REGIONS HAVE THEIR SAY WITH REGIOLIS

BOOSTING PAINTING EFFICIENCY
ENHANCED METHODS & EQUIPMENT

WI-FI ON TRAINS SPREADING
FROM EUROPE ACROSS THE WORLD

RCAS RAIL COLLISION AVOIDANCE SYSTEM

ERTMS SAFETY & PERFORMANCE
A STATISTICAL APPROACH

EUROPEAN LEGISLATION, STANDARDS & RESEARCH

RUSSIA RAMPS UP & SOCHI IN TRAINING
Local to European

Territorial collectivities are increasingly conscious of the notion of sustainable development and the need to consolidate local economies, as well as boosting their appeal. They are rightly concerned that limited rail links risk depriving them of access to Europe’s rail freight network. In this context, they are keen to adopt initiatives to reclaim freight traffic by way of cooperation. There is a need to clearly distinguish two levels of rail organisation that should be made to function hand in hand – one that is highly industrialised and favours growth in rail productivity at a European level, and another, more firmly established and ‘closer-to-home’, to ensure maximum flexibility and the seamless flow of local traffic. These structures have yet to see the light of day in the current European framework, still characterised by a wide diversity of territories and activities. The idea is to encourage greater proximity between rail transport and sectors of activity, encouraging more partnership-orientated approaches to boost the reliability of offers and productivity of rail resources. The notion of a local rail operator with a strong foothold in the local economy is starting to take hold. Sustainable development has become much more than just a concept to seduce the media and the public. Companies are well aware that under the growing pressure of public and consumer opinion, plus the impacts of development across the globe, sooner or later economic players are going to feel the squeeze. And this ‘squeeze’ is likely to open up new markets. Indeed, anticipating these changes may well prove a smart decision. Hence the reason many companies are keen to be well connected to the rail freight offer, particularly since it is drawn towards networks supplying Europe’s economic space. The risk of part of the regional territories being sidelined from Europe’s rail scene is only too real. And so awareness is growing among local actors of the importance of stepping up the number of trains operating on their networks to keep their economies in good health. At the same time such a move will also encourage a welcome modal shift from road to rail. The recovery of rail freight is an economic issue for all companies, which will otherwise continue to struggle to survive without the lifeline of access to Europe’s network. Important too, if the sector finds its feet again, society as a whole is set to reap the benefits.

Jean-Yves Jadot
NOTICE BOARD
8 Railway events in Europe 2011

INTERIORS
12 Passenger behaviour & vehicle design
18 Boarding for all

FOCUS / MODELLING
26 Prototypes, mock-ups & models – a magic world in the making

VEHICLES
30 SNCF puts B30 to the test
40 EURAXLES – keeping European railways rolling
46 Addressing the fundamentals of rail freight
50 Track defects – the never-ending story for vehicles
54 Winterisation – learning from cold experience
60 Regions have their say with Regiolis
66 KTX technology & speed for South Korea
68 Driver training – into the blender
74 Interview with André Navarri, president, Bombardier Transportation

FOCUS / FIRE
80 Transfeu – a European step forward for engineering fire control

SURFACES
84 Boosting painting efficiency through enhanced methods and equipment
88 Imag’in the train of the future
92 Preparation – key to high-quality coatings for aluminum car bodies

SAFETY & TESTING
98 RCAS rail collision avoidance system
102 Breaking glass

SERVICES
104 SUBITO takes CCTV one step further
106 CELTIC BOSS ups commuter security with advanced surveillance technology
108 Passenger information – the future is round
112 Ticketing distribution & sales with Amadeus
114 Box TGV comes to France
118 Wi-Fi on trains spreading from Europe across the world
118 Eurostar caters across the Channel
SUMMARY [2/2]

- STATIONS
  120 More space & better flow at Gare de Lyon Paris

- INFRASTRUCTURE
  124 Changeovers between security equipment at borders – a key to interoperability
  130 ERTMS safety & performance – a statistical approach
  140 €310 million for 20 minutes – France & Switzerland move closer
  146 Lowering track lifecycle costs with sleeper pads
  148 Interview with Hendrik Abma, executive director, EIM
  152 Network Rail opens longest domestic passenger line in Scotland
  158 Russia ramps up & Sochi in training
  162 Railvolution in Israel
  166 Power swings come to rail

- NOISE
  168 European legislation, standards and research

- FREIGHT
  172 Electric motorised platforms offers attractive alternative
  176 TIGER eyes the bigger picture

- TUNNELS
  178 Interview with Jacques Gounon, managing director, Eurotunnel Groupe
  182 Gotthard Base moves mountains

- WEB DIRECTORY
  186 Find your way

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First case is highly inefficient. Not more than 80% of the seats offered can be taken, the dwell time may triple and safety risks will rise. However more efficient vehicles can be designed by taking actual passenger behaviour into account. This is the conclusion reached by Vienna University of Technology (TU Vienna), following 10 years of studies by its Research Centre for Railway Engineering.

Passenger vehicles can be divided into three areas with different influences on passenger behaviour. Firstly immediate access, secondly the entry area and thirdly the passenger saloon. The general design of all three decides whether the wagon or the whole train can be operated efficiently or not.

**Access**

Too narrow doors, too steep and too many steps cause difficulties especially for the elderly, handcapped or simply for passengers with luggage, prams or bicycles. With regards boarding trains in various situations, i.e. different vehicles combined with different platforms, the problems faced by passengers can be categorised as following[1]:

There are two alternatives for designing passenger vehicles. One possibility is to try to obtain the maximum number of seats per wagon in order to increase capacity; the other is to take care of passengers’ needs and expectations.
Cat 1: level boarding, one stair step max.: travellers of all ages, with or without luggage, rarely have difficulties.

Cat 2: access with two stairs, wide doors and stairs with flat angles: travellers with luggage independently from age rarely struggle when accessing the vehicle. Nevertheless more than 10% do have severe and very severe difficulties, of which 7% need assistance.

Cat 3: access with UIC wagons and related trains (three steps from platform): Between 10-15% of travellers have difficulties or a lot of difficulties when accessing the train without luggage and 25-30% when carrying luggage. Whereas only between 1 and 2% need assistance for themselves, more than 10% need assistance for their luggage.

Cat 4: old-type vehicles, steep stairs (three to four steps from platform): 20-30% of travellers do have difficulties and severe difficulties without and 50% of travellers with luggage. Approximately 20% of travellers with luggage do need assistance. Approximately 8% of the 40 to 59-year-old group, and approximately 20% of the over 60-year-old group, require personal assistance when accessing the vehicle.

Perfect entrance solution: level boarding, wide doors, divided passenger flow.
Figures 1 to 4 illustrate the combinations and connections between parameters such as access type, luggage and passenger age:

**Fig. 1. Difficulties encountered by passengers WITHOUT luggage when accessing trains**

![Diagram showing difficulties encountered by passengers without luggage when accessing trains.]

**Fig. 2. Difficulties encountered by passengers WITH luggage when accessing trains**

![Diagram showing difficulties encountered by passengers with luggage when accessing trains.]

**Fig. 3. Assistance required when boarding with luggage, based on different access categories**

![Diagram showing the ratio of railway passengers requiring assistance with their luggage when boarding based on access category.]

**Fig. 4. Personal assistance needed when boarding, based on different access categories and age**

![Diagram showing the ratio of railway passengers requiring assistance to access train based on access category and age.]

Surveys clearly reveal that the majority of travellers have no trouble when using an access without a step or even just one. However, negotiating two steps with luggage is more problematic.

To speed up passenger flow in stations to gain shorter dwell times, the most comfortable access possible must be provided – in the best case level boarding, in the worst, two, non-steep steps and wider doors (at least 90cm). In addition to the operating benefits, customer satisfaction will rise too.

**ENTRY AREA**

This must also function as retention area. Here a ‘long’, rather than a ‘wide’ space is needed since passengers always walk in a row. It is more important that about 5 to 10 passengers can wait and walk in a row before reaching the passenger saloon.

For example, in compartment coaches passengers normally need to walk further to reach the first compartment, but also many trains such as the German ICE have a longer route at least at one car end because of the toilets. Even more effective entry areas are those leading to a division of the passenger flow; as occurs in the old, Danish IC3 multiple units or generally in double deck trains.

A missing retention area causes an earlier passenger tailback from the passenger saloon plus dwell times may rise considerably. Vehicles with well-designed entry areas and the possibility of passenger flow division deliver shorter dwell times than conventional wagons. This time difference can be up to 100%.

**PASSENGER SALOON**

This is the area in a train where most design mistakes can be found. A too narrow aisle, too little space for luggage and a uniform adjustment of seats lead to trouble with passenger flow, strongly reduce the number of available seats and increase passenger dissatisfaction.

**PASSENGER BEHAVIOUR, DIFFICULTIES, NEEDS & EXPECTATIONS**

Passengers behave differently depending on their age, group size, gender and especially luggage. Most travellers on high-speed or long distance trains have luggage. This circumstance is not taken into account in most of the trains in service today. Approximately every passenger has one medium or large bag, plus hand luggage. Regarding luggage storage, this raises two points:

- passengers do not want to lift up their bags
- passengers want eye contact with their bags

The fact is that for each passenger approximately the space for one item of luggage must be offered. Otherwise travellers will store their belongings on or in front of seats, in the aisle, etc. This occurs not only when there is no or insufficient space for the luggage but also when storage is badly designed. As mentioned above, passengers must not be coerced into lifting up their bags. Most of them won’t do it. Similarly they want to keep an eye on their possessions. And if they can’t, they will once again store it close by. Both facts result in the following behaviour – if there are
no luggage racks nearby offering comfortable storage, passengers will store all their belongings, including large items, close at hand on the floor.

Interior designs providing unsuitable and insufficient space for luggage will increase dwell times because of a rapidly forming tailback caused by bags in aisles, as well as passengers trying to store them in the overhead rack and blocking the path of others. So where is the ideal space for storing luggage? Two possibilities are efficient and appreciated by travellers:

- Luggage racks in the saloon
- Space between seat backrests

To meet the need for eye contact, the racks must not be in the entry area. Passengers also hardly ever use them if the wagon is fully occupied and there is no space for bags in the saloon. Additionally, racks in the entry impede passenger flow and so impact dwell times. The same is true for those located just inside the saloon at the entrance. In both cases we have ‘lost space’ because passengers rarely make use of it.

The best solution is to provide racks fitted around the quarter points of the saloon. This location provides good eye contact and causes minimum disruption to passenger flow. The space between back-to-back seats is also likely to be used. The big advantage here is that there is no need to raise bags, plus they can be stored close to their owners and within eye range. Besides the location of storage space, its size is important too. Just a few centimetres determines whether the space is efficient or not. For example, if the backrest distance at the top of the headrest of standard seats is approximately 30cm, 95% of all suitcases can be stored upright. If the distance is 20cm, only 20% of large- and medium-sized suitcases can be stored upright, and all of them in a tilted position. When the gap is only 10cm, no more than 20% of medium-sized suitcases can be stored upright.
And if there is no gap between the headrests of seats no medium or large luggage items can be stored at all. And unfortunately this is the situation in most rolling stock today!

The same applies to luggage racks. If they are designed 5 to 10cm too low, 50% of suitcases cannot be stored. Likewise if the racks are narrow. For efficient luggage storage every centimetre counts! To ensure efficiency, it is important to take into account the estimated mix of travel purposes then design the storage space on demand. The vast amount of findings gathered by TU Vienna is proving extremely helpful for precise and efficient designs, demonstrated by research studies.

**SEAT PREFERENCES**

Beside behavioural problems with luggage, passengers also have different preferences for seats. TU Vienna analysed real-life passenger behaviour in trains in Austria, Switzerland and Germany. On the one hand passengers were given questionnaires about their wishes and expectations; on the other their actual behaviour was analysed. Out of more than 2,000 trains (about 50 different vehicle types) all information on the real behaviour of about 120,000 passengers, combined with personal data, was collected. This database provides precise details on where passengers stow their bags, which seat types are preferred, which ones remain free the longest and much more besides.

Data interpretation of vehicles with a 20% maximum utilisation rate reveals passengers can normally chose the seat they prefer. However at higher rates, not every preferred seat is free, so they ‘must’ take a seat, but maybe not the one they prefer.

**OPEN SALOON COACH OR COMPARTMENTS?**

If passengers are free to choose, one half prefers compartments and the other open saloon coaches. As they get older, travellers prefer sitting in open saloons: only about 40% of teenagers prefer open saloon coaches, compared to 55% of adults and 60% of seniors. There are no gender differences for groups of at least two, but a big difference depending on the sex of people travelling alone.

While more than 50% of men travelling alone choose compartments, only about 20% of women do. Eighty percent of women travelling alone prefer sitting in open saloons than in closed compartments, but if travelling accompanied, i.e. with family or friends, many more also prefer sitting in compartments. In the latter, facing seats are chosen approximately as often as row seats.

**WINDOW, AISLE OR AGAINST THE DIRECTION OF TRAVEL?**

About two thirds of passengers prefer sitting in the direction of travel: one third chooses seats against. About 75% prefer window seats, although this depends on whether they anticipate many passengers boarding the train at the next stations. Passengers don’t want to be confined. That means if they are sitting in a facing seat group with a table, or in a row seat and they expect many other passengers to board at the next stations – meaning there is a risk someone will sit at the window then there is a strong likelihood that they also won’t take the free window seat and instead search for another free seat. But if the traveller is sitting at the window and the aisle seat is free, it is highly likely another passenger will choose the latter, facing seats are chosen more often than window seats against.

**DESIGNING AROUND BEHAVIOUR[5]**

The decade of research at the Research Centre reveals that it is vital to take passengers’ wishes, needs and expectations, plus all knowledge of their actual behaviour, into consideration when designing new vehicles or redesigning them. A maximum seat load in a vehicle does not increase the potential capacity. The break point of the maximum possible capacity is about 15% lower than for vehicles in service today. That means that typical, open saloon coaches with about 84 seats only provide capacity of 65 to 70 seats because the others are blocked – mostly by bags that can’t be stored because of the lack of space in general or missing storage space. If only 74 seats are offered in a vehicle, all of them can usually be used because there remains enough space for luggage.
Besides the huge ‘luggage issue’, paying attention to the general behaviour of passengers and their seat choice is also important. Offering a diversified seat arrangement is vital. A good mix between compartments, facing and row seating helps meet both passenger wishes but also matches the needs of different group sizes. Fitting interiors for most of the passengers and different groups not only increases satisfaction but also efficiency, since fewer seats will be blocked compared to today. The greatest wishes of passengers that must be taken into account when designing efficient passenger coaches are:

- luggage storage that offers eye contact at floor level
- most passengers – single travellers or groups – want to isolate themselves from others
- comfortable access – 90cm wide doors, level boarding or two, non-stEEP steps (maximum)
- good mix of compartments, facing and row seating
- efficiently-designed luggage storage – between seat backrests and in racks. The space between headrests must be at least 20cm in order to efficiently exploit the space for luggage

This article sums up the key recommendations, but of course there are plenty of others. Nevertheless by following the main suggestions dwell times can be minimised, actual capacity and passenger satisfaction can be maximised and safety risks reduced.

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