

## BASICS FOR EFFICIENT RAILWAY INTERIORS

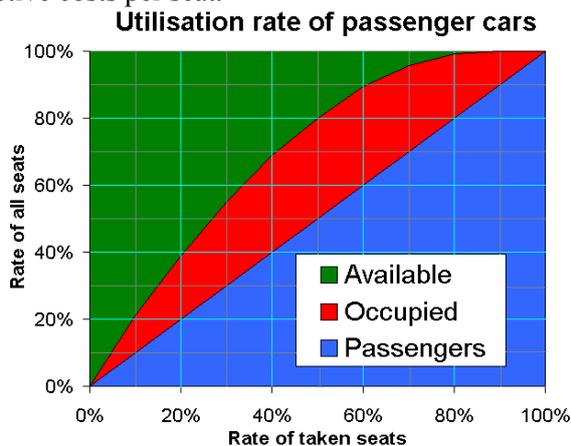
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*Abstract – In order to increase the efficiency of passenger wagons, there is a trend towards maximising the amount of seats per wagon. Extensive research by the Institute for Railway Engineering of the Vienna University of Technology points out that maximising the number of seats does not lead to an increase in efficiency, but instead reduces the actual utilisation rate of wagons.*

**Key words:** *passenger behaviour, luggage, utilisation rate, passenger cars, efficiency, interiors*

### 1. INTRODUCTION

Efficiency of long-distance public transport usually means increasing the number of passengers at no extra expense in order to minimise the costs per traveller for the railway company. This concept of efficiency is also found in the manner of constructing coaches where providing a large number of seats per wagon increases the capacity. This approach minimises the effective costs per seat.



*Fig. 1: Actual Utilisation Rate of Passenger Cars*

This idea seems to be theoretically correct but cannot and does not take into account practical considerations. This situation is shown by an extensive investigation of Austrian long-distance trains by the Institute for Railway Engineering of the Vienna University of Technology\*.

Many ways of using available space in rolling stock usually disregard the actual behaviour of

\* These findings were based on a survey of over 13,000 passengers in Austrian and international long-distance trains and approximately 2,000 holiday makers that travelled by car as well as several hundred observations and measurements in passenger trains.

passengers. If the passenger behaves differently from the assumptions of the manufacturer, the theoretical utilisation of the car will not be achieved.

In today's commonly used passenger cars, the actual utilisation rate is about 20% lower than intended due to ignoring passengers' behaviour (see Fig. 1). Even at a utilisation rate of 80% there are no more free seats to be found.

### 2. REASONS FOR LOWER UTILISATION RATES

Reasons for lower utilisation rates are passengers' demands of comfort and resultant behaviour.

If the passenger is not satisfied with the provided environment, he will try adjusting the situation by achieving a comfort zone for themselves. This is done mainly by occupying additional/adjoining seats.

For example, if individual people or groups don't want to be disturbed, nearby seats will be artificially 'reserved' by luggage, clothes or other personal items; or if passengers want to be even more comfortable, they will put their legs on the seat opposite. These are only two examples of how demands of comfort can reduce the number of available seats.

The parameter which influences the actual utilisation rate most significantly is luggage and travellers' behaviour caused by luggage.

### 3. REQUIREMENTS OF MODERN RAILWAY INTERIORS

In order to be able to arrange interiors efficiently, one has to pay attention not to optimizing individual ranges but to search for a total optimum. Therefore it is necessary to know exactly about the customer's needs as well as the actual behaviour of the passengers. From the investigations carried out by the Vienna University of Technology, the following basic rules can be derived which have to be kept in mind for

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designing efficient interiors.

### 3.1. Size of passenger groups

Individual persons or passenger groups do not usually want to be disturbed by other travellers. Therefore it seems to be worthwhile to take into account the sizes of groups. Only if sufficient space and appropriate seclusion is granted to each traveller or passenger group will one expect that further seats are not 'blocked' as a way of protecting a passenger's privacy.

### 3.2. Luggage racks

Although a sufficient number of luggage racks are provided in most passenger wagons, misplaced luggage often results in obstructing travellers or the railway staff. Another possibility is putting the luggage nearby or on the seats, which reduces the actual utilisation rate by about 50%.

There are different points of view regarding the storing of luggage because passengers have different behaviour and requirements than manufacturers expect. Railway carriage designers try to maximise the number of seats in order to increase capacity. This however leads to the fact that valuable luggage deposit areas are reduced and therefore in many passenger train carriages only overhead racks are available.

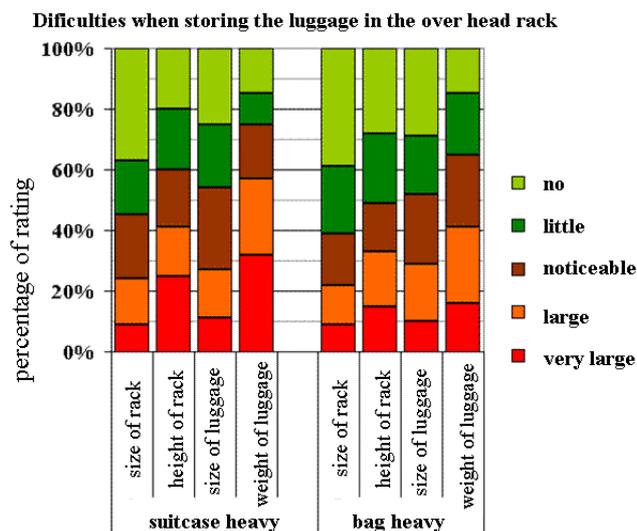


Fig 2: Difficulties when storing luggage

However, the majority of the travellers want to avoid lifting their luggage and prefer to store it at ground level. Even on days with high passenger volumes, a large number of luggage items are deposited on the floor, in the corridor, in front of or even on the seats. This leads to the fact that, as a rule, a maximum of only 80% of all seats are actually available for travellers. All other passengers have to either stand or sit on their suitcases. This does not only constitute a safety risk, it also contradicts all

requirements for comfort (see fig. 3)!

For heavy luggage items, more than three quarters of the travellers indicate having had a medium to high level of difficulty when putting their luggage in overhead racks. Also the height of the rack gives rise to more than 50% of the problems. Even when lifting medium sized luggage, 40% of travellers have had problems. (compare to fig. 2).

These difficulties also lead to the fact that on main travel days, 40% of the heavy luggage items are left on the floor, on, in front of, or between the seats. Also, approximately 40% of medium-sized luggage items and even 60% of hand baggage are not deposited in the places planned for it.



Fig 3: Passengers avoid lifting their luggage – the overhead rack is partly empty, luggage is stored in the aisle and on seats, passengers have to stand or sit on a suitcase

### 3.3. Space requirement for luggage depositing

As a rough approximation, a luggage storage possibility of at least 25 x 75 x 40 cm (W x L x H) and up to 35 x 100 x 60 cm per traveller at ground level must be offered!

## 4. COMPARISON OF TWO CONTRARY RAILWAY INTERIORS

In Fig. 6a and 6b, two types of interiors are given as examples. These are compared with each other with regard to the luggage storage possibilities and to the behaviour of passengers:

A 2<sup>nd</sup> class open saloon coach of the ÖBB (Austrian Federal Railways) (Fig 4) has two seats on one side of the aisle and one seat on the other side and these seats are arranged in a position facing each other. This arrangement is compared to a 2<sup>nd</sup> class open saloon IC/EC-wagon of the DB-AG (German Railway Company), having the majority of the seats in rows (Fig. 5) all facing the same way.

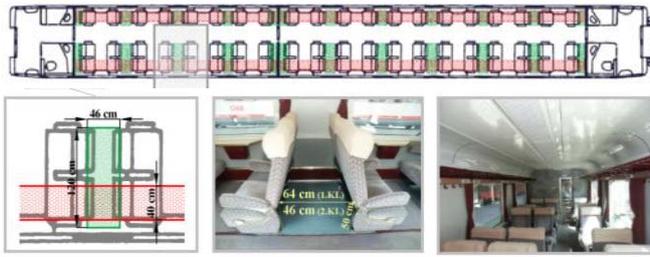


Fig. 4: 2nd class saloon coach of the ÖBB

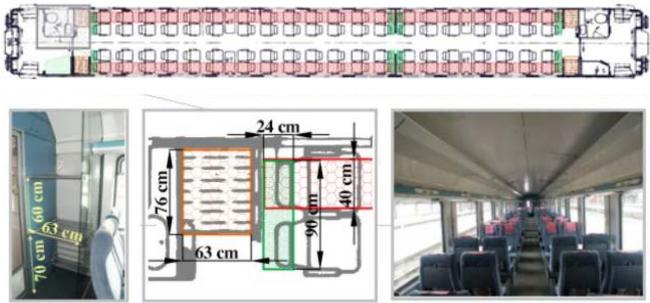


Fig. 5: IC/EC saloon coach of the DB-AG

In the ÖBB coach there is enough space for putting the luggage on the floor between the seats, whereas in the DB coach you can only find luggage racks overhead and at both ends of the carriage. On closer examination of the actually observed behaviour of the travellers in these two railroad car types, it becomes clear that where sufficiently storage possibilities on the floor are present, only a little more than one third of the luggage items are stored in the overhead rack (see Fig. 6, 6a and 7).

In wagons which practically only offer overhead racks, up to a third of the luggage items are still not stored there, but in places not planned for the luggage where it frequently disturbs other passengers.

proportion: storage possibility - usage

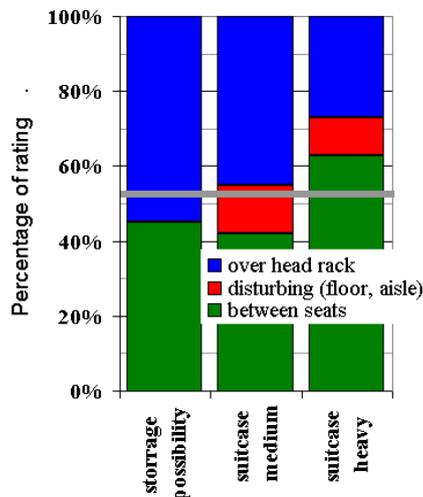


Fig.6a: ÖBB open saloon coach (type 4010); Storage possibilities - actual availment

proportion: storage possibility - usage

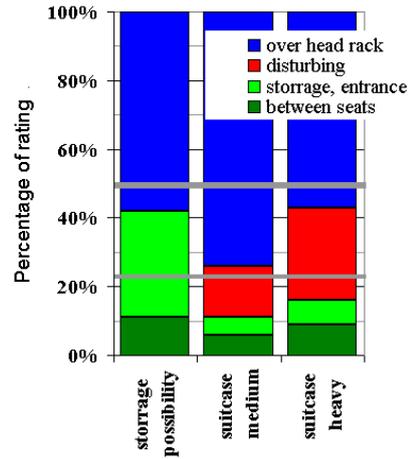


Fig.6b: DB-IC/EC open saloon coach; Storage possibilities - actual availment

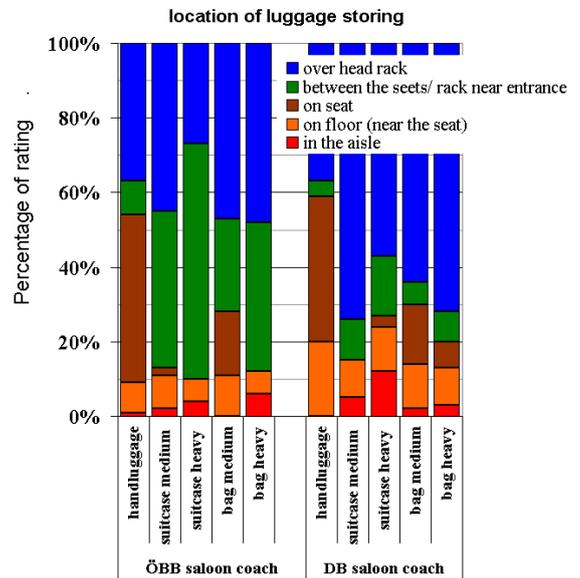


Fig. 7: Actual behaviour: luggage stored by travellers

### 5. PASSENGER BEHAVIOUR - CONCLUSIONS FOR EFFICIENT RAILWAY INTERIORS

The following behaviour of the passengers and also customers' requests are shown by observations and surveys/questionnaires:

#### 5.1. High acceptance of luggage racks on the floor or at floor level

If travellers are able to store their luggage without having to lift it, they will for sure do this. If however travellers are in fact forced to lift their luggage, a majority of the luggage (above all for the heavy items) will be placed in a manner such that it often restricts other travellers and the railway staff (see fig. 3, 6a, 6b and 7). With fully occupied compartments, up to 20% of the luggage items are left in the side corridor. This is an average of one to two suitcases per compartment.

This does not only impair the passengers but also the guard or ticket inspector, and also of course the mobile on-board food & drink service! Therefore offering a sufficient amount of luggage storage possibilities at ground level is also important for compartment coaches.

### 5.2. Visual contact of their own luggage

Passengers obviously want to see their luggage at all times for security reasons. This is clear when looking at the DB wagon (see Fig. 6b). About a quarter of all luggage racks in this type of railroad car fulfil the comfort criteria of those at ground level, yet these are used only for approximately 5% of all luggage items. This is because the luggage racks are located near the entrance and they cannot be constantly observed by the passengers.

### 5.3. Desire for taking luggage along in the train

About 80-90% of the travellers would like to take their luggage along with them into their compartment or a distance close enough to keep an eye on it. Only with vacation trip journeys, which comprise only 12% of all train travel, can up to 40% of all travellers imagine alternative luggage transport systems such as registered luggage or check-in systems such as at airports.

## 6. SUMMARY - CONCLUSIONS

These findings point out that it is essential for the design of railway interiors to aspire to a total optimum. Each attempt to optimize only a certain domain leads to lower efficiency. **A maximisation of seats without contributing to the aforementioned considerations will always cause a reduction of utilisation!** However, by removing a few seats and instead offering sufficient luggage rack options that will be accepted by customers, a majority of the currently unusable seats would be available and thus the rate of utilisation increases!

Moreover, if the group sizes are taken into consideration and storage possibilities for clothing (coats, hats, etc.) and pieces of hand baggage are also offered, even more currently blocked seats will be available. Efficiency and attractiveness are therefore not compelling contrasts, but valuable additions. Design of attractive railway interiors for passengers maintains more available seats and simultaneously increases the actual utilisation rate!

Furthermore it must not be forgotten that two thirds of non-rail users assess the current situation of luggage transport as a substantial reason for not using the train. Even if only a small amount of the non-rail users can be won as new customers, it will inevitably increase the utilisation rate. In consideration of all these criteria, appropriate customer friendliness also

affects increasing efficiency of the railway company, whereby attractiveness leads to an increase of the effectiveness and does not limit it!

## REFERENCES

- [1] All datas are taken out from an investigation done by the institut for Railway Engineering of the Vienna University of Technology.
- [2] Rüger Bernhard, Reisegepäck im Eisenbahnverkehr, Dissertation 2004.