



CETRA²⁰¹²

2nd International Conference on Road and Rail Infrastructure
7–9 May 2012, Dubrovnik, Croatia

Road and Rail Infrastructure II

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BOARDING ACCESSIBILITY TO TRAIN VEHICLES FOR EVERYONE

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Abstract

EU regulations require that public transportation systems be accessible for everyone without any restrictions. This includes not only disabled people, but also elderly, passengers with baby carriages, big sized luggage etc., i.e. all people with some kind of reduced mobility. Assuring accessibility for all is an inevitable future obligation for railway operators. The interface between the platform and the rail vehicle is one of the largest railway accessibility problems particularly for wheelchair users. To advance the current situation a project consortium (PubTrans4All) funded by the EU in FP7 will develop a new boarding assistance system that can be used not only by wheelchair users, but by other people with reduced mobility.

Keywords: accessibility, vehicle entrance, boarding assistance device, PRM

1 Introduction

The process of boarding rail vehicles consists of several connected steps: passengers must get to the rail station; they must get to the platform; finally, they must get from the platform to the rail vehicle. Once on the rail vehicle they must have an appropriate space in the vehicle and access to various services. The process of alighting follows the same steps in reverse. The PubTrans4all project - funded by the EU within the 7th framework programme - focuses on the problems of people with reduced mobility when getting from the station platform into the rail vehicle. The project's main goal is the development of a better boarding assistance system (BAS).

1.1 Main problem—existing high floor vehicles

The main accessibility problem for rail transport operators is that many old trains, suburban or tramway lines have significant vertical differences (e.g. steps) and horizontal gaps between the vehicle and the platform. This problem is accentuated by the fact that rail rolling stock and infrastructure has a very long service life. Railway operators will use their current rolling stock for many more years and therefore, temporary solutions must be found until the fleet can be replaced with modern fully accessible rolling stock.

1.2 Difficulties – huge variety of platforms and vehicles

It is difficult to develop a standard accessibility solution because of the huge variety in rolling stock and platform heights. Even on a single railway line several different types of rolling stock are often used and platforms may have different heights and profiles. 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 margin between the train and platform to account for train rocking etc. Finally, accessibility devices must work under all types of environmental conditions (e.g. rain, snow, etc.).

2 Evaluation Criteria for boarding assistance systems

The PubTrans4All-Consortium developed an evaluation criteria catalogue of all relevant parameters that need consideration when designing a new boarding assistance system. The following tables give a summarised overview of the evaluation criteria. Features rated as not important, are not shown herein.

2.1 User related criteria

For wheelchair users and some groups of people with walking disabilities like people being depended on walking-aids, technical boarding assistance systems are a must in order to be able to board a high-floor vehicle.

For most other passengers the use of a Boarding Assistance System would be a 'nice to have' feature. These passengers are the ones with luggage or baby prams, persons with walking disabilities, which are the absolute majority of passengers. On one hand this leads to the fact that these groups also need be content when using a train, and especially while boarding, on the other hand it is not possible to offer technical devices which require a longer operational time, and do block the entrance for other passengers like lifting devices, normally being used for wheelchair users only.

For big group of travellers it is ideal that personnel assistance is asked for before boarding, because in this way, only passengers needing help will call on it, and staff can also act flexibly and quickly. The ultimate solution, ideal for all passenger-groups, is a level boarding situation. Technical devices like automatic gap bridging systems, or occasionally short ramps can also be used for all passengers without causing any train delay.

Another user-related criterion is automatisisation. The possibility of operating boarding assistance systems automatically scores as 'impotent'. Automatisisation means that the system either works automatically in each and every station (e.g. folding steps or gap bridging systems), or can be operated by the users themselves. The difficulties of offering systems operated by the users are not technical reasons, but safety and legal issues.

Table 1 Boarding assistance – necessity for different user groups

Score	Users
Very important ("must have")	wheelchair walking frame
Important high benefit for users & operators ("nice to have")	baby prams walking disabled with a crutch or sticks elderly diminutive people passengers with luggage
Less important ('nice to have' - but not absolutely necessary)	children pregnant visual and hearing impaired

2.2 Operator and manufacturer related criteria

Table 2 operator and manufacturer – evaluation criteria

Framework Requirements	limit
Very important ('must have')	Reliability of boarding assistance system: Prevention of malfunction Operational quality: Short dwell time Operational effort: Number of required staff Failure management: Problems easy to solve Costs: Costs as low as possible Safety risks: No safety risks to be tolerated Safety/Alert features: Visual , e.g- flash-light, contrast etc, and audio signals Maintenance effort: Number of personnel required? Special tool required?
Important high benefit for operators ('nice to have')	Operational quality: malfunctions must not influence train operations Universalism: The system needs to be universal and allow retro-fitting Manufacturing effort: The manufacturing/installation effort needs to be low – especially when retro-fitted on vehicles
All regulations according to TSI-PRM must be fulfilled as a minimum standard. Some specifications in project PT4All have been set higher and in more detail than the minimum requirements as specified in the current version of the TSI PRM.	

Table 2 shows an overview of the importance of different criteria that a boarding assistance device must fulfil, e.g. technical features, from the operators' point of view. Most criteria are evaluated as 'very important' by the operators, especially a high level of reliability, operational quality, easy maintenance, low cost, and no safety risks are scoring high as very important.

3 Improving the vehicle accessibility situation on the rolling stock

Improving accessibility means either creating level-boarding situations by adjusting the platform height according to the vehicle floor height, or providing boarding assistance systems 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 manually operated devices simple to apply. 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 boarding assistance system operator. Before the train arrives at the station, the boarding assistance system 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) as 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 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 boarding assistance systems. For each boarding assistance system 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 the following chapters. Existing systems for low floor vehicles, i.e. gap bridging systems, are not part of this project.

3.1 Ramps as a Boarding Assistance System

Ramps are generally the simplest and least expensive boarding assistance devices. However, they can only be used if the vertical difference between the vehicle floor-platform is not significant, typically not more than 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 the rail operating staff.

There are five different types of ramps based on boarding assistance systems 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 only.

3.1.1 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 and 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. Fig.1 shows an example of platform based ramps used in Norway.

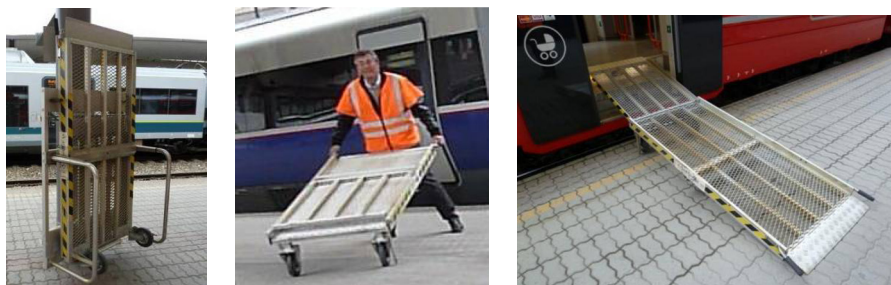


Figure 1 Platform based Ramp NSB, Norway

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

3.1.2 Manual Ramps – vehicle-based applications

Vehicle-based manual ramps are ramps 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.

Fig.2 shows the example of a vehicle based ramp used for bridging vertical gaps, and height differences where needed. Such short ramps can theoretically be used by all passengers. Some operators provide such easy to handle ramps in each station. The main advantage of manual, vehicle- or platform-based ramps is that many passengers, other than PRMs, are using that particular entrance for their convenience, as the provided ramp is more comfortable than taking an entrance with a step, or more than one. The ramp as shown in Fig.8 can be stored on board but also on platforms.



Figure 2 Manual mobile Ramp (Port-a-Ramp, UK), bridging the gap between the train and the platform (South Eastern Trains, England)

3.2 Lifts as Boarding Assistance System

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 but also on very narrow platforms on low floor vehicles if ramps are too long.

A key advantage of lifts is 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.

3.2.1 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. Fig. 3 shows an example of platform-based lifts.



Figure 3 Platform based lift used in Switzerland (and many more countries)

3.2.2 Mechanical Lifts – vehicle–based applications

They consist of elevator platforms that deploy and unfold from the train, and are operated by the railway operating staff only, due to a complex lift operation, and the operator's legal responsibility, in order to avoid potential injuries.

These boarding assistance systems can be used to provide access for differences in platform to vehicle floor heights of 1100mm, which is more than a platform-based lift can manage.

Usually this type of boarding assistance systems requires a sufficient width of the platform in order to provide enough space for entering the lift platform safely with the wheelchair, but less than platform based lifts. Existing vehicle-based lifts designed for a boarding and alighting process parallel to train are suitable for narrow platforms, which ultimately enhances passenger flow.

An additional advantage of most 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 must be provided, one on each side of the vehicle. The measurements of the lift platform in a folded stowing position need to be narrower than the door width. Lifts occupy space at the entrance doors and behind it, inside the wagon, which is a difficult situation in classic UIC wagons since space is at a premium. Fig.4 shows examples of vehicle based lifts.



Figure 4 Examples for vehicle based lifts in Norway, Switzerland, Sweden and Germany

4 Conclusion and Outlook

Today accessibility is a must for each railway operator – not only because of regulations. One special barrier is the link between the platform and the wagon. Two possibilities are state of the art – either level boarding which means accessibility and advantages for all passengers and the operator, i.e. shorter boarding time, or classical high-floor railway coaches fitted with steps, which represent boarding and alighting problems for mobility impaired people. The second case will be an ongoing situation within the next decades in the field of long-distance travelling, especially in high speed traffic. Here we need some kind of boarding assistance devices to make vehicles accessible, especially for wheelchair users. A variety of types of railway vehicles and the variety of platform heights lead to the today's situation of having various different solutions for making boarding accessible. The PubTrans4All project tries to find a standardized boarding assistance device that can be implemented in as many coaches in Europe as possible and can be used at a variety of different platform heights. Additionally the project tries to find a technical solution for as many of the users as possible.

The goal of the PubTrans4All project is to develop an improved boarding assistance system, in order to facilitate the accessibility of railway vehicles. 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 boarding assistance system to be designed. The second step was the completion of a comprehensive research study about existing boarding assistance systems across Europe and the world, and finally to evaluate these boarding assistance systems and apply those criteria accordingly.

The results of these activities illustrate the complexity of developing a universal and standardised boarding assistance system 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 boarding assistance system 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 Technology and University of Belgrade, industrial manufacturers such as MBB Palfinger as the developer of the Boarding Assistance System, Bombardier and Siemens for the train-vehicle side, BDŽ, the Bulgarian passenger railway operator, and Rodlauer Consulting, project coordinator. A final Prototype Solution will be presented at the Innotrans 2012.

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