

University of Niš  
Faculty of Mechanical Engineering



## PROCEEDINGS

XVI | SCIENTIFIC-EXPERT  
CONFERENCE ON  
RAILWAYS  
RAILCON '14 

October 09 - 10, 2014, Niš, Serbia

Publisher

Faculty of Mechanical Engineering Niš  
Prof. Vlastimir Nikolić, Dean

Editor

Prof. Dušan Stamenković  
Prof. Miloš Milošević

Reviewers

Prof. Dušan Stamenković  
Prof. Miloš Milošević  
Prof. Zdenka Popović

Technical preparation

Milan Banić  
Aleksandar Miltenović  
Nikola Petrović

Cover design

Prof. Miloš Milošević

Number of copies

160

Printing

UNIGRAF, Niš

CIP - Каталогизacija у публикацији  
Народна библиотека Србије, Београд

629.4(082)  
656.2(082)  
625.1(082)  
338.47(497.11)(082)

SCIENTIFIC-Expert Conference of Railways  
(16th ; 2014 ; Niš)  
Proceedings / XVI Scientific-Expert  
Conference on Railways - RAILCON '14, October  
09-10, 2014, Niš ; [organized by] University  
of Niš, Faculty of Mechanical Engineering ;  
[editor Dušan Stamenković]. - Niš : Faculty  
of Mechanical Engineering, 2014 (Niš :  
Unigraf). - XXI, 282 str. : ilustr. ; 25 cm

Tiraž 160. - Napomene uz tekst. -  
Bibliografija uz svaki rad. - Registar.

ISBN 978-86-6055-060-8

1. Faculty of Mechanical Engineering (Niš)  
a) Железничка возила - Зборници b)  
Железнички саобраћај - Зборници c)  
Железничке пруге - Зборници d) Србија -  
Саобраћајна политика

COBISS.SR-ID 210153228



Ministry of Education, Science and Technological Development of the Republic of Serbia has participated in printing costs of the Proceedings of the XVI International Scientific-expert Conference on Railways - RAILCON 2014

**All the publications in these Proceedings have the authorship, whereas the authors of the papers carry entire responsibility for originality and content.**



University of Niš

# XVI SCIENTIFIC-EXPERT CONFERENCE ON RAILWAYS RAILCON '14



Faculty of Mechanical  
Engineering

## Program Committee

Prof. Dušan Stamenković, President, Faculty of Mechanical Engineering Niš, SRB  
Prof. Boban Anđelković, Faculty of Mechanical Engineering Niš, SRB  
Prof. Dobrinka Atmadžova, VTU Todor Kableškov Sofia, BG  
Prof. Branislav Bošković, Faculty of Traffic Engineering Belgrade, SRB  
Prof. Dragan Đurđanović, University of Texas at Austin, USA  
Prof. Miroslav Đurđanović, Faculty of Mechanical Engineering Niš, SRB  
Prof. Ratko Đuričić, Faculty of Traffic Engineering Dobož, R. Srpska  
Prof. Eberhard Hohnecker, Karlsruhe Institute of Technology, GER  
Prof. Daniel Kalinčák, University of Žilina, SK  
Prof. Dragutin Kostić, Faculty of Traffic Engineering Belgrade, SRB  
Prof. Stjepan Lakušić, Faculty of Civil Engineering Zagreb, HR  
Prof. Vojkan Lučanin, Faculty of Mechanical Engineering Belgrade, SRB  
Prof. Dragomir Mandić, Faculty of Traffic Engineering Belgrade, SRB  
Prof. Dragan Marinković, Technical University of Berlin, GER  
Prof. Dragan Milčić, Faculty of Mechanical Engineering Niš, SRB  
Prof. Vojislav Miltenović, Faculty of Mechanical Engineering Niš, SRB  
Rešad Nuhodžić, PhD, Ministry of Transport and Maritime Affairs, MNE  
Nena Tomović, MSc, Serbian Railways, SRB  
Prof. Nenad T. Pavlović, Faculty of Mechanical Engineering Niš, SRB  
Prof. Snežana Pejčić Tarle, Faculty of Traffic Engineering Belgrade, SRB  
Prof. Dragan Petrović, Faculty of Mechanical and Civil Engineering Kraljevo, SRB  
Prof. Mihaela Popa, University Politehnica of Bucharest, RO  
Prof. Zdenka Popović, Faculty of Civil Engineering Belgrade, SRB  
Privatdoz. Andreas Schoebel, Technical University of Vienna, AUT  
Prof. Kiril Velkov, Technical University of Sofia, BG  
Prof. Radisav Vukadinović, The Railway College of Vocational Studies Belgrade, SRB

## Organizing Committee

Prof. Miloš Milošević, President  
Aleksandar Miltenović, PhD  
Miroslav Mijajlović, PhD  
Srđan Stojičić, MSc  
Milan Banić  
Srđan Mladenović  
Nikola Petrović  
Predrag Milić  
Dušanka Nikolić  
Vesna Grozdanović

## **Patrons**

Ministry of Education, Science and Technological Development of the Republic of Serbia  
JSC SERBIAN RAILWAYS  
MIN Lokomotiva a.d.

## **Cofinanciers**

STADLER  
ALTPRO  
STRAIL  
MIN DIV Svrlijig  
THALES  
OPEN TRACK

# CONTENTS

## Plenary Session

- PRECEDENT-FREE FAULT LOCALIZATION FOR HIGH SPEED TRAIN DRIVE SYSTEMS I  
Asad UL HAQ, Dragan ĐURĐANOVIĆ  
University of Texas at Austin, Austin, USA
- IMPROVING SERBIAN RAILWAYS: POLICY OPTIONS AND STRATEGIC DIRECTIONS XI  
Nena TOMOVIĆ,  
JSC Serbian Railways, Belgrade, Serbia  
Snežana PEJČIĆ TARLE  
Faculty of Transport and Traffic Engineering, Belgrade, Serbia
- IMPORTANCE OF COTIF TO INTERNATIONAL TRAFFIC XVII  
Bas LEERMAKERS, Dragan NEŠIĆ  
OTIF, Bern, Switzerland

## Rolling stock

- 1.1. EXPERIMENTAL RESEARCH OF CHARACTERISTICS OF IMPROVED TYPE OF COMBINED TUBE ENERGY ABSORBER 1  
Jovan TANASKOVIĆ, Dragan MILKOVIĆ, Vojkan LUČANIN, Žarko MIŠKOVIĆ  
Faculty of Mechanical Engineering, Belgrade, Serbia
- 1.2. HYBRIDIZATION- THE WAY OF DECREASING CARBON DIOXIDE EMISSION AND FUEL ECONOMY 5  
Martin MIKOLAJČÍK, Daniel KALINČÁK  
University of Žilina, Slovakia
- 1.3. NEW STADLER “FLIRT3” EMU’S FOR SERBIAN RAILWAYS 9  
Fadi KHAIRALLAH  
Stadler Bussnang AG, Bussnang, Switzerland
- 1.4. REQUIREMENTS FOR CUSTOMER FRIENDLY RAILWAY INTERIORS 13  
Bernhard RÜGER  
Vienna University of Technology, Vienna, Austria
- 1.5. EXPERIMENTAL MEASUREMENTS AND NUMERICAL SIMULATIONS OF THE WHEEL-RAIL ANGLE OF ATTACK 17  
Dragan MILKOVIĆ, Goran SIMIĆ, Jovan TANASKOVIĆ, Živana JAKOVLJEVIĆ  
Faculty of Mechanical Engineering, Belgrade, Serbia
- 1.6. DETERMINATION OF FRICTION HEAT GENERATION IN CONTACT OF WHEEL-RAIL SET USING FEM 21  
Aleksandar MILTENOVIĆ, Milan BANIĆ, Dušan STAMENKOVIĆ, Miloš MILOŠEVIĆ, Miša TOMIĆ  
Faculty of Mechanical Engineering, Niš, Serbia
- 1.7. ANALYSIS OF THE RESULTS OF THEORETICAL AND EXPERIMENTAL STUDIES OF FREIGHT WAGON FALLS 25  
Svetoslav SLAVCHEV, Kalina GEORGIEVA, Valeri STOILOV, Sanel PURGIĆ  
Technical University, Sofia, Bulgaria
- 1.8. ABOUT THE PROCESS OF BRAKED WEIGHT LOSS IN THE FREIGHT TRAINS 29  
Kiril VELKOV, Oleg KRASTEVA, Sanel PURGIĆ  
Technical University, Sofia, Bulgaria
- 1.9. ISSUES OF WAGON MODELLING WITH SHELL ELEMENTS 33  
Svetoslav SLAVCHEV, Kalina GEORGIEVA, Valeri STOILOV  
Technical University, Sofia, Bulgaria
- 1.10. FRICTION CHARACTERISTICS OF THE FRICTION PAIRS IN DISC BRAKES 37  
Vasko NIKOLOV  
Todor Kableshkov University of Transport, Sofia, Bulgaria

## REQUIREMENTS FOR CUSTOMER FRIENDLY RAILWAY INTERIORS

Bernhard RÜGER <sup>1</sup>

**Abstract** – Within the project „FLEXICOACH“, in cooperation with Technische Universität Wien, Fachhochschule St. Pölten, Fachhochschule Joanneum, Siemens, netwiss and ÖBB Personenverkehr AG, passenger opinion surveys regarding their wants and needs were conducted. The aim of those surveys was to obtain information about everything a passenger requires; in order to get all information needed various subjects such as duration and frequency of journeys, activities during journey, well-being, stress factors, age, gender and group dimensions, were interrogated.

**Keywords** – Passenger needs, expectations, experiences, comfort.

### 1. INTRODUCTION

Overall 3.826 questionnaires were analyzed. All questionnaires were conducted in summer 2012 on the Austrian Westbahn-line between Vienna and Linz. Due to the summer holidays a lower participation of students must be considered methodically. Furthermore and also due to summer vacations less rides to or from work are expected.

Approximately 50% of travellers undertake a trip lasting several days, around 10% are free time trips without an overnight-stay. Journeys in connection with education or work (rides from / to work, rides from / to education facilities, business trips either one-day or with a several day's duration) account for 25% of all journeys. The remaining 10% are to be allotted to private settlements.

Rail travellers mostly are young, approximately 12% are aged between 13 and 18 years, almost half of all interviewees are between 19 and 39 years old. 27% are part of the “40 to 60 years of age” group and around 12% are older than 60 years. The fact that children under the age of 12 are underrepresented is simply because they rarely fill in questionnaires.

54% of travellers are female, 46% are male. With the exception of people older than 60 years, in all age-groups female passengers form the majority.

Approximately one third of the passengers travel alone. Another third travels in a group of two persons. Around 11% travel in a group of three, 7% in a group of four and 12% in a group of five or more people.

The journeys were classified in journeys up to 30 minutes, 30-60 minutes, 60-90 minutes, 90-120 minutes, 2-3 hours, 3-4 hours, 4-5 hours and more than 5 hours. Most journeys (respectively 20-30%) in

all age-groups last between two and three hours. With increasing age the duration of journey as well increases slightly, short-term rides mostly are done by younger people. Summing up all general information gained, elderly people take the train less frequently, but if they do, they go for longer free time rides. In opposition, younger people take the train more often, and mostly for short business trips.

The better part of all interviewees quoted “comfort” as the major reason to take the train, around 40 % of all passengers declared “environment”, “no car” and “price” as their major reasons to choose the train (see Fig. 1). “Safety” and “duration of journey” are an inferior aspect.

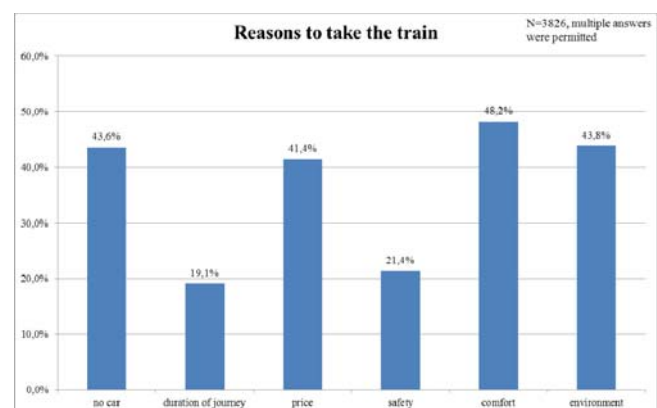


Fig. 1: Reasons to take the train

### 2. BAGGAGE

Regarding baggage, most information were attained from a diploma thesis [1], which treats issues of baggage transport on an extensive data basis. Amongst other things, various pieces of luggage were

<sup>1</sup> Bernhard RÜGER, Vienna University of Technology, Karlsplatz 13/230-2, 1040 Vienna, Austria, bernhard.rueger@tuwien.ac.at

weight and measured. The accumulated x-, y- and z-dimensions of all luggage measured (not included is carry-on baggage) are demonstrated in Fig. 2.

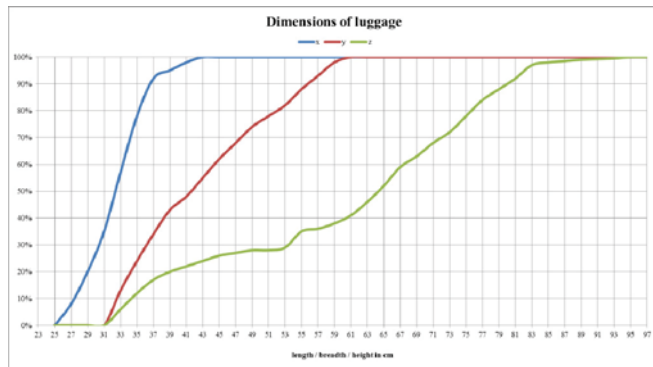


Fig. 2: Dimensions of luggage

Those accumulated measurements can be used in order to design adequate storage between the seat backs or baggage racks.

Analysis show that there are two main issues regarding baggage room. First passengers do not want to lift their luggage, and especially not to the height of overhead storage. This attitude is more common amongst women and increases with age.

Second and due to security reasons, passengers wish to have their luggage in visual range. If these requirements are not met, passengers are very willing to store their luggage in not-intended place, like seats or corridors. This behaviour leads to a lower quality level and to a loss in capacity due to occupied seats.

**3. ACTUAL USE OF JOURNEY TIME**

A major aspect was the purpose of the journey (business trip or free time ride). Every other business traveller declares to use his laptop, smart phone or tablet while travelling, while only one quarter of travellers on a free time ride uses those devices. Fig. 3 shows the details.

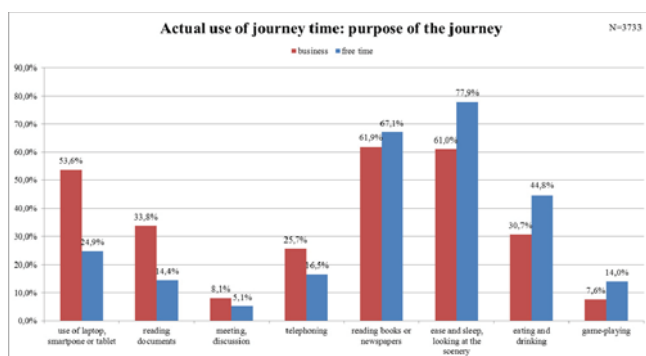


Fig. 3: Actual use of journey time - influence of the purpose of the journey

Another major aspect regarding the use of the journey time is the age of the traveller. Generally speaking there is a slight decrease regarding actually performed activities with rising age. However activities need to be considered separately, while using

electronic devices decreases with increasing age, activities like “looking at the scenery” or “reading a book / the newspaper” increase with increasing age.

**4. EXERCISES ON THE TRAIN**

The longer the journey, the higher need to move. Around 20% of passengers travelling up to an hour wish to exercise during their journey. The percentage rises to 40% when the duration of the journey rises up to five hours or more.

**5. DESIRED USE OF JOURNEY TIME**

Analysis (Fig. 4) shows that there is a connection between the use of journey time and the purpose of the journey.

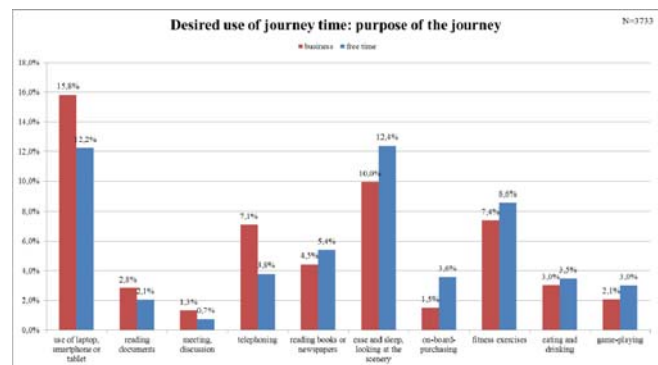


Fig. 4: Desired use of journey time: influence of the purpose of the journey

All too often (around 20% of all interviewees) passengers criticize missing mobile services. Because of several comments it is obvious that a missing WLAN-connection is intended. Together with the absences of tables (respond 12% of all interviewees), this is the biggest obstacle when it comes to using tablet, smartphones and laptops. Around 17% of all interviewees criticize uncomfortable and fixed seats as well as absent silence, which holds them from their desired activity “ease and sleep”. The need to move reflects in the desire for a possibility to exercise.

The age has significant influence regarding the desired use of travel time. The younger the interviewee, the more non accomplishable activities are quoted. Anterior passengers are significantly more satisfied with the possibilities offered, respectively less frequently express a wish to use the time in another way.

In Fig. 5, every desired activity is marked in a different colour (the lowest layer indicates “using the laptop”, the second lowest “using tablet or smartphone” and so on).

Similar images with heavy age-related variation often occurred in the course of the examination, for instance regarding questions about well-being, stress factors, activities, etc.

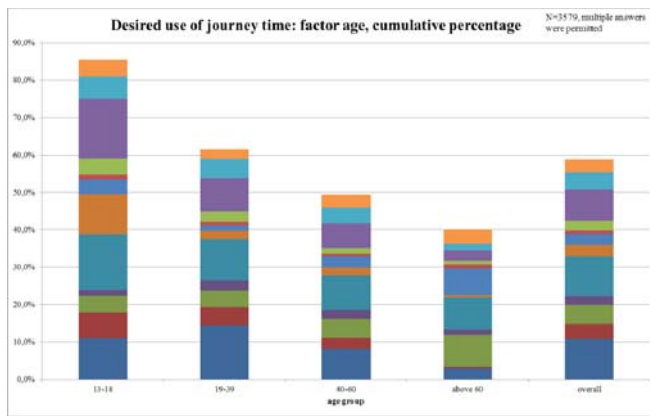


Fig. 5: Desired use of journey time: factor age, cumulative percentage

The journey time is a major aspect when it comes to desirable use of time. The longer the journey time, the more requirements were quoted, in particular if the duration exceeds two hours.

## 6. TIME WELL-BEING

Around 33% of the interviewees feel “very well” when travelling by train, about 52% feel “rather good”, 14 % feel “rather bad” and only 1 % of the passengers do not feel well during train journeys.

The assumption that those outcomes correspond with the fact that younger passengers mostly are on business trips, while anterior passengers use the train prevailing for free time trips, is unfounded. Around 50% of all train journeys are leisure time trips, lasting several days. Interviewees between 13-18 years, the group that feels most uncomfortable during train journeys, mostly goes on free time rides without an overnight stay. Thus there is no obvious connection between the purpose of the journey and the well-being.

Passengers travelling first class are feeling better than passengers travelling second class. Furthermore there is a strong connection between the well-being of the passengers and the degree of capacity. Therefore on weekdays from Monday to Thursday passengers mostly feel “rather well” or “very well”, while travellers on Fridays and weekend feel “rather bad” or “not well”. The higher degree of capacity during weekends leads to an oftener nomination of stress factors like “high degree of capacity”, “search for seat”, “noise” and “fellow passengers”.

## 7. STRESS FACTORS

The stress factor most frequently nominated was “search for a seat”, around 20% of the passengers feel stressed (see Fig. 6). Also sensed as stress factors were “high degree of capacity”, “noise” and “fellow passengers”. The factors most frequently mentioned are those which appear at a high degree of capacity and obviously lead to a deterioration of the well-being.

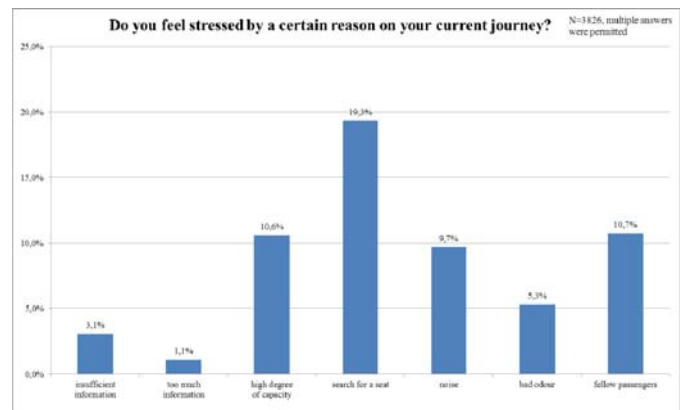


Fig. 6: Stress factors during the current journey

Analogue to the well-being, the age of the passengers is crucial when it comes to cognition of stress. Younger passenger are more stressed than anterior passengers, at least they quote it more often. With increasing age (groups from 13-18 years, till 60 years) the nomination of arising stress factors during an actual train journey decreases under 50%. Considering the most frequently quoted stress factor “search for seat”, the nominations in the age group “over 60 years” decrease even to a third of those from passengers between 13-18 years. This is a very notable fact, because precisely this stress factor was assumed to arise with increasing age, also in terms of luggage.

Generally speaking, anterior passengers are more satisfied with the frame conditions than younger ones.

## 8. SERVICE FEATURES

Most frequently nominated when it comes to service features were „reasonable priced meals” (31%), “purchase of newspapers” (24%), “transmission of knowledge” (23%), “entertainment” (20%), “possibilities to exercise “ (18%), “relaxation practises” (17%). With increasing age the interest in service features heavily decreases.

With increasing journey duration, the interest in service features increases as well. Passengers on a free time ride show more interest in service features than travellers on a business trip. Around two-thirds of all respondents show interest in healthy nutrition during their train journey. This desire is more common under female passengers than under male ones.

## 9. ATMOSPHERIC ENVIRONMENT

The outcomes of this particular subject won't be discussed any further. Generally speaking, the nominations made by the passengers are very subjective and do not always refer to any comprehensible objective criteria. For instance, in every sort of train the temperature was between 25 and 26 °C, nevertheless there are different sensations and evaluations regarding the temperature, which can



be connected to the sort of train. The highest percentage of satisfied passengers is to be found in trains of the private operator Westbahn (over 80% satisfaction). The average registered temperature is exactly identical to the temperature registered in the Railjet-trains of ÖBB. However, Railjet was evaluated ten percentage points less than Westbahn. It is obvious that not only the temperature, but rather the general well-being or the consciousness of a deliberately taken decision to travel with a new operator (Westbahn was operating only eight months at the moment of the opinion survey) contributed to this outcome.

The opposite way around also Railjet was not only evaluated regarding temperature, but rather general well-being (for that matter Railjet scores rather low).

There is a similar effect notable when it comes to train categories (first or second class). Passengers travelling first class rated the atmospheric environment higher than passengers travelling second class, there was no objective difference however.

It has to be considered that subjective sensations had a great influence also on questions regarding well-being, illumination and stress factors. Advanced studies would be very helpful in order to interpret the outcomes in the right way.

## 10. CONCLUSION

Compared to other modes of transportation the railway system has got the big advantage that passengers are able to use the travel time efficiently. This is one of the biggest advantages of competition.

Unfortunately today's vehicles hardly offer the requested equipment which allows the best possible time use. Train passengers are very interested in using the travel time for working, mostly on technical devices like one note books or tablets, for reading or for relaxing. For efficient time use the investigations have shown that the individualisation of the space in the train is essential. It is important that all passengers can follow their requested activities without affecting other passengers. For example people who are working may produce noise but on the other hand need calm for concentration. Additionally they need light whereas people who want to sleep need it dark and calm. So further investigation must focus on how the space in the vehicle can be individualized in a best possible way.

## ACKNOWLEDGEMENT

The outcome is part of the project FLEXICOACH, fundet by the Austrian Ministry of Transportation. More info is available under: <http://FLEXICOACH.netwiss.at>

## REFERENCES

- [1] Viktor Plank: Dimensionierung von Gepäckanlagen in Reisezügen, Wien 2008
- [2] Viktor Plank, Bernhard Rüger, "Grundlagen für eine optimierte Gepäckunterbringung in Reisezügen"; ETR - Eisenbahntechnische Rundschau (eingeladen), 07+08 2009 (2009), 07+08; S. 417 - 421
- [3] Flexicoach, Endbericht AP2, Nutzerbedürfnisse, Wien 2013