of the whole passenger transport system is dependent on effective operation and economics of the transport companies.

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