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CURRENT PROBLEMS IN RAIL VEHICLES

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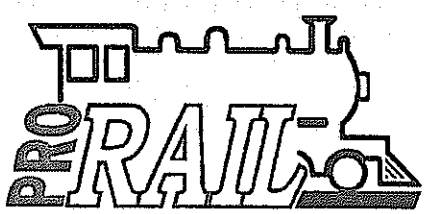

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BOARDING ASSISTANCE DEVICES – EXPECTATIONS AND EXPERIENCES

POMOCNÉ ZARIADENIA PRE NASTUPOVANIE – OČAKÁVANIA A SKÚSENOSTI

Bernhard RÜGER *)

1 INTRODUCTION

EU regulations require that public transportation systems be accessible for everyone without any restrictions for People with Reduced Mobility. This does not only refer to disabled people, but also elderly people, passengers with baby carriages, big sized luggage etc. i.e. all people with some kind of reduced mobility, assuring that accessibility for all is an inevitable future obligation for railway operators. The interface between the platform and rail vehicle itself is one of the largest railway accessibility challenges, particularly for wheelchair users.

Most railway vehicles require special boarding devices in order to provide sufficient accessibility. To advance the current situation a project consortium (PubTrans4All) funded by the EU in FP7 faces the challenge to develop an improved version of a new retrofit-able boarding assistance system.

The reseaerch methods which have been applied in this project had been performed through conducting personal interviews amongst experts throughout Europe, done by interviewers being experts themselves in the field of accessibility and interviewing the key-representatives of railway operators, e.g. ATOC Association of Train Operating companies U.K., as well as talking to representatives from user-groups such as JMCPS, UK, and professional organisations such Campanions of SNCF/RATP France, in order to find out about their professional experiences and personal views, as well as asking in depth in regards to daily real-life experiences with the various boarding assistance systems being in use across Europe.

Also quantitative research methods had been applied, by conducting a survey amongst 5.000 train users for creating a better understanding for the basic needs of Persons with Reduced Mobility, and by including various European railway-regions and their experiences when facing different environmental conditions within the specific regional railway-environment, as well as doing a research on the daily use of various different types of Boarding Assistance Systems in Europe.

The process of boarding rail vehicles consists of several steps connected to one another: passengers must get to the rail station; they must get to the platform; finally, they

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must get from the platform into the rail vehicle. Once on the rail vehicle they require appropriate space to ride and have access to various services. The process of alighting follows the same steps in reverse. The PubTrans4all project focuses on the difficulties of people with reduced mobility in getting them from the station platform into the rail vehicle. The project's main goal is the development of an improved boarding assistance system (BAS), preferrably vehicle-based.

1.1 Main challenge - existing high floor vehicles

The main accessibility problem for railway operators is that most old classic trains, e.g. UIC wagons, as well as suburban or tramway lines have significant vertical differences, often one step or more, as well as horizontal gaps between the vehicle and the platform. These difficulties within the infrastructure are accentuated by the fact that rail rolling stock and general railway infrastructure have a very long service life both. Railway operators will use their current rolling stock for many more years to come and therefore, temporary solutions must be found until the fleet will be replaced with modern fully accessible rolling stock.

1.2 Challenges for the railway infrastructure and rolling stock

The technical and operational environment of a BAS and its capabilities under which it needs to perform are considered within the PubTrans4All project, as well as the important role of an effective, universal retro-fit Boarding Assistance System. Both criteria are being evaluated from an operators' and manufacturers' perspective, e.g. environmental conditions, time and space required for the operation and installation of the BAS. The main focus is on conventional heavy rail high-floor vehicles of the existing rolling stock.

It is difficult to develop a standard "one-fits-all" boarding device as a universal accessibility solution due to the huge variety of differences within rolling stock and platform heights. Even on a single rail line several different types of rolling stock are often used, and platforms may have different heights and profiles, platforms along straight track or curved and elevated alignment. Moreover, the exact physical dimensions of rolling stock (e.g. height) can also vary depending on its occupancy and wear. Designers must also consider a safety cussion between the train and platform to account for train rocking etc. Finally, technical accessibility devices must work under all types of environmental conditions, e.g. rain, snow, frost, etc.

2 EVALUATION CRITERIA

Evaluation criteria provide an overview of all relevant parameters that must be considered when designing a new boarding assistance system. ***TABLE 1*** presents the importance scores used in order to rank the evaluation criteria. ***TABLE 2*** summarizes the evaluation criteria. Features rated as not important, are not shown herein.

TABLE 1 Criteria importance scoring

TAB. 1 Kritériá hodnotenia významu

Score	Meaning
1	Very important – critical to successful operation ("must have")
2	Important – high benefit for users and operators ("nice to have")
3	Less important – some benefit for users and operators, but not absolutely necessary

TABLE 2 BAS evaluation criteria – overview

TAB. 2 Prehľad BAS hodnotiacich kritérií

Criteria	Remark	Importance
User		
User with devices	wheelchair, walking frame, baby prams	1-2
Physically impaired	Walking disabled, with crutch or sticks, elderly, diminutive people	2
User with special needs	Visual and hearing impaired	2-3
General passengers	Passengers with luggage, children, pregnant	2-3
Operation without staff	Operation by passengers themselves, automation	2
Operators		
Reliability of BAS	Prevention of Malfunction	1
Operational quality	Short dwell time, malfunctions must not influence train operations	1-2
Operational effort	Number of staff	1-2
Failure management	Problems easy to solve	1
Manufacturing/ Implementation		
Universalism	The system needs to be universal, retro-fitting allowed	1-2
Manufacturing Costs	Manufacturing Costs (per unit) and Market Price as low as possible	1
Integration effort	The effort for integration needs to be low – especially when retro-fitting	1-2
Safety		
Safety risks	No (operational) safety risks to be tolerated	1
Safety features	Optical and audio signals	1-2
Maintenance		
Maintenance effort	Number of personnel required, special tool required	1
Costs	Life Cycle Costs	2
Sustainability	recyclability and energy consumption	3
Aesthetics		
Optical design	Aesthetics is important for customer acceptance	2-3
All regulations must be fulfilled (currently according to TSI-PRM) as a minimum standard. Some specifications in project PT4All have been set higher than required.		

TABLE 3 presents the most important technical and operational requirements that must be considered when designing a BAS.

TABLE 3 BAS technical and operational requirements

TAB. 3 BAS technické a prevádzkové požiadavky

Framework Requirements	limit
Total duration for use *preparation, use, stowing*	< 2 min
Platform width	> 130 cm
Vertical gap platform - vehicle	< 110 cm
Access door width	≥ 80 cm
Access door resting height from the floor	> 174cm
Load Capacity (wheelchair)	350kg
*Relative angle platform-vehicle**	< 13.2% or 7.5°

* Transverse gradient of platform and super elevation of track

3 IMPROVING THE VEHICLE ACCESSIBILITY SITUATION ON ROLLING STOCK

Improving accessibility means either creating level-boarding by adjusting the platform height to the vehicle floor height, or providing boarding assistance systems (BAS) that enable mobility impaired passengers to reach rolling stock floor levels from the platforms at different levels. There are two main types of boarding assistance systems: platform-based and vehicle-based versions.

Platform-based systems are usually simple, manually operated devices. At least one device is needed at each station that is usually only suitable and designed according to wheelchair user's specifications and needs. One person per station should be available as BAS operator. Before the train arrives at the station the BAS must be moved to the exact position on the platform where the adapted vehicle for wheelchair users is expected to stop.

The advantage of all vehicle-based devices is that they are always available (i.e. at the right time and place and in all stations), because they are stored on the train-vehicle. This enables people with reduced mobility to travel even without making travel-arrangements in advance. This is very important for both the users and the "accessibility for all" policy of the railway operators.

The on-board conductors are trained to operate this kind of boarding equipment, which is more convenient for operators than the use of platform-based BAS.

For each BAS there are two main technologies: ramps or lifts; and, two sources of powering them, manual or electro-mechanical.

A short overview of existing systems that are typically used for high floor vehicles is given in ***Figures 1 - 6***. Systems for low floor vehicles (e.g. gap bridging systems) are not part of this project.

Fig. 1 Non-Level Boarding: Gaps and different levels between vehicle and platforms to be bridged

Obr. 1 Medzery a rôzne úrovne medzi vozidlom a plošinou musia byť odstránené

3.1 Ramps as Boarding Assistance System

Ramps are generally the simplest and least expensive BAS devices. However, they can only be used if the vertical difference between vehicle floor-platform is not significant (typically one step), since otherwise the ramp gradient would be too steep in order to use the device safely, otherwise the ramp-platform would be too long to be used on narrow platforms. Most ramps cannot be operated without the assistance of rail operating staff.

There are five different types of ramp based BAS solutions: platform-based manual ramps, vehicle-based manual ramps, vehicle-based electro-mechanical ramps, vehicle-based and platform-based gap-bridging devices to close horizontal gaps.

3.2 Manual Ramps - platform-based applications

A movable ramp is usually located on the station platform and requires staff assistance to be operated.

Manual ramps must have an ergonomic design both for the wheelchair users' comfort, also to ensure good operating conditions for the train-staff such as weight, manoeuvrability, etc. If a boarding assistance system is easy to handle, staff will be more willing to use it.

Several railway transportation operators are using manually deployed ramps for high floor vehicles also, although ramps do have their technical limits.

3.3 Manual Ramps - vehicle-based applications

Vehicle-based manual ramps are ramps that are located on the train vehicle. They also require the assistance of the rail operating company staff to be deployed and used. The advantage of vehicle-based ramps is that they provide accessibility to all stations from the train since they are stored on board. The ramps may be permanently attached to the vehicle or simply stored on the vehicle.

Figure 2 shows the example of a vehicle based ramp used for bridging vertical gaps, and height differences where needed.

Fig. 2 Vehicle-based Ramp as used on UK South Eastern Trains, King´s Cross St. Pancras Station, London

Obr. 2 Nástupná plošina použitá vo vlakoch v UK

Lifts are mechanical lifting devices either installed on the vehicle, or mobile lifts placed on the platform. Lifts are the preferred solution over ramps in situations of great height differences, usually more than one step), where slopes are too steep for the application of ramps.

A key advantage of lifts is that their vast flexibility. Platform-based lifts can be adapted to almost all types of rolling stock and stations since they can be moved around on the platform and can bridge variable horizontal gaps and vertical changes. Similarly, vehicle-based lifts can be adapted to many different platform heights accordingly.

3.4 Lifts - platform-based applications

These lifts are operated by train-operating staff and are usually pushed on the platform to the train door and then manually operated. Similar to manually deployed ramps, these lifts require ergonomic design, not only to be used for the wheelchair users, but also for the staff who moves and operates the lift. ***Figure 3*** shows some examples of platform-based lifts.

Fig. 3 Platform based lift used in Germany (ICE) and France (TGV Duplex)

Obr. 3 Plošina založená na platform výťahu v Nemecku (ICE) a Francúzsku (TGV Duplex)

3.5 Mechanical Lifts - vehicle-based applications

They consist of elevator platforms that deploy and unfold from the train, and are usually operated by the railway operating staff.

This BAS can be used to provide access for differences in platform to vehicle floor heights of 1100 mm or more as a platform-based lift does. Usually this type of BAS requires a sufficient width of the platform in order to provide enough space for safe wheelchair roll on/roll off, but a little bit less than platform/based lifts. Lifts for boarding and alighting parallel to train do also exist.

An additional advantage of vehicle based mechanical lifts is the possibility to evacuate wheelchair users under extraordinary conditions in case of an emergency, even without platforms in-between stations, as lifts can usually manage greater floor-to-ground distances than ramps.

Vehicle-based mechanical lifts require an energy source. Two devices per vehicle must be provided, one on each side. The dimensions of the lift platform in a folded stowing-position needs to be narrower then door width. Lifts occupy space at the entrance doors and behind inside the wagon, which is a difficult situation in classic UIC wagons since space is at a premium. ***Figures 4*** shows an example of a vehicle based lift.

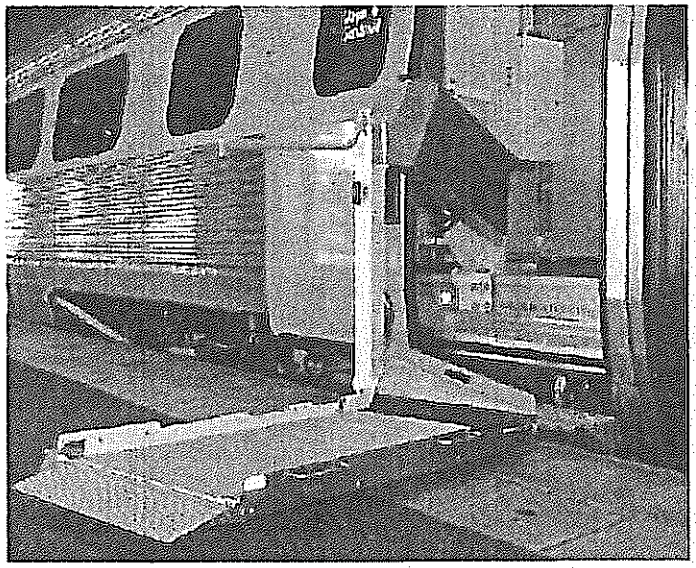

***Fig. 4** Vehicle based lift in Sweden*

***Obr. 4** Výťahová plošina vo Švédsku*

A combination of results from the PT4All research and relevant European projects was taken into consideration, European or national regulations etc. in order to come up with a comprehensive overview on recommendations based on existing Boarding Assistance Systems. E.g., the analysis of the accessibility situation on UIC wagons shows that there are no existing BAS solutions on passenger coaches with doors of 800 mm width, which is a very common situation with existing UIC type coaches, and represents one of the technical restrictions and main design challenges ahead.

4 CONCLUSIONS - OUTLOOK

The goal of the PubTrans4All project is to develop an improved boarding assistance system, in order to facilitate the accessibility of railway vehicles, especially for refitting the classic UIC wagon. The project is being completed as part of the EU Commission's 7th Framework Programme.

The project's first step completed was the development of evaluation criteria for both existing and new BAS to be designed. The second step was the completion of a comprehensive research study about existing BAS across Europe and the world, and finally to evaluate these BAS and apply those criteria accordingly.

The results of these activities illustrate the complexity of developing a universal and standardised BAS solution which shall work for as many types of vehicles and platform conditions as possible.

The project focuses on the most difficult scenarios of accessibility situations for classic UIC wagons, expecting an effective solution for these vehicles, being universal and covering most other types of rail vehicles as well.

By creating an "Existing Boarding Assistance System Evaluation Matrix Report", the evaluation and assessment of existing solutions has been performed. Further steps included the definition of recommendations and requirements for new BAS for existing UIC type vehicles, provided and developed by a task-force, the "Prototype Development Group of the FP 7 PubTrans4All Project", consisting of the Vienna University of Techology and

University of Belgrade, as well as industrial manufacturers from MBB Palfinger, Bombardier and Siemens. A final Prototype Solution will be presented at the Innotrans 2012.

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[1] Rüger B, Tauschitz P, Petutschnig B.: Boarding Assistance System Evaluation Criteria Report, deliverable 2.1, June 2010. EU-FP7-Project Public Transportation – Accessibility for all. **[2] Rüger B, Tauschitz P, Petutschnig B:** Existing Boarding Assistance System Evaluation Matrix Report, deliverable 2.2, August 2010. EU-FP7-Project Public Transportation – Accessibility for all.

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Summary

Regarding to EU regulations today's public transportation systems must be accessible for everyone without any restrictions. The relevant question is: How can trains be accessible for everyone? The huge variety of different vehicles and different platforms does not allow level boarding everywhere, only in so called "closed" systems. The paper gives an overview about the needs and expectations of the many different groups of passengers, about the operator's point of view and it will point out several technical and different service solutions around whole Europe in order to offer accessible trains.

Resumé

Pokiaľ ide o predpisy EÚ dnešných systémov verejnej dopravy, tá musí byť prístupná pre všetkých bez obmedzenia. Relevantná otázka znie: ako môžu byť vlaky dostupné pre každého? Obrovské množstvo rôznych vozidiel a rôzne nástupištia neumožňujú použitie univerzálneho bezbariérového prístupu, len v tzv "uzavretom" systéme. Článok poskytuje prehľad potrieb a očakávaní rôznych skupín cestujúcich týkajúcich sa prevádzkovateľa a poukazuje na niektoré technické riešenia využívajúce sa v celej Európe s cieľom ponúknuť dostupné vlaky.

Reviewed by Prof. Dipl.-Ing.Dr.techn. Klaus Riessberger, TU Graz, A