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## IMPACT OF SERVICE QUALITY ON TRANSPORT DEMAND IN INTERCITY TRAINS

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**Abstract:** For the specific traffic demand in passenger transport, railways respond by their offer of defined timetable. Various types and categories of trains are intended for different passenger profiles according to their needs for transport services and the length of their journey. Therefore, the result is profiling of railway supply in order to meet the market needs in a proper and competitive way. Intermodal competition, as result of liberalization of railway traffic, is forcing railway operators to increase the efficiency and attractiveness of their services. Increased efficiency is achieved with higher capacity trains, higher utilization of coaches and larger annual mileage of trains. All cars are expected to be flexible when it comes to their usage, which means that they have to be usable both for day and night operation, with minimum holdings in stations. This primarily refers to the introduction of appropriate traffic and commercial ranks of trains composed of adequate rail vehicles. In many European countries the words InterCity and Euro-City are official brand names for the network of regular-interval, relatively long-distance train services that meet certain criteria of speed and comfort and in most cases provide international services, due to the close proximity of the European countries. Passengers of EuroCity and InterCity trains require the highest level and standards of the transportation service; therefore, it is not acceptable to decrease passenger comfort by increasing the number of seats in any given coach. This paper will research in detail the needs, demands and level of service for the users of InterCity and EuroCity trains. Research data on the structure of InterCity passenger trains of the Croatian Railways will be presented, along with their travel habits and needs, satisfaction with services provided and suggestions for improving the service quality. The paper focuses especially on the categories of potential passengers who had not been using the rail for their travel needs, or had participated in it to a minor part. To achieve a better passenger load factor, the demands of a wide base of customers should be satisfied with carefully chosen equipment and interior design of each coach. The business travellers demand more privacy during their travel which ensures that they can work in peace, roomier seats and tables with AC connections for their laptops. For parents with little children it is necessary to have extra space for feeding and changing diapers, and also the coaches need to be adapted for easier entry and exit of baby carriages. Travellers with special needs require wheelchair-accessible trains and adapted onboard toilets; also, it is necessary for the train crew to be educated about their needs. Air-conditioning units must have antiallergenic filters installed for better air quality; trains have to have designated places for storing bicycles, and also special area for transporting pets. With modern concepts of interior design it is possible to increase the efficiency and to keep the required level of passenger comfort, especially for the trains which are used in night-time operations. Based on the processed data, a possible solution has been offered for the concepts and the equipment onboard the InterCity and EuroCity passenger coaches.

**Key words:** traffic demand, service level, interCity trains, passenger structure, passenger coach

## INTRODUCTION

The passenger flows in the Republic of Croatia can be divided into:

- ◆ international,
- ◆ national (inter-regional),
- ◆ regional,
- ◆ local (urban - suburban).

The railway has been responding to the traffic demand by its offer, defined by the timetable, and the ranking of trains for passenger transport is as follows:

- ◆ passenger (they operate locally and regionally),
- ◆ accelerated (they are used for regional connections),
- ◆ high-velocity (they connect regions, they operate also in international traffic),
- ◆ express (national and international traffic, this rank is fading out),
- ◆ InterCity (the highest rank of a train in national traffic, used to satisfy the interregional traffic demand, operates also in international traffic), EuroCity (the highest rank of a train in international traffic, daily train),
- ◆ EuroNight (night train, counterpart to the daily EuroCity train).

The mentioned trains are intended for different profiles of passengers. This results in profiling of the railway offer in order to respond in an adequate (competitive) way to the market requirements. This means in the first place the introduction of different traffic and commercial ranks of trains which are covered by different railway vehicles, motor coaches, railcars and compositions consisting of passenger and traction vehicles.

The satisfaction of passengers is affected by: clean transport service (time of travel, timetable, punctuality), comfort onboard train/coach (space design, attractiveness of the interior, seat comfort, spaciousness, lighting, noise level, quality of air-conditioning, adequately equipped toilet facilities, installed additional equipment), additional services onboard train, and services at departing/destination railway stations.

The international railway union (UIC) has defined three types of coaches: X, Y and Z. In their rolling stock the Croatian Railways have coaches of types Y and Z. In the majority of railway companies of Western Europe the rolling stocks consist predominantly of Z coaches. The passengers of IC/EC trains impose the highest requirements of the transport service, and therefore their desires and needs have been analysed in more detail. The paper presents the data on the requirements, satisfaction and the structure of the InterCity train passengers of the Croatian Railways obtained through the studies carried out in the field

## STRUCTURE OF INTERCITY TRAIN PASSENGERS AND THEIR REQUIREMENTS

The information about the users and other relevant knowledge necessary to create the business strategy has been acquired through market research carried out on the Croatian Railways trains.

The studies for the HŽ requirements were carried out on the trains that operate on Zagreb – Osijek – Zagreb, Zagreb – Vinkovci – Zagreb, Zagreb – Rijeka – Zagreb and Zagreb – Čakovec – Zagreb relations. The research was carried out in order to gather the data about the structure of passengers and their satisfaction with the new Aeelt and Bee coaches, certain trains, i.e. railway in general.

The data were gathered by survey methods and observation methods. The study gathered the attitudes of 1,008 passengers of Bee coaches and 116 passengers of Aeelt coaches.

There were 892 questionnaires collected on the InterCity trains. The study was carried out on all IC trains that operated according to the timetable in domestic traffic.

The analysis of the questionnaires of IC train passengers showed the following:

- ◆ IC trains are used by a slightly greater number of male persons (53.8%),
- ◆ IC trains are used mostly by young people from 15 to 24 years of age (32%), followed by the middle aged persons (35 – 49 years, 23%) and persons from 25 to 34 years of age (22%),
- ◆ the services of IC trains are most used by schoolchildren and students (30%) and employees (20%).

**Table 1: Age structure of the surveyed passengers**

AGE	15 – 24	25 – 34	35 – 49	50 – 64	65 and more
PERCENTAGE	32	22	23	18	5

The motivation for travelling of the surveyed passengers was mostly for business reasons (46%). Somewhat fewer passengers mentioned education as the reason for travelling (24%) and family reasons (17%). These are followed by medical reasons (10%) and tourist-recreational reasons (2%).

The passengers chose the InterCity trains for the following reasons:

- ◆ safety (24.4%),
- ◆ speed (23.3%),
- ◆ acceptable timetable (22.3%),
- ◆ comfort (15.7%),
- ◆ affordable prices (14.3%).

The passengers would be equally motivated for a more frequent usage of IC trains by lower prices and shorter travel times. A somewhat lower influence on the selection would be better timetable, more comfortable and higher-quality coaches.

The influence of prices on the selection of the transport means is understandable. A strong influence of the shorter travel time and better timetables on the more frequent usage of IC trains can be understood after comparing the timetables of bus carriers and the timetables of IC trains.

**Table 2: Comparison of timetables**

	SHORTEST TRAVEL TIME		LONGEST TRAVEL TIME		NUMBER OF DEPARTURES IN 24 HOURS	
	BUS	IC	BUS	IC	BUS	IC
ZAGREB – RIJEKA	2:15	3:17	3:00	3:23	25	1
ZAGREB – OSIJEK	3:50	2:53	5:40*	4:00	11	2
ZAGREB – VARAŽDIN	1:20	1:33	1:45	---	26	1

*\*only one line per day, the majority of buses travel the Zagreb-Osijek relation in 4 hours*

The table shows that the bus carriers mainly offer better service regarding speed and the number of departures than the InterCity trains of the Croatian Railways. The difference is so obvious that they outshine even, as a rule, more comfortable trains, that is, the difference in comfort is not sufficient to make passengers use the slower trains with fewer departures. Therefore, it is easy to understand why the passengers assessed the more comfortable and higher quality coaches as a less important motivation to opt for the IC trains.

## PASSENGER SATISFACTION WITH MODERNIZED HŽ COACHES

The aim of the study about modernised coaches was to find out how successful the reconstruction has been, i.e. what is the level of satisfaction of the passengers with the coaches themselves.

For **Aeelt** coaches the following data have been obtained:

- ◆ 82% of passengers are satisfied with the comfort of Aeelt coaches;
- ◆ 89% of passengers are satisfied with the interior;
- ◆ the comfort of seats satisfies 71% of passengers, and does not satisfy 23% of passengers;
- ◆ 65% of passengers are satisfied with the leg space, 31% of passengers are not satisfied with it;
- ◆ 82% of passengers are satisfied with the air-conditioning system;
- ◆ 81% of surveyed passengers are satisfied with the spaciousness of the baggage storage racks;
- ◆ 75% of passengers are satisfied with the toilet facilities;
- ◆ 84% of passengers are satisfied with the lighting;
- ◆ 53% of passengers are satisfied with the public address system, and 41% are not;
- ◆ 51% of passengers assessed the new coaches as much better than the old ones;

- ◆ 29% of passengers assessed the new coaches as better than the old ones;
- ◆ 5% of passengers assessed the new coaches as equally good as the old ones;
- ◆ 9% of passengers assessed the new coaches as worse than the old ones;
- ◆ 3% of passengers assessed the new coaches as much worse than the old ones;
- ◆ 44% of surveyed passengers like to travel in coaches both with and without compartments;
- ◆ 32% of passengers prefer coaches with compartments;
- ◆ 23% of passengers prefer to travel in coaches without compartments.

For **Bee** coaches the following data have been obtained:

- ◆ 66% of passengers are satisfied with the comfort of Bee coaches;
- ◆ 31% of surveyed passengers are not satisfied with the comfort;
- ◆ 81% of passengers are satisfied with the interior;
- ◆ 68% of passengers are satisfied with the comfort of seats, and 29% of passengers are not;
- ◆ 44% of passengers are satisfied with the leg space;
- ◆ 52% of passengers are not satisfied with the leg space;
- ◆ 67% of passengers are satisfied with the air-conditioning system;
- ◆ 28% of passengers are not satisfied with the air-conditioning system;
- ◆ 73% of surveyed passengers are satisfied with the spaciousness of the baggage storage racks;
- ◆ 22% of passengers are not satisfied with the baggage storage racks;
- ◆ 75% of passengers are satisfied with the toilet facilities;
- ◆ 89% of passengers are satisfied with the lighting;
- ◆ 64% of passengers are satisfied with the public address system and 29% are not;
- ◆ 42% of passengers assessed the new coaches as much better than the old ones;
- ◆ 35% of passengers assessed the new coaches as better than the old ones;
- ◆ 10% of passengers assessed the new coaches as equally good as the old ones;
- ◆ 8% of passengers assessed the new coaches as worse than the old ones;
- ◆ 4% of passengers assessed the new coaches as much worse than the old ones;
- ◆ 56% of passengers prefer coaches with compartments;
- ◆ 31% of surveyed passengers like equally to travel in coaches both with and without compartments;
- ◆ 12% of passengers prefer to travel in coaches without compartments.

Great satisfaction with the interior of Aeelt and Bee coaches shows that the passengers have recognised an improved approach to the visual design of the coaches. Until the introduction of new coaches the interior design had not been standardised. High percentage of passengers not satisfied with the leg space and comfort of seats shows that the passengers expect the trains to provide spaciousness and greater comfort than other transport means.

#### **POTENTIAL INTERCITY TRAIN USERS**

The market research has resulted in data which show that mostly young people, between 15 and 24 years of age (32%) travel by HŽ IC trains. These are followed in the number by the middle-aged passengers (35 to 49 years – 23%) and passengers in the age from 25 to 34 (22%). At the same time, only 5% of passengers are in the age of 65 and more.

The predecessors of InterCity trains, the business trains, had been mostly used by business passengers, as their name tells us. Only 2% of passengers opted to travel by train due to tourist-recreational reasons.

The HŽ services are almost never used by the passengers with special needs, which means that these passengers do not use IC trains either.

Based on the obtained data the following are the potential users of the services provided by the Croatian Railways:

- ◆ business passengers: the centralisation of the government is the cause of a large number of business trips between the rest of Croatia and Zagreb. The number of potential business

passengers is impossible to determine. A major barrier to greater usage of IC trains to business passengers is the travel time and inadequate timetable. Nevertheless, one has to keep in mind that these limiting factors will be eliminated over time and with the reconstruction of coach interior they will be designed so as to be attractive to business passengers. This refers primarily to the 1<sup>st</sup> class coaches, which have to provide more privacy and allow undisturbed work. Such coaches need to be fitted with roomy seats and tables, wardrobes and a number of electrical connections.

- ◆ tourists and recreational tourists: it is important to consider as potential users also the mountaineers and cyclists. A great part of railway line routes in RH pass along the regions interesting to tourists. The advantage of the railway lies in the fact that the tourists do not have to return to the same place, which cannot be avoided when using a car. And while mountaineers have no special requirements regarding the coach design, the cyclists need special compartments for the storage of bicycles.
- ◆ commuters: the change of working habits and the need for greater working mobility result also in the possibilities of commuting from the city of residence to the city of work. In Western Europe and the USA this phenomenon is widespread so that the individuals commute for even more than 100km to the city where they work and back. In order to make this possible the trains have to provide a very reliable timetable and high speed without stopping at local stations. The interior of the very coaches has to satisfy all the conditions that are required by the business passengers.

## CONCLUSION

The passengers require from the railway good timetables, short travel times, safe, comfortable and pleasant coaches at affordable fares. The railway operators require that the railway vehicles be universal, to have low operating, maintenance and cleaning costs, along with their affordable purchasing price.

All the mentioned requirements refer also to passenger coaches. In short, the requirements include:

- safety,
- high reliability and simple and inexpensive maintenance,
- flexibility and applicability to a wide circle of users.

Greater intermodal as well as intramodal competition (because of the oncoming liberalisation of railway traffic) forces the railway operators to increase the efficiency and attractiveness of their services which is achieved by higher vehicle capacity, higher usage of vehicle capacity and greater number of the travelled kilometres annually. The increase in the vehicle capacity affects also greater productivity, but caution is necessary not to disturb the necessary comfort by the increase in the number of seats, and thus reduce the interest of the potential users. In order to achieve maximal usage of the capacity (occupation rate) of the coaches, it is necessary to satisfy by interior design the requirements of all or the majority of passenger profiles. For everything mentioned it is necessary to develop a new concept of interior design. A modern interior allows more flexible usage of coaches by increasing the efficiency and retaining the necessary level of comfort required on the market. The coach concept has to enable the usage of coaches equally in day and night traffic operation. The research carried out in Croatia shows that the Croatian Railways passengers prefer coaches with compartments. A compromise solution is the introduction of coaches with several bigger compartments that would provide the passengers with sufficient privacy. This would at the same time enable travelling of smaller groups. Certain seats can be separated by light partitions instead of heavier bulkheads such as used in classical coaches with compartments.

The seats have to satisfy all the ergonomic requirements. The 1<sup>st</sup> class seats that are used in new HŽ coaches do not deviate to any large extent in dimensions from the seats installed in TGV and ICE trains. The seats in the mentioned high-speed trains are fitted with pneumatic mechanisms for changing the seat pitch, with built-in LCD monitors, headphone connections, electrical connections for portable computers, big foldable tables, glass holders. A litter bin is built in the seat backrest. The seat backrests contain also the nets for the newspapers. The headrests are provided with the height-adjustable small pillows. The mentioned equipment (with the exception of the LCD monitor) has to be accommodated in the seats of the IC train coaches. It is useful to install a seat rotating mechanism.

This allows a more flexible arrangement of seats, depending on the passengers' desires and easier maintenance (cleaning).

The storage of luggage should be solved by baggage storage racks within the passenger space and by baggage lockers at the beginning of the coach. In the 2<sup>nd</sup> class coaches the possibility of installing lockers in the passenger space as well should be considered. Instead of the lockers at the beginning of the coach, it is useful to install lockers under locks. A large number of passengers do not use any additional train facilities (toilet, restaurant) because of fear of luggage theft. In the first class the lockers should be installed in order to prevent crumpling of clothes hooked up next to the seat (target 1<sup>st</sup> class users are business passengers).

Apart from the main lighting, all the seats have to have reading lights. In the first class seats the light installed on the seats would be useful, and it could be used by the passengers independent of the position of the backrest (it is useful to apply the experiences from the first class and the business classes of air carriers). The use of coaches without compartments in night trains would be facilitated by the lights installed in the seat base. The adjustment of trains to various categories of passengers can be achieved by equipping of special compartments. For passengers with small children the compartments with playrooms have to be designed. If there is no great interest in playrooms, in the coaches without compartments the seats can be removed as necessary, and they may be replaced by mats and toys for children (similar example is converting passenger aircraft into freight aircraft). The coaches need to ensure also space for changing diapers. Such space should be equipped by a table, hot water, dirty diaper bins and bottle heaters. It would also be useful to have a space for breast feeding next to the room for changing diapers. For normal travelling of passengers in wheelchairs it is necessary, apart from satisfying the requirements for reduced-fare documents, to ensure also electrical connections for wheelchair battery charging. Due to different heights of platforms it is currently more difficult to realise the construction of unified elevators / platforms which would make it possible for the persons in wheelchairs to board the train. Currently, there are no elevators for persons in wheelchairs who could handle them independently. For other categories of persons with special needs it would be sufficient to install high-quality information systems, either visual or auditive.

Monitors properly arranged along the coach without compartments would serve to provide information on the train, timetable, railway operator services (there is the possibility of providing precise position of the train owing to the GPS system, current train velocity, etc.). For the persons with impaired vision a high-quality public address system should be organised. Besides, on certain (standardised) places it is necessary to set up notices in Braille alphabet. For recreational tourists it is necessary to provide a space for the storage of bicycles/skiis. Attractive design, comfortable and spacious ambient, low level of noise and smooth coach running are understood implicitly. In the coach interior high-quality materials have to be used, resistant to dirt and damage. Simple maintenance and cleaning (the drawback of the new HŽ coaches) reduces the necessary staying of coaches, i.e. increases the availability. The difference in coach classes has to be obvious. Because of the identification on the market the visual identity of the railway operator has to be applied not only on the external painting of the coaches but also on the solutions of the interior.

With all the mentioned interventions the railways would successfully respond to the challenge of converting different categories of passengers into the actual traffic demand. Moreover, the more flexible coaches would additionally reduce the operating costs.

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## **ВЪЗДЕЙСТВИЕ НА КАЧЕСТВОТО НА ОБСЛУЖВАНЕ ВЪРХУ ТРАНСПОРТНИТЕ ПОТРЕБНОСТИ В МЕЖДУГРАДСКИТЕ ВЛАКОВЕ**

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**Резюме:** Тази статия е резултат подробно проучване на нуждите, изискванията и нивото на обслужване на потребителите на междуградски и влакове Евросити. Данните от изследванията върху структурата на междуградските пътнически влакове на хърватските железници са представени заедно с навиците и нуждите за пътуване, удовлетвореност от предоставяните услуги и предложения за подобряване на качеството на услугата. Докладът е насочен по-специално към категориите на потенциалните пътници, които не са използвали железниците за своите транспортни потребности или са пътували по-малко. За да се постигне по-добър фактор на натоварване на пътници, трябва да бъдат изпълнени изискванията за широка база от клиенти чрез внимателно подбрано обзавеждане и интериорен дизайн на всеки пътнически вагон. Бизнес пътниците изискват повече лично пространство по време на пътуването си, което гарантира, че могат да работят спокойно, на просторни седалки и маси с електрозахранване за своите лаптопи. За родителите с малки деца е необходимо да има допълнително пространство за хранене и смяна на пелени, и вагоните трябва да бъдат адаптирани за по-лесно влизане и излизане на бебешки колички. Пътуващите със специални нужди се нуждаят от влакове с достъп за инвалидни колички и адаптирани тоалетни, също така е необходимо персоналът на влака да бъдат обучен за техните нужди. Климатизиците трябва да имат инсталирани антиалергични филтри за по-добро качество на въздуха, влаковете трябва да има определени места за поставяне на велосипеди, а също и специална зона за транспортиране на домашни любимци. Със съвременните концепции за интериорния дизайн е възможно да се повиши ефективността и да се поддържа необходимото ниво на комфорта на пътниците, особено за влаковете, които се използват за експлоатация през нощта. Въз основа на обработените данни се предлага възможно решение за концепция и оборудване на пътническите Интерсити и Евросити влакове.

**Ключови думи:** транспортни потребности, равнище на обслужване, междуградски влакове, пътнически структура, пътнически вагон.