PubTrans4All

Public Transportation - Accessibility for All

Deliverable 2.2

Existing Boarding Assistance System Evaluation Matrix Report

Grant agreement no.: 233701
Project acronym: PubTrans4all
Project title: Public Transportation – Accessibility for All
Filename: PT4A_D2_2_ExistingBoardingAssistanceSystemEvaluationMatrixReport_EN.doc
Title of the Deliverable: D 2.2 – Boarding Assistance System Evaluation Criteria Report
Report Version: 1.0
Dissemination Level:

PU	Public	
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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Workpackage contributing to the deliverable: WP 2
Delivery Date: 2010/08/31
Due Date: 2010/08/14

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The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 233701.

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1 Introduction

Deliverable 2.2 gives an overview on existing systems dealing with and helping to overcome horizontal and vertical gaps between the train-vehicle and the platform. Its main focus is railway-vehicles in their classic sense. Due to the "Best Practice Study" being part of the prototype development project that seeks for input and new ideas, also other areas of traffic/transportation environments, as well as the building-business and its accessibility systems represent a part of this survey.

Besides looking into various available Boarding Assistance Systems in great detail and depth, also an assessment of existing systems that are being in use on trains these days is made. Detailed technical information, that was gathered through primary research by conducting surveys and in personal expert-interviews is also shown within the assessment, including hard and soft facts. A usability study of various systems has also been made, implying various different technical environments looking into a possible real-life use by different user groups (Persons with Reduced Ability) at the same time.

However it shall be mentioned that Deliverable 2.2 provides a basic assessment only, which is a basic assessment based on primary research (surveys, personal interviews) and secondary research (literature, internet) in order to provide a basic overview to build a basis for Deliverable 3.1.

All Boarding Assistance Systems bearing a specific meaning to the PubTrans4All project, are being looked into in detail. All systems which are not relevant to classic railway wagons, not even in an adapted version, and therefore have no relevance to the PubTrans4All project are only being shown in an overview.

2 Methodology

In order to gain information on existing Boarding Assistance Systems for developing a "customer/user/operator-satisfaction analysis" and an "Assessment of the Usability of existing systems", the following working-methods had been applied:

2.1 Literature & Internet research, trade-show visits (secondary research)

Through the extensive use of vast literature in several languages and internet research (secondary research), a basic information pool on available Boarding Assistance Systems was developed. Data on countries outside Europe has been gathered through Secondary Research via the internet, and via qualitative methods via email by personally contacting targeted experts and opinion leaders (primary research).

Also personal visits of operators in Europe, e.g. with Swiss Federal Railway SBB, SJ Swedish rail, French Federal Railways (SNCF), South Eastern Trains UK only to mention a few, and meetings with e.g. the Association of Train Operating Companies and The Department for Transport, Railways, both in England, had been conducted, as well as visits at trade-shows, e.g. Mobility Roadshow Peterborough in June 2010, and are also planned for September 2010, e.g. Innotrans in Berlin, as well as meetings with representatives from the European railway and mobility industry.

2.2 Personal Interviews with Operators - Primary Research (Qualitative methods)

In order to find out about the needs of operators and user-groups at the same time and to gain information on the various Boarding Assistance Systems being in use, it was necessary to conduct personal interviews amongst experts, using e.g. interviewers being experts themselves in this field who interviewed representatives of operators (e.g. ATOC Association of Train Operating companies), as well as representatives from user-groups (JMCPS, UK, Campanions SNCF/RATP France etc.) to ask for their personal opinions, views and experiences about the various BAS being in use.

In addition to personal expert-interviews (qualitative research) with operators and representatives of handicap-organisations in various countries, a large amount of information has been gathered through electronic questionnaires by contacting these experts. The questionnaires covered the satisfaction-level of operators and users in reference to the BAS being in use, which prove to be useful information for further steps within the project.

Contrary, in Deliverable 2.1 quantitative research methods had been applied, by conducting a survey amongst 5.000 train users.

The applied methods had been necessary as only little information on this subject is available through literature, in order to receive information on these crucial soft facts that are building the basis of the project. Additionally a better understanding for the basic needs of Persons with Reduced Mobility was created.

Personal interviews with operators and user had been conducted in the following countries: Austria, Switzerland, Germany, Denmark, Sweden, Norway, United Kingdom, Ireland, France, Spain, Bulgaria, Hungary, Slovenia, Croatia, Serbia, Rumania, Netherlands, Belgium, Slovakia, Bosnia-Herzegovina, Montenegro.

It was necessary to implement this vast amount of countries in order to implement various European regions and their point of views, as facing different environmental conditions within the railway-sector and daily use of various different BAS.

3 Evalution Criteria - Deliverable 2.1

In order to provide a better overview of the evaluation-criteria in Deliverable 2.1, they are listed in Tab. 2. Only the main-criteria are covered herein, detailed information on each criterion are described in Deliverable 2.1.

Tab. 1 also describes the definition for the level of importance of each criterion.

Score	Meaning
1	**Very important** („must have“)
2	**Important** („nice to have“– high customer & operators´ value)
3	**Merely important** („nice to have“ – benefit for user and operator does exist, but is merely important)

Tab. 1: Importance of each criterion and its importance (score card)

Super-Criterion	Note	Importance
User Groups		
Users with technical aids	Wheelchair, walking-aid, pram	**1-2**
Physically impaired people	Walking impaired with/without crutches/walking stick, elderly, small people	**2**
User groups with special needs	Visually impaired, hearing impaired	**2-3**
Travellers	Passengers with luggage, pregnant women, children	**2-3**
Operation of the BAS personnel	Self operation of the system by the customers themselves or by automatisation	**2**

Operators		
Reliability of the BAS	No cases of malfunction	**1**
operation quality	Short dwell-times, no hindrance of train operation or passenger flow in case of mal-function	**1-2**
Operational costs	Need for personnel	**1-2**
Trouble-Shooting Management	Malfunctions to be resolved easily	**1**
Manufacturing/ Installation		
Universalism	The system needs to be universal and enable retro-fitting	**1-2**
Costs	Keeping costs as low as possible	**1**
Manufacturing effort	The manufacturing effort needs to be low – especially when retro-fitted	**1-2**
Safety		
Safety risks	No safety risks to be tolerated	**1**
Safety features	Optical and sonic warning devices/signals	**1-2**
Maintenance		
Maintenance	Little need for personnel and rare need for special technical tools	**1**
Costs	Role of costs	**2**
Environmentally friendly	Recyclability, energy consumption	**3**

Aesthetics		
Design & Appearance	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 this document had been set-up as more severely.		
Technical and operational specifications and environmental conditions see Deliverable 2.1 and 3.1 (appearing in December 2010).		

Tab. 2: evaluation criteria - overview

4 Boarding Assistance Systems, Mobility Aids - Overview

Mobility aids enabling to overcome barriers are seen in many daily-life situations. Whereas the railway-sector has just started about a decade ago to build accessible train-stations and train-vehicles, the building-sector has been doing so for a long period, having accessibility in mind as a priority.

What all Boarding Assistance Systems do have in common is to make them wheelchair-friendly, and safe for the wheelchair-user. A number of mobility-aids though focuses on other groups of Persons with Reduced Mobility, or are serving for comfort-purposes only, such as fixed ramps, lifting devices or escalators.

4.1 Accessibility/Boarding Devices on Trains - Overview

Railway-vehicles differ according to its area of usage, long distance/heavy rail or local-service operation, and are either high-floor or low-floor vehicles accordingly. Double-deck wagons, e.g. TGV/Tallin (SNCF) are able to provide level-boarding, or „almost“ level-boarding, depending on the provided platform-infrastructure.

Low-floor vehicles are mainly used in urban and regional transport-services, including tramway transportation-services. In combination with low-floor platform designs, low-floor vehicles provide almost level-boarding. The remaining gap is often bridged by sliding bridging-plates. Height differences are overcome by using ramps, or in some instances by electro-hydraulic lifting-devices.

High-floor vehicles are mainly used for long-distance service, the height-difference between platform (ground-level) and vehicle floor (floor-level) is typically between 35 and 110 cm depending on the vehicle itself, the flooring-height and platform-height, whereas a large number of height-differences is in the area of 70cm[1]. In these instances of such height-differences, mainly electro-hydraulic lifts are being used, ramps are used very seldom only. In the following chapter various different BAS that are currently in use are getting described, categorised in four groups. A detailed description is made in chapter 5.

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[1] Platforms 55cm and floor-level 125cm above track-surface

4.1.1 Ramps

Ramps are mainly used up to 18% inclination-angle to overcome little height-differences only. These ramps are either platform based, or permanently installed into the railway vehicle. Their operation is either done manually, semi-automatic, or automatic.

Loose elements, as well as ramps being installed permanently into the vehicle are being used. The usability and application of a ramp is limited by its required length according to the gradient that needs to be met.

4.1.2 Lifting Devices

Lifting devices being used in railway-traffic, are grouped into platform- and vehicle based. Platform-based lifts are either platform-based and typically operated manually using hydraulics or a winch. Sometimes also platform-based devices operated by a motor are being used. Vehicle-based lifting-devices are usually semi-automatic and are operated by trained personnel.

4.1.3 Gap Bridging

Devices that bridge and reduce gaps between vehicle and platform enable level boarding in combination with levelled platforms. Automatic sliding-steps which are connected to the automatic doors through the door-opener controlling unit, horizontally bridge the gap between the platform and vehicle, as well as fixed steps which are permanently mounted to the outside of the vehicle are being used.

4.1.4 Additional Steps

Additional Steps are being used by railway vehicles as an additional aid for the passenger. They are necessary for platforms varying in height along the journey. The control is managed by the door-opening control unit. Additional steps also serve to reducing or bridging and closing the horizontal gap between the train and the platform.

4.2 Miscellaneous Mobility Aids – An Overview

4.2.1 Bus Traffic

There is a recognisable trend amongst bus traffic towards the use of low-floor vehicles within regional traffic. Low-floor vehicles are typically equipped with kneeling-systems and provide an almost level-boarding situation at bus stations which had been designed for that purpose. For wheelchairs there is usually an additional foldable ramp integrated into the vehicle in order to bridge and close the remaining gap between the bus and the bus stations´ ground-level.

Especially during the last decade the bus-building industry has followed the European Directive 2001/85 specifying the accessibility requirements for urban and long-distance buses. Since then each bus needs to comply with these regulations in order to pass homologation process for buses that are registered within European Member-States.

Buses serving on long-distance routes are typically high-floor buses, which are usually equipped with lifting devices, see Pic. 1 (right), in order to enable wheelchair-occupants to use long-distance bus-service. These lifting devices are typically electro-hydraulic lifts which are almost exclusively used for wheelchair-occupants.

Mini-buses are mainly used by Community Transportation Services (e.g. Red Cross and Johanniter in Germany, GHIP in France and CTA in the U.K.), as well as private transportation service providers, that need to fulfil local safety requirements for the homologation of their specialised vehicles for wheelchair-occupant transportation. Depending on the country, electro-hydraulic lifts are being used (e.g. U.K., Scandinavia), or manual ramps (e.g. Germany, France), see Pic. 1 (left).

Pic. 1: Electro hydraulic lifts (Minibus, left; High-floor bus, right)

4.2.2 Low-Floor Technology

Public buses within urban transportation have been using fleets consisting of vehicles using low-floor technology equipped with kneeling systems mostly using air-suspension.

Low-floor technology covers vehicle constructions providing little height-differences between the vehicles´ floor level and ground level of the bus or train-station platform.

This technique is being applied for buses as well as for train vehicles, and enables level-boarding of the train and accessibility of the vehicles in combination with bridging-devices or ramps.

The low-floor technology is achieved by applying various measures and is lowered between the axils. Therefore the floor-level within the vehicle is not the same along the whole vehicles due to the construction of the bogie and the clutches**,** hence only the middle section of the railcar is equipped with the kneeling system. In order to access the other the floor levels amongst the vehicle, stairs or ramps are used.

4.2.3 Air Suspension Technology

Air suspension technology is being applied amongst road vehicles, especially buses, and enables a one-sided suspension of the vehicle (kneeling function). In combination with low-floor technology an almost complete and accessible situation is provided, which can be completely designed step-less by using an additional ramp.

Railways do not only use the air-suspension technology for improving the comfort during the journey, but also to enable the lowering of the train-vehicle according to the ground-level of the platform. This technique is mainly applied on high-speed services, the possible compensation of the floor to ground level is within the range of a few centimetres only.

4.2.4 Automotive Traffic

For the individual road traffic in automotive vehicles one distinguishes between Active drivers (PRMs), and Passive users, so called “passive drivers” who are getting driven in motor vehicles, e.g. wheelchair occupants. Wheelchair Occupants these days also have the possibility to drive from the wheelchair, typically using converted Minivans (Pic. 2).

Active drivers are using 2 main types of Boarding Assistance systems based on their function: Wheelchair stowing systems, which automatically stow the wheelchair on the rear-seat behind the driver row or trunk after the wheelchair user has moved over from the wheelchair into the driving seat him or herself (with upper-torso movement abilities).

Pic. 2: EDAG Wheelchair Stowing System (left), TMN trunk stowing system (right)

The second category are swivel-seats that turn out of the vehicle half automatically, declining their horizontal level of the seat base to facilitate the boarding/access process. (see Pic. 3).

Pic. 3: car boarding aid (AUTOADAPT)

This mobility aid can be fitted into almost every passenger car.

4.2.5 Building/Construction Business

Construction business is usually installing ramps and elevators to make their buildings accessible and "barrier-free". Their major advantage is that they are usable by each user group amongst people with reduced mobility.

Ramps are mainly used to overcome little height differences and are mostly used in combination with stairs. Due to the limit of 6% of inclination-angle in building business, ramps are accordingly designed and built, meaning long-length ramps!

Elevators can be adapted according to all conditions and for all usage purpose. They operate either electro-mechanical or hydraulic. Key-factor for its fully accessible usage is a cabin that provides generous and sufficient space (see Pic. 4).

Pic. 4: Leoba Hublift MB (left)

For the adaption of houses, stir-lifts are being used, which is installed and integrated directly into the stairs-area (Pic. 5 and Pic. 6).

Pic. 5: stair lift (Ango Reha)

Pic. 6: stair lift (Leoba HL 150)

A mobile alternative to permanently installed mobility-aids is a stair-climber for wheelchairs in order to overcome stairs (see Pic. 7).

Pic. 7: stair crawler (Leoba)

5 BAS in the railway sector

For the railway sector there is a large number of accessibility systems in use. The systems can be grouped according to various specifications.

The following list groups the systems according to their functional principles:

- Ramps
- Lifts
- Bridging devices

Within each of the above mentioned groups, the systems are again divided based on their constructional principles, e.g. manual, semi-automatic or automatic. The division is depending on the type of motor of the device, or if the systems are either vehicle based or platform based.

5.1 Ramps

Ramps are mainly used in cases of little height differences, but there are also ramp constructions available which handle medium and large height differences. Due to their enormous length and design in order to accommodate the maximum inclination-angle, they are depending on the width of the station-platforms. In general, ramps are either permanently integrated into the vehicle, or mobile ramps that are applied manually, as well as versions that are situated on the platform, being either mobile on wheels or can be carried to the train.

Most operators are quite satisfied using ramps, due to their ease of use and simple reliability, and low chance of wrong-use or and no mal-functions. Ramps are relatively against weather and can usually be used by all passenger groups as providers are happy to provide them for non-wheelchair users as well.

5.1.1 Manual Ramps

This type of ramps is either vehicle-based or platform-based, is mounted on either side of the door entrance area, and can be unfolded or slid out from the vehicle onto the platform. One example is the ramp which is in use by Austrian Federal Railways made by MediVent, which is used in low-floor vehicles (Pic. 8).

Pic. 8: Mobile Ramp ÖBB (MediVent)

The series of pictures in Pic. 9 describes the operation of the MediRamp. The order of pictures is showing the required operations step by step in chronological order, left to right:

1) Block doors – preventing automatic closure of the door.
2) Disengage ramp – the ramp is locked while stowed to prevent misuse.
3) Swivel ramp around 90°.
4) Move ramp onto the platform.
5) Unfold ramp.

Pic. 9: Typical Operation of a manual ramp

The mediVent ramp can be installed on either side of the door-entrance area of the vehicle, and is generally designed for low-floor vehicles in order to overcome gaps, or for height-differences of up to 190mm at a maximum inclination-angle of the ramp platform of 18%.

In general it can be applied for doors with a minimum door-width of 80cm, providing space for the installation inside the vehicle. The low-floor train Talent as used by Austrian Federal Railways ÖBB the original door-width of 130cm is narrowed by the installation. The entrance cannot be used at the same time by other passengers when the ramp is in use by wheelchair-occupants.

Allowing all passengers to use the ramp when in operation means a great improvement for all passengers and their comfort when travelling.

The minimum cycle for its operation is 50 seconds, in which case the trained personnel needs to be situated at the door entrance besides the ramp already. In case is not situated there already, the required time for the whole operation longer accordingly. Especially if there is no personnel other than the driver on board, the driver needs to leave and lock the driver´s compartment, walk the distance to reach the accessible boarding area, and do the same reverse procedure after having run the full cycle of the Boarding Assistance System (BAS). The whole procedure can take from 3 minutes up to 6 minutes, depending on the location of the accessible boarding area.

This procedure leads to severe delays of the train schedule, and is therefore criticised by the operators.

Pic. 10 is showing a similar system that is used by the Danish Federal Railway (DSB). The technical parameters and basic complications are similar to the MediVent ramp Pic. 8.

The difference regarding the installation is that the ramp is locked in a locked compartment inside the train. South Eastern Trains in England is also using a similar stowing system. The main difference installation-wise is that the ramp is getting stowed in a locked compartment. The basic satisfaction-level of the operators is quite high, especially in regards to ease of operation and maintenance.

When installed into a vehicle-door that accommodates the system as shown in Pic. 10 the main advantage is sufficient remaining space so that other passengers can use the entrance unhindered, which has a positive effect on passenger-flow.

Pic. 10: Ramp DSB (Guldmann)

Larger height differences can be overcome with ramps that are foldable into two half as shown in Pic. 11 and Pic. 12. This application requires a platform though that provides a sufficient width.

Pic. 11: Ramp in Belarus

Pic. 12: Semi-Automatic Ramp Latvia (MediVent)

Furthermore there are non-vehicle based, mobile ramps in use, which are deployed at the vehicle and operated accordingly, and stowed again after the operational cycle. They are either stowed in the vehicle or at the train station on the platform at a central location.

Pic. 13 and Pic. 14 are showing short and light weight mobile ramps, that can be applied with ease. They mainly serve to bridge gaps or small height-differences. They are mainly used for wheelchair-occupants only, if applied though, real life shows that its use is also welcome by other passengers.

Pic. 13: Manual Ramp (SBB)

Pic. 14: Manual Folding Ramp Thurbo AG (Carosserie Hess AG)

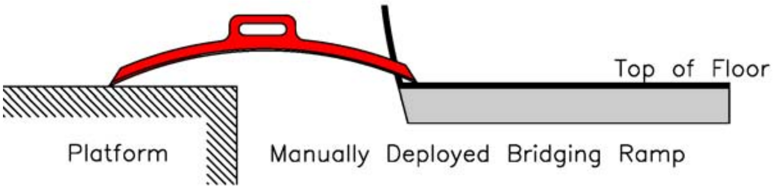
Pic. 15 is showing a manual folding ramp of JR (Japan Railways). It can be folded twice and can easily be stowed without taking much space. Its operation is similar to the ramps in Pic. 13 and Pic. 14.

Pic. 15: Manual Folding Ramp, Japan Railways JR

Source: http://www.petertan.com/blog/2006/02/16/kuala-lumpur-city-of-barriers/

Pic. 16 and Pic. 17 show bent a bridging device (bridging ramp) which are applied manually as used in the U.S.

Pic. 16: arched manual gap bridging - USA



Pic. 17: Manually Deployed Bridging Ramp (bent base plate)

Source: Email Andrew Nash

For greater differences in height, mobile manual ramps with longer base plates are in use. They are either stored in the vehicle itself or on the train station platform, and operated by the train staff, or staff of the train-station.

Especially in Great Britain and Ireland this particular type of ramps is very popular, due the common platform height of 915 mm und 960 mm as shown in Pic. 18, Pic. 19 and Pic. 20. This ramp-type is welcome by all other passengers as well due to the improvement of their comfort when travelling.

Again the satisfaction-level scores high amongst both operators and users.

Pic. 18: Ramp as used by Irish Railways (Port-a-Ramp, UK)

Pic. 19: Ramp as used by Irish Railways and by South Eastern Trains, England

Pic. 20: Manual mobile Ramp (Port-a-Ramp, UK) to bridge the gap between the train and the platform (South Eastern Trains, England)

Mobile manual ramps have the additional advantage that they can be used to overcome a higher height difference, e.g. height of a stair).

Pic. 21: Ramp bridging a stair downwards, Eastern German Railways (Ostdeutsche Eisenbahngesellschaft)

Pic. 22: Transportable Ramp (MediVent)

Other types of mobile manual ramps, are telescopic ramps, as used for Minibuses as their origin is the automotive sector as shown in Pic. 23. They are easy to handle, although operators dislike their use due to their design, consisting of 2 ramps, usually telescopic, which bare the risk of the wheelchair-wheel getting stuck and therefore baring a certain risk, especially when leaving the train.

Pic. 23: Telescopic Ramp , City Bahn Chemnitz

This type of ramp is used by the Norwegian Train (NSB) in the telescopic version, also in high-floor vehicles, managing height-differences of 50-60cm as shown in Pic. 24.

This system is very popular especially in Norway, as all other systems used in Norway face great difficulties due to harsh weather conditions die do icing and amounts of snow. From a user´s and operational point of view the application of this type of ramp is not without problems die to safety reasons and potential hazards as mentioned before.

Staff needs to be positioned between the telescopic ramps which means a great amount of physical effort to push wheelchair and occupant onto the train, which is a great effort the further up the wheelchair is pushed.

Pic. 24: Telescopic ramps, NSB (Norway)

For greater differences in height a lot of operators do use as well platform-based foldable ramps as shown in Pic. 25 and Pic. 26.

Their main advantage is their ease of use although being heavy in weight due to their length. A considerable disadvantage is the need for a considerable amount of platform-width, which has a negative influence on passenger-flow.

Pic. 25: Ramp DB AG (MediVent)

Especially the Norwegian type of ramps is very flexible and easy to manoeuvre. The operators are very happy with this type of ramp, the only critical part is towards its end facing the inside of the vehicle as clearly shown in Pic. 26.

Pic. 26: Platform based Ramp NSB, Norway

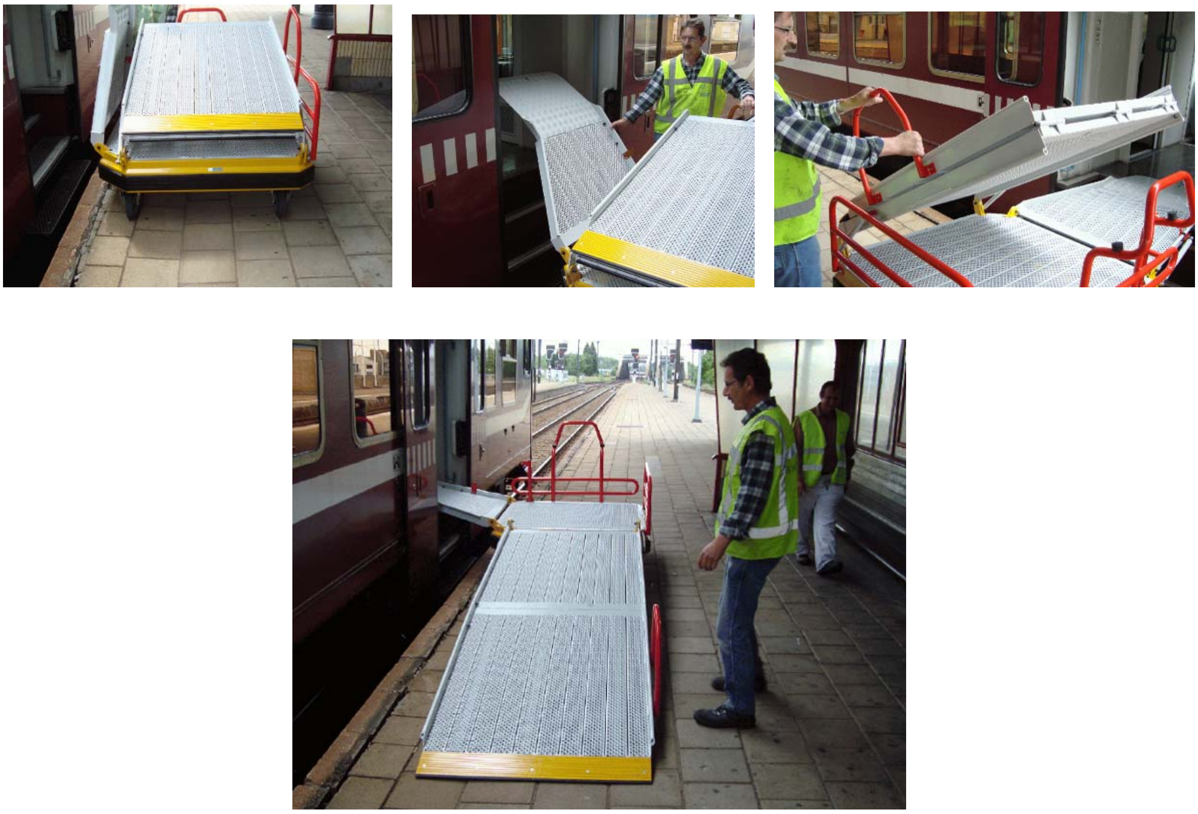
These ramps are designed for wheelchair users, but can also be used by all other passengers. The operation is handled though personnel only though.

An operational cycle takes up to 3 minutes, so many operators face a delay in their schedule due to the application of the ramp, especially when train-personnel needs to operate the ramp. When railway station is available, the duration of the operational cycle is shortened, so that other passengers can use the entrance area again without being hindered. A registration of the journey by wheelchair-users is not necessary, but very welcome due to the limited amount of wheelchair-places that are available.

Mobile ramps score very high in the operator´s assessments in terms of reliability and mobile application options.

Great differences in height between the train floor level and ground-level of the platform require a large amount of ramp-length. As long ramps do hinder passenger flow when used across the platform, ramps that are positioned parallel to the platform are getting used, as shown in Pic. 27. Therefore the wheelchair occupant needs to turn around at 90°. There are also designs available incorporating a round, swivel base-plate as shown in Pic. 28.

Designs differ depending on different platform heights.



Pic. 27: Parallel Ramp (Belgium)

Pic. 28: Swivel Base Plate

5.1.2 Integrated Ramps

This type of ramps is vehicle based and installed around the door-entrance area. Its origin is the automotive industry where this design is mainly used for family Minivan conversions. They are either powered by electricity, or manual devices as shown in Pic. 29 and Pic. 30, operated fully automatic. This type of ramp is used in low-floor vehicles or tramways.

Pic. 29: Sliding automatic ramp, MBB Palfinger

Pic. 30: Ramp (Guldmann)

5.1.3 Permanently Installed ramps

This type of ramps is vehicle-based, installed into the flooring of the vehicle at the entrance area, and is operated electrically or manually.

This ramp consists of one part only or is designed as a telescopic ramp. Its operation is fully automatic. Also this type of ramp is mainly used for low-floor tramways and low-floor trains in order to bridge gaps as shown in Pic. 31 and Pic. 32.

Pic. 31: permanently installed manual ramp

Pic. 32: Metronom

Permanently installed manual ramps are also designed as telescopic versions as shown in Pic. 33. This ramp-type is integrated into the vehicle-flooring at the entrance area.

Pic. 33: Telescopic ramp, inegrated into vehicle-floor (Masats)

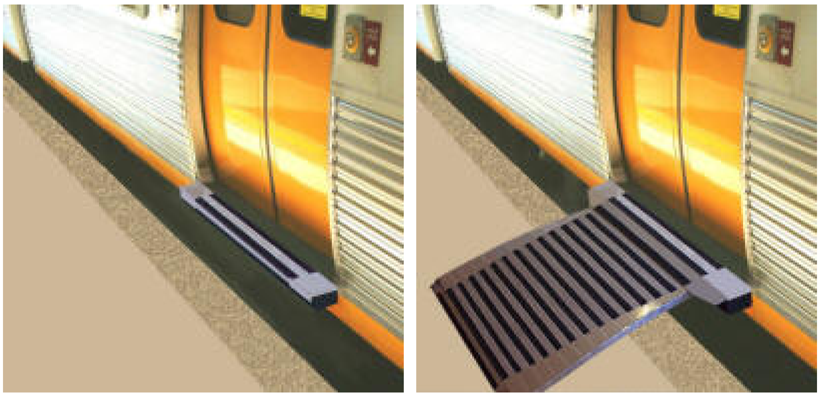
5.1.4 Folding Ramps

This type of ramps is vehicle-based, installed at floor level of the vehicle, and manually deployed when in use. Folding ramps are mainly used in urban transport in tramways or buses as shown in Pic. 34. Operators are very satisfied with this type of ramp as it is very reliable due to the lack of mechanical "motors" and has only one swivel operation to perform.

Pic. 34: Ramp RBS (IBEG)

5.1.5 Ramps – extra designs

Pic. 35 and Pic. 36 show the idea of a telescopic ramp that is permanently into the vehicle floor, which has not yet been realised. According to the designer, this ramp can be retro-fitted into existing vehicles.



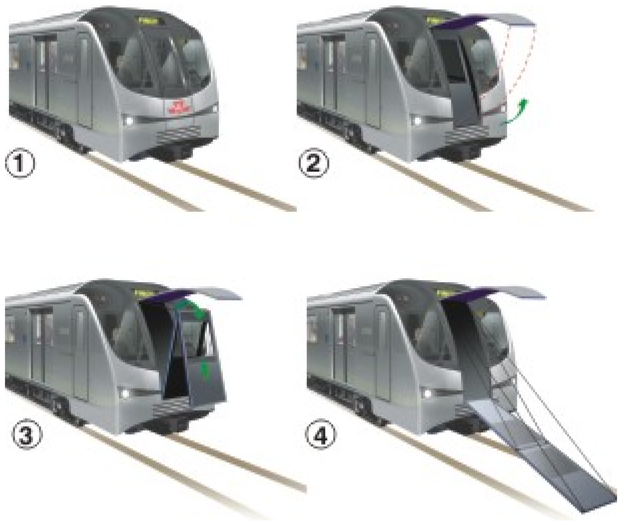
Pic. 37: Telescopic ramp (Idea – not yet realised)

Source: http://www.scienceinpublic.com/freshinnovators/2005/Kevin/kevinfullerton.htm

Pic. 38: Operation of integrated telescopic ramp

Source: http://www.scienceinpublic.com/freshinnovators/2005/Kevin/kevinfullerton.htm

Pic. 39 is showing a special case for a ramp solution. The shown ramp only serves fo evacuation in case of an emergency only. The operators expect a safer, simpler and faster evacuation-process.



Pic. 39: TTC Subway Trains (Toronto Transit Commission) – Ramp for simplified evacuation

Source: http://www3.ttc.ca/About_the_TTC/Projects_and_initiatives/New_Subway_Train/Overview_and_key_features.jsp

5.1.6 Platform-based ramp

Besides various manual mobile ramps, there are also permanent platform-based ramps in use. Their advantage is that they are easy to find and to locate at the train station for PRMs, and can also be used by other passengers, as opposed to lifting-devices. It is necessary though that the train does always stop at the exact same location.

These ramps serve to overcome a tremendous height-difference which is quite common on North-American long-distance trains due to the height of the first step of train-vehicles that are typically used.

Travellers are able to use the ramps before arrival of the train, which helps to save time in the boarding process in order to keep the time-schedules. The gap between the train and the permanent ramp is bridged by a foldable ramp as shown on Pic. 40, Pic. 41 and Pic. 42.

Pic. 40: permanent platform-based ramp - USA

Pic. 41: platform based ramp for double decker trains – USA

Pic. 42: Harrington Hump, UK

Another version of a permanent platform-based "ramp" is used on the underground in Hamburg (Hamburger Hochbahn) as shown in Pic. 43, and London Underground. This is actually achieved by raising a part of the platform up to vehicle floor height, also enabling accessing non low-floor vehicles and can be used bby all PRMs and other passengers for their comfort, as the rest of the vehicle-entrances bears one stair-height to overcome when accessing the vehicle. The entrance area for PRMs is clearly marked.

Pic. 43: U-Bahn-Station St.Pauli (Hamburg – Deutschland), Risen Platform section

Source: Jivee Blau, http://de.wikipedia.org/wiki/Datei:Hamburg-_U-Bahn-Station_St._Pauli-_auf_Bahnsteig_zu_Gleis_1-_Richtung_Barmbek-_U-Bahn_HHA_Typ_DT4_9.4.2009.JPG#filelinks

5.2 Vehicle-based Lifts

Lifts, in various versions, play a main role amongst classic train-vehicles, especially in combination with standardised platform heights as used nowadays. There are both platform-based and vehicle-based lifts available that are permanently integrated into the vehicle. For the PubTrans4All project especially vehicle-based systems are playing a major role for the future, based on the findings of the surveys of deliverable 2.1 amongst the great part of operators and users.

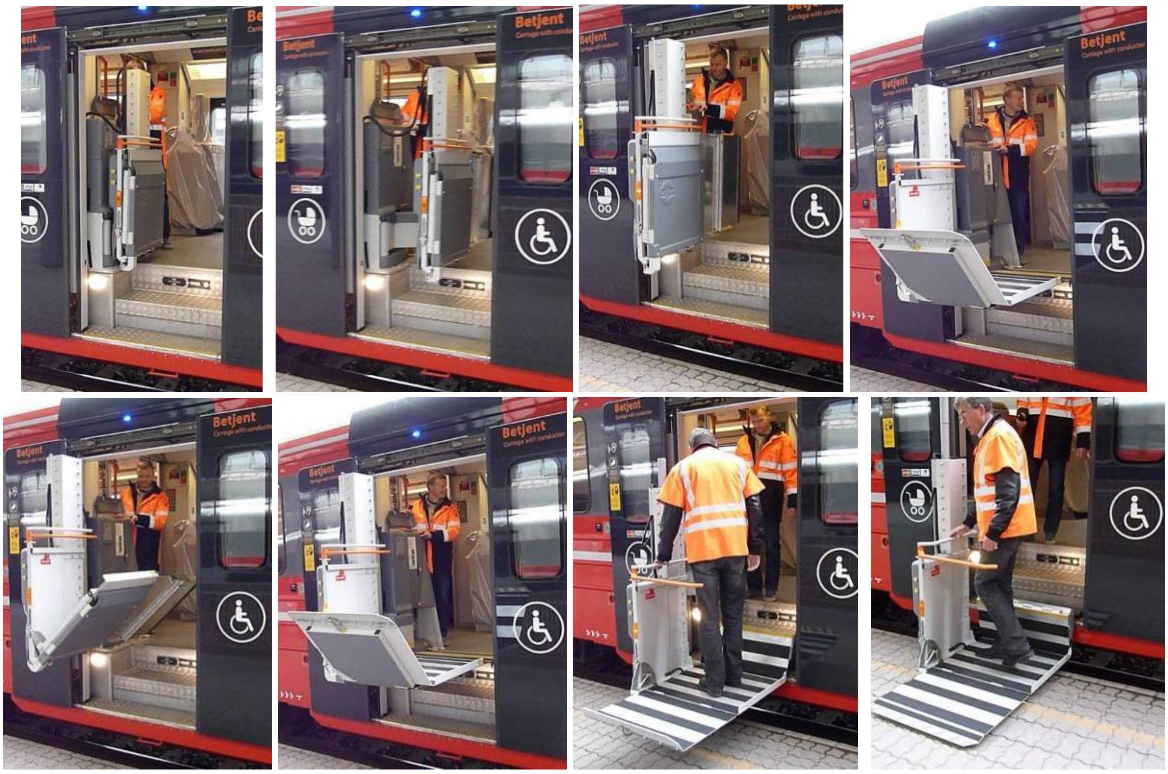
The basis satisfaction-level is scores high. Occurring problems and criticism is concerning technical and constructional details mainly, which differ from operator to operator. The same lift-type can cause many problems with one operator, but non with another one for example. In this context no exact statements are possible in regards to the advantage of platform-based devices over vehicle-based devices, and vice versa. Only the wish and request for vehicle based solutions is commonly found.

5.2.1 Pivoting/“Swing“ Lifts

This lift-type is vehicle based and permanently installed inside the vehicle at either side of the door entrance area. If needed the platform is swivelled outside the vehicle by a pivoting one arm operation, operated hydraulically. The operation is either semi- or fully- automatic see Pic. 44 to **Fehler! Verweisquelle konnte nicht gefunden werden.**). This design version is used for overcoming both small and great height-differences, especially when platforms are too narrow to use ramps.

Pic. 44: Pivoting lift (MBB Palfinger Trainlift TR 1)

Pic. 45: Lift ÖBB-Railjet



Pic. 46: Schwenklift bei der NS (Norwegen)

This lift-type is only used by wheelchair occupants, is operation is performed by trained personnel. The operational cycle is 2 to 3 minutes, depending on the model. Due to the operation of the lift potential delays in the time-schedule are caused, a pre-registration of the journey by the wheelchair-occupant is not necessary though.

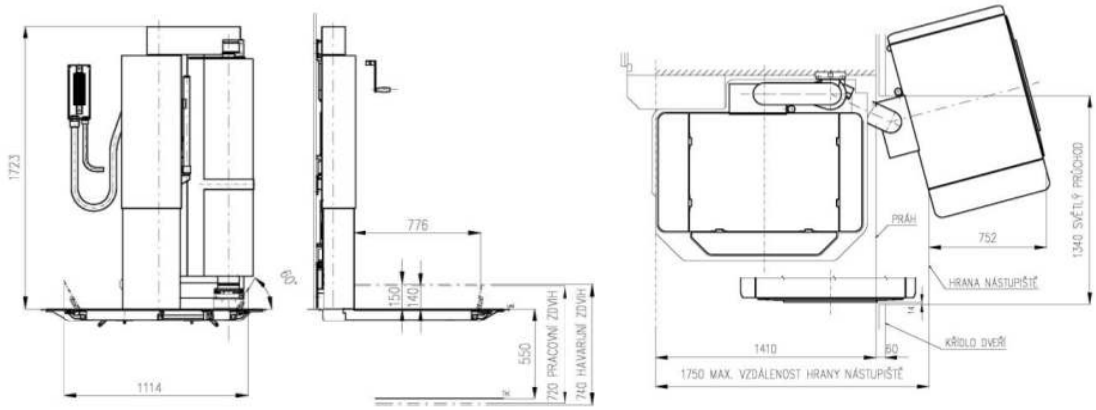
This system scores between a good and very good reliability when in operation and has a good satisfaction level amongst operators. Also users are very satisfied with this system.

For narrow platforms, lift design by Pic. 47 and Pic. 48 "Pars KOMPONENTY" in Czech Republic are very useful. The wheelchair user enters the platform inside the vehicle, and is then moved outside though a platform that swivels around enabled through a pivoting one-arm construction.

Due to required space of this design it can only be used in combination with wide door dimensions in the entrance area. Based o comments of the manufacturer, this particular model can only be used in double-deck trains.

Pic. 47: Lift PARS KOMPONENTY (Czech Republik)

Sourcee: http://www.parskomponenty.cz/katalog.php?typ1=plosiny&urceni1=vlak&kt=05_002&mutace=de



Pic. 48: layout of PARS KOMPONENTY lift

5.2.2 Pivoting one arm lift

This lift-type is installed into the door area of the vehicle, and has yet only been applied to low-floor vehicles and urban buses.

For the installation an opening in the vehicle floor is required, in which the device is moved up- and downwards by electric power. When in Use, the platform is lengthened by a telescopic operation as shown in Pic. 49.

Pic. 49: lift (MBB Palfinger Medilift SB 300)

5.2.3 Lifting device (cassette lift)

This lift-type is installed into the door area of the vehicle. Also this type of installation requires an opening in the vehicle floor in which the lift is moving up- and downwards inside an electrically powered parallel operation, and its platform operates telescopic when used. Also this version has yet only been applied to low-floor vehicles.

A main advantage of the cassette-design is the little space that is requires on the platform, which enables its usage on narrow platforms.

Pic. 50: lifting device (MBB Palfinger Medilift R 3.3)

5.2.4 Linear Lifts: Single and Dual Parallel Arm (DPA) Lifts

This lift type is also vehicle based and as well installed at the door entrance area, directly onto the vehicle-floor as shown in the examples of Pic. 51 to Pic. 54. The operation is either semi- or fully automatic. Its platform prescribes a linear operation when operated, a linear up- and down operation. Usually a bridging-plate enables the wheelchair user to enter the unfolded horizontal platform with its front wheels facing towards the platform-end outside the vehicle. An automatic roll-stop prevents the wheelchair user to collapse from the platform while moving from floor to ground level and vice versa.

Especially this lift type scores differential in regards to its satisfaction-level. A reason for this fact could be that it is the most common lift type used in all areas of transportation in general worldwide, so there is a great variety of brands and models available. Main manufacturers and global players do have hundreds of models and versions available in their product-portfolio.

In general operators are very satisfied with this lift-type. Some operators are not very satisfied though concerning its reliability.

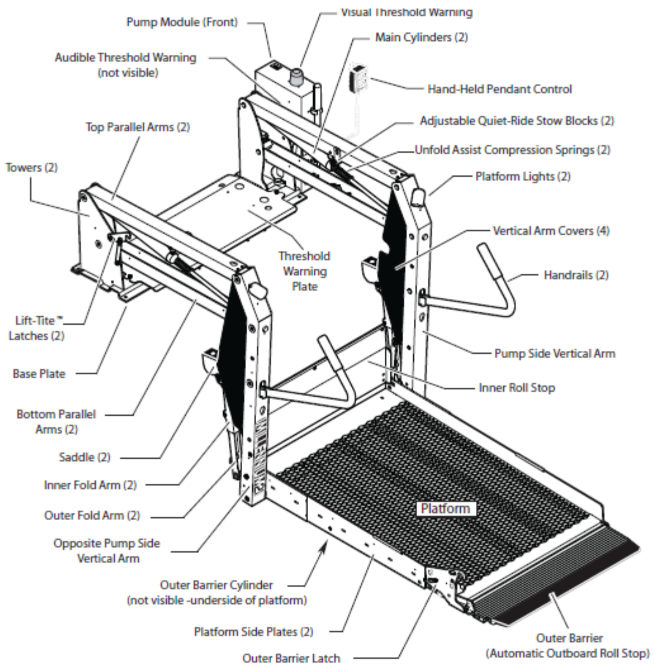
Pic. 51: Linear lift (Ratcliff Palfinger Trainlift RVT 300)

Pic. 52: Linear lift SJ (Ratcliff Palfinger X 2000)

Pic. 53: Lift SBB

Pic. 54: Linear lift (U-Lift)

"The" classic linear lift is the so called, Dual Parallel Arm lift (DPA lift) which is the most common lift version around the globe. It is mounted on 2 parallel arms, hence its name.



Pic. 55: Drawing & Design Parts: Typical Linear- Lift, Type DPA Dual Parallel Arm

Source: http://www.braunability.com/commercial/ebrochures/Millennium-2.pdf

As shown in Pic. 56, the "Schweizerischen Zentralbahn" applies a special construction, a "slide-to-the-side function". Instead of having the base-plate permanently mounted to the vehicle floor, it is mounted on a slay so the lift slides out of the way sideways, powered electro-mechanically, and stowed parallel to the vehicle-door as shown in Pic. 56.

DPA lifts unfold its platform into a horizontal position, which is then ready for power-up or gravity-down operations. The operator is very satisfied with this particular lift-type. So far there is only one case of mal-function known to the operator.

Pic. 56: Lift Zentralbahn (Switzerland)

Other versions do use vertical split-platform versions, which stow each half of the platform at the left and right tower, positioned at 90degrees in relation to the door.

Linear Lifts are only used by wheelchair-occupants and need to be operated by trained personnel. The operational cycle is 2-3 minutes and leads to short delays in the time-schedule. A pre-registration and booking by the wheelchair user is not necessary, but advised due to the limited amount of wheelchair places available.

The satisfaction is scoring high, as assessed by the user.

5.2.5 Cassette lift

This lift type is also vehicle based and as well installed at the door entrance area, typically below the door. It is stowed in a cassette, hence its name, protecting it from all weather-influences as ice, dust, sand etc. It is powered electrically, hydraulically, and semi-automatic. Due to lack of sufficient space (cable installation, clutches) at the door entrance towards the ends of classic train wagons, it cannot be applied for retro-fitting.

Pic. 57: Cassette Lift (RICON Mirage, used at FS – Italien)

5.2.6 Other Lifts

SJ (Sweden) The railcar is using a vehicle-based lift integrated into the vehicle floor as shown in Pic. 58. The entrance is positioned 55cm above track-surface.

On all platforms that are designed at the same height, a level-boarding situation is possible. In order to provide a fully accessible boarding situation, a fully-automatic bridging-device is applied. The user is provided with a fully accessible level-boarding situation, and can operate the device him or herself in order to reach the floor level of the vehicle, as shown in the series of pictures in Pic. 59.

Pic. 58: SJ – Regina Lift

Pic. 59: Operation – SJ-Regina Lift

The lift is designed for all user groups and can be operated by the traveller. It´s operation cycle is one minute and does not lead to delay or influence the passenger flow, as there is space available and stairs besides the lift.

The reliability is assessed as good by the operators due to its self-service operation ability, and no need for pre-registration of a journey, see Pic. 59. The only criticism concerns misuse of the lift, when operated by travellers without its real need. Therefore some train drivers do de-activate the device.

A comparable similar device, but not the same, is used on TGV Duplex trains (double decker) of SNCF France. In this application, the device is lifted from platform level down to floor level of the lower floor of the double-decker train, as shown in Pic. 60. The device is only designed for wheelchair-users, but not for other passengers, and needs to be operated by the train personnel.

Pic. 60: TGV Duplex – SNFC - Lift

Source: Pintsch Bamag

Pic. 61 is showing another lift as applied by SJ. The operation of this lifting-device is very simple. This particular lift is still working reliably after 30 (!) years of operation.

The lift is integrated into the wagon-floor, and the platform only needs to be unfolded, and the lift moves onto the platform in a similar way as linear lifts. The operation is done very quickly, even though the lift does not satisfy today´s requirements, e.g. it is only designed for 125k capacity. Doors only have a clear width of 80cm, therefore the lifting-platform is narrower as the required 80cm minimum.

Due to the two pillars, which fulfil the function of spreading the load of the pressure-forces of the buffers, there is no space on the end of classic wagons for the installation of pillars with pivoting arms. For that reason the door is installed at a door located further away from the wagon´s end, moved towards the middle section of the vehicle as shown in Pic. 62.

For weakening-reasons of the vehicle cars´ rigidity, vehicle manufacturers do not like to install doors towards the middle section of the train-car.

Pic. 61: Lifting device SJ - Sweden

Pic. 62: Wagon adapted for PRMs (SJ) – door location

Pic. 63 is showing a patented idea of the Berlin based company MediVent, which is registered for a patent. The device is fully integrated into the vehicle and the use can operate it completely independently.

This new design principle enables the wheelchair user to board a cabin which is closed on 3 sides which is then lifted and integrated into a door-opening. An operation- and control-system is connected to the driver during the boarding operation

http://www1.messe-berlin.de/vip8_1/website/Internet/Internet/www.innotrans/deutsch/Presse/Neuheiten-2010/index.jsp?selektion=M

Pic. 63: Lifting device – Moving Side-Wall – Idea: MediVent

Source: http://www1.messe-berlin.de/vip8_1/website/MesseBerlin/htdocs/Bilder_upload/Neuheitenreport/9845.jpg

5.3 Platform Based Lifts

There is various versions of platform-based lifting devices applied by different operators. They are operated manually or are electrically powered (see Pic. 64) by using a winch (see Pic. 65) or hydraulics (see Pic. 66).

There are also permanently installed devices in use as shown in Pic. 67 to Pic. 69, they can be used by all Persons with Reduced Mobility, and require the train to stop at the same spot each time.

5.3.1 Manual platform based lifts

Pic. 64: platform lift (Herkules WG 300)

Trained and experienced is preparing the device prior to the arrival of the train to keep the operational cycle as short as possible. Passengers who alight the train are already awaited at the platform at the specific door. The wheelchair and occupant move from the train vehicle floor onto the platform of the lifting-device and the platform is moved downwards. He entrance is only blocked for a minimum amount of time.

For the boarding process the wheelchair-occupant is waiting until all other passengers have boarded the train, and he or her board the deployed lift platform pre-positioned on the ground-level of the platform, and is then lifted up to floor-level of the train in order to enter the vehicle. Also the boarding process only takes up little time as compared to vehicle-based solutions.

As soon as this operation is finished, the lifting-device is stored again on the platform.

Pic. 65: Lift as used by Deutschen Bahn AG (Herkules WG 300)

Another advantage of platform-based lifts is hat a potential mal-function does not harm the departure process of the train. Furthermore the personnel can double-check the functions of the device prior to train arrival. Also the period in which the entrance cannot be used by other passengers, is very short, as the preparation of the device is done independently from the boarding-process.

Basically the reliability is very good, also the satisfaction level of the wheelchair occupants, who are the only users of this system. Usually train station personnel is responsible for the operation of this system, as with all other platform-based devices. If required also train personnel can operate this lift-type, the required amount of time for the operational circle is longer though.

A critical climate area for is usage in Europe is Scandinavia due to the harsh local weather conditions. Large amounts of snow that often cannot be removed in time, operating the device during snow fall, as well as gravel on the platform make it difficult to manoeuvre platform-based boarding devices. In cold weather conditions icing occurs as well, leading to blockage of operational and moving parts of the device. Hydraulic oil thickens which lead to mal-functions of cylinder. Therefore leading global lift-manufacturers are using aero-grade oil, which is thinner and prevents crystallisation.

A major disadvantage is that each train station within the network needs such a BAS locally in order to provide accessibility amongst the network.

Also the station needs to provide personnel, leading to a large amount of personnel required, who sometimes need to travel to the specific, unmanned station. Another disadvantage is that the journey needs to be booked one to two days in advance. In addition, the personnel need to know the exact stopping position of the accessible wagon in order to keep the operational cycle short.

If operated by train personnel, a long delay occurs accordingly due to the time consumption for the walking-distance to the stowing-location of the BAS, unlocking the stowing compartment, position the lift at the platform, and preparing the lifting-device for usage. After its use it needs to be carried back to its stowing compartment and locked again.

Pic. 66: electric platform lift (Guldmann)

Manual platform-based lifting devices are the most common systems within heavy rail long distance service. Assistance requires bookings a day in advance with most railway-operators. Larger train-station offer this service without pre-registration. Its reliability and ease of use is assessed varies from “good” to “very good”, based on different versions and builds, with no need for regular maintenance, hence the varying range in their assessment

As the system cannot be operated by the user himself, it is only rated as a „good“ amongst them.

5.3.2 Permanently installed, platform-based Lifting Devices

Especially overseas permanently installed, platform-based lifting devices are very common. The traveller can easily locate it from time to time again, which is a great advantage. For operational reasons the vehicle needs to stop with its accessible wagon at the exact same location each time. These devices are commonly found at regional train services, tramways, buses (including long-distance), as the location of the the cars is usually always the same with these types of vehicles, or can easily be built as required.

Pic. 67 to Pic. 69 zeigen are showing such examples. There are also such lifting devices for buses trains (Pic. 68) and tramways (Pic. 67 and Pic. 69).

Pic. 67: Platform-based, permanently installed lift for tramways

Source: http://www.worldofstock.com/closeups/TRO2862.php

Pic. 68: Platform-based, permanently installed train-lift, U.S.A.

Pic. 69: Platform-based, permanently installed tramway-lift, U.S.A.

5.4 Gap-bridging devices

Bridging devices for gaps are mainly used in urban transport and are used for reducing and closing („bridging") the gap between station-platforms and vehicle floor-level. They are mainly vehicle-based, but there are also platform-based versions available, especially in the United States.

5.4.1 Vehicle-based bridging devices

A vehicle-based bridging device only requires little space for its installation. It can bridge a gap of approximately 150mm at the max. Design-wise there are several different versions available.

Besides permanently-installed devices as shown in Pic. 70, which can touch the platform horizontally without being harmed and only reduce the gap but do not fully close it, there are also mechanical and fully-automatic versions available, which either extend or unfold and partially close the gap as shown in Pic. 71 and Pic. 72).

As these systems do not play a major role within this project, only an overview is given in this report.

Pic. 70: Permanent bridging-device/bridge-plate (Wiener Linien U6)

Pic. 71: Sliding bridge-plate

Pic. 72: bridging device (IFE Knorr)

Pic. 73 is showing a bridging device of the Viennese Underground. A sliding bridge-plate which is extended in each station for boarding and alighting. It touches the edge of the platform and bridges the gap completely.

Pic. 73: sliding bridge-plate, Vienna Underground

Source: http://www.ife-doors.com/en/products/accessdevices/gapbridges/gapbridges.jsp

5.4.2 Platform based gap bridging

Pic. 74 shows a platform-based system as used at New York Underground and manufactures by Manning&Lewis. The advantage of platform based devices are their easy retro-fit and upgrade abilities.

Operation-wise the train needs to stop at the exact same location each time in order to halt at the accessible entrance area designed for PRMs. This system is more tolerant in regards to the accuracy of the exact positioning of the train than platform based ramps and lifts (see chapter 5.1.6 und 5.3.2).

Pic. 74: Permanently platform -based bridging-device New York Underground

Sourcee: www.manninglewis.com

5.5 Sliding and Folding Bridge-Plates

5.5.1 Sliding Bridge-Plates

This type of device is applied to provide an easy boarding process for PRMs, see Pic. 75 and Pic. 76. In Pic. 75 is showing a sliding step which provides an additional stair in order to overcome a considerable height with high-floor vehicles, and Pic. 76 is showing a device which enables level-boarding when deployed. The implication of operational conditions in the winter-period is as important as its technical design according to the passenger-load.

Pic. 75: Sliding Bridge Plate (IBEG)

Pic. 76: Sliding Bridge Plate BLS AG

The application of this type of device vehicle-based without exemption, and are mainly used in Low-Floor Vehicles and regional transportation. It can be used by all passengers as is operation is fully automatic as soon as the door opens, so there is no additional personnel required. There is no additional time consumed for its operation, as it is harmonised and connected with the door-opening operation and mechanism.

User do like to make use of this type of device, and the operators` rating is “very good“ due to its reliability.

5.5.2 Folding Bridge Plates

Folding bridge plates are prescribing a fixed route when extended due to their cinematic, which is adapted as required by the vehicle-type. Is main field of application is Low-Floor Vehicles in Public Transportation. Functionality and resistance against harsh weather-conditions are playing an important role in order to provide highest reliability of the door operation.

Pic. 77: Folding Bridge Plates SBB (Type “Flirt”)

Pic. 78: Folding Bridge Plate ICE (Dowaldwerke)

Even if the vehicle is moving due to passengers boarding the train, mal-functions with folding ramps are impossible as compared to sliding bridge plates. Doors cannot be anchored in the floor though when closed in combination with folding bridge plates. For that reason folding platforms can only be used in combination with train that do not exceed 160 km/h in speed, see Pic. 77.

The operational cycle of the folding-bridge plate is also harmonised with the door-operation cycle, and therefore does not lead to delays. A pre-registration of a journey is not necessary. Folding bridge plates as shown in Pic. 78 are used on classic trains as well as on high-speed trains and mainly serve as reduction of the first stair´s height when entering the vehicle. At the same time the horizontal gap is being reduced.

Folding bridge plates are very welcome by passengers and due to their high reliability and their application-options they are rated as “very good“.

6 Boarding Assistance Systems (BAS)/Accessibility Aids in the Bus sector.

Boarding Assistance Systems (BAS)/Accessibility Aids in the Bus sector widely spread, wider than in the train sector. Due to a shorter life-cycle of the vehicles, they are always built or the latest legal specifications and requirement before going into operation, so local laws and European directives. e.g ECE 2001/85 “Bus-Directive”, are applied quicker than in the train sector.

The BAS in use are only used for the barrier-fee access of wheelchair occupants, exempt vehicles equipped with kneeling Systems. Most systems need to be operated by personnel, usually the bus-driver, and are not designed for automatic operation. Their operation therefore leads to delays sometimes.

Buses can be categorised into high- and low-floor vehicles as done with train vehicles, based on the height difference between the ground level of the station-platform and the floor-level of the vehicle.

6.1 High Floor Vehicles

High-floor buses are mainly used for long-distance services. Due to the considerable height that needs to be overcome when boarding the vehicle and the large distance between ground level and vehicle floor, mainly permanently installed, vehicle-based systems are used. The distribution of these systems within Europe varies quite considerably

Due to regulations and national laws, a retro-fit of existing vehicles is demanded by many countries within the European Union.

Pic. 79: High-Floor Bus (Mercedes Integro 100), Long-Distance Bus (Scania Irizar)

6.2 Low Floor Vehicles

These vehicles offer either a level-boarding entrance area, or have a low-floor design though out the vehicle. They are mainly used for urban transport. In recent years this type of bus is also used on inter-city services.

Low floor-buses are usually equipped with a kneeling system in order to provide a nearly Step less boarding scenario in combination with accessible station platforms. In order to bridge the remaining gap between the train and the platform, ramps are applied.

Pic. 80: Low-Floor Bus (Mercedes Citaro LE 100)

6.3 Minibuses

Minibuses are mainly used fort the transportation of pupils and operated by community transportation service companies. The maximum seating is 9 passengers including the driver in class M1 vehicles.

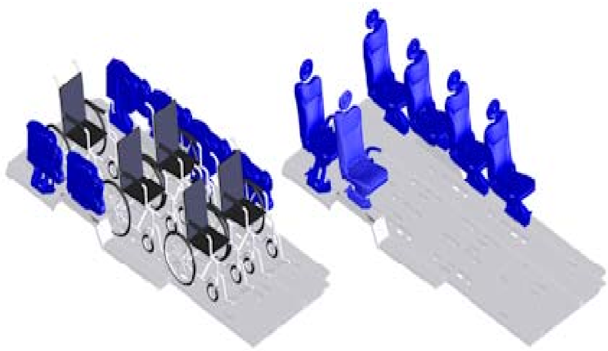
Pic. 81: Opel Minibus for Wheelchair Transportation equipped with DPA Linear Lift

Source; http://www.biermanab.nl/index.php?mid=234

Pic. 82: Minibus Conversion, Linear DPA Lift (Mercedes Sprinter. High-Roof)

Source: http://www.flex-i-trans.com/en/bin/39E74BD4-1BBE-410B-A334-DCDA4207FC31/FiT%20brochure%20English.pdf

These vehicles are equipped with BAS such as ramps or lifts, and converted accordingly. In Sweden also kneeling system in combination with folding ramps are installed at the rear entrance.

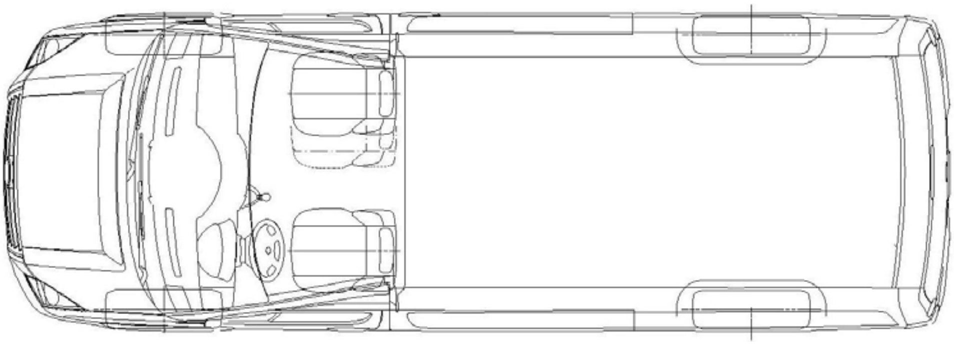


Pic. 83: Layout Wheelchair Minibus (Mercedes Sprinter)

Source: http://www.flex-i-trans.com/en/mainmenu/1473/mercedes-benz-en.html, http://www.flex-i-trans.com/en/mainmenu/1480/mb-sprinter-3665-frontentry.html,

Pic. 84: VW Crafter Minibus Conversions

Source : http://www.biermanab.nl/index.php?id=295



Pic. 85: Minibus-Floor Layout

Source: http://www.biermanab.nl/index.php?mid=234

6.4 Ramps

Ramps that are applied as a BAS, are used in buses for gap-bridging reasons at the station.

The design and operation is very similar to the train sector, most design originate from the bus-sector.

Ramp designs that are mainly permanently installed and mainly used are:

- (Classic) Manual Ramps
- (Floor-integrated) Sliding Ramp (Pic. 88)
- (Floor-integrated) Ramp (Pic. 89)

- (Freestanding) Folding Ramp (Pic. 90)
- Mobile Ramp (not installed)

Manual ramps are vehicle based and installed at the door entrance area, on either side. They can be unfolded from or swivelled and turned out of the vehicle if needed.

Additionally also non-vehicle based mobile ramps are applied, which are only put onto the vehicle when operated and stowed again after use, see Pic. 86. Another version, a fixed ramp, is shown in Pic. 87. Pic. 87, which shows a conversion according the wheelchair accessible vehicle of Bierman AB in the Netherlands.

Pic. 86: Manual Ramp at Taxi-vehicle

Source: http://www.dft.gov.uk/transportforyou/access/landaccessibilitystandards/accessibilitystandardsreview.pdf

Pic. 87: Manual Ramp Renault Kangoo (WAV Wheelchair Accessible Vehicles Concept, Bierman AB)

Source: http://www.biermanab.nl/index.php?id=396

Floor-integrated Sliding Ramps are vehicle based and installed on either side of the door entrance area. They are powered electrically or manually, its operation is fully automatic.

Pic. 88: (Floor-integrated) Sliding Ramp (MBB Palfinger MEDIRAMPE Euron)

Floor-integrated Manual Ramps are vehicle based and installed at the door entrance area. It consists of one main-element or is designed as a telescopic ramp.

Pic. 89: (Floor-integrated) Ramp (MBB Palfinger MEDIRAMPE FV 850)

Freestanding, detached folding-ramps are vehicle based and installed at the door entrance area on vehicle-floor level. For its application it is manually unfolded, usually by the driver who needs to leave the driver-seat to run the operation.

Pic. 90: (Freestanding) Folding Ramp

6.5 Lifting-Devices

Lifting devices are mainly used as accessibility-aids/boarding-assistance systems (BAS) and serve as mobility-aid for wheelchair-occupants only.

In order for a bus to be fully accessible and used accordingly, the interior design needs to be useable for wheelchairs. This is done through e.g. lowering the floor, providing spacious design in general so that the wheelchair can turn inside the vehicle,

The distribution of lifting devices for long-distance and intercity service buses is very inconsistent. Due to the implementation of anti-discrimination laws that have become effective in many countries in Europe, a more intense usage it is expected.

These devices are already integrated and homologated into new vehicles, or need to be integrated within a usual 5 year period according to EU legislation, once the directive has become effective in the specific European member-state.

The systems are similar to the designs for trains as described before, as they originate from the bus-sector.

6.5.1 Pivoting/Swing- Lift, One Arm

This lift-type type is vehicle-based, installed sideways besides the entrance-doors. If needed the platform is swivelled outside the vehicle. It is powered hydraulically and its operation is manual or semi-automatic as shown in Pic. 91.

Pic. 91: Pivoting/Swing-Lift, One-Arm

6.5.2 Floor-Integrated Lift (lifting-column version)

This lift-version is installed into the door area of the vehicle. This type of installation requires an opening in the vehicle floor in which the lift is moving up- and downwards inside a lifting-column, and its platform operates telescopic when in use. There is also a fully automatic version available (See Pic. 92).

Pic. 92: Floor-Integrated Lift, lifting-column version (MBB Palfinger MEDILIFT LB 300)

6.5.3 Cassette Lift (floor/under-vehicle-integrated)

This lift-version is installed at the door-entrance area of the vehicle. This type of installation requires an opening in the vehicle floor, run by an electrically powered parallel-motion, moving upwards and downwards. Its platform operates telescopic when in use, and there is also a fully automatic version available (See Pic. 93 to Pic. 94).

Pic. 93: Cassette Lift (U-Lift ULC-400)

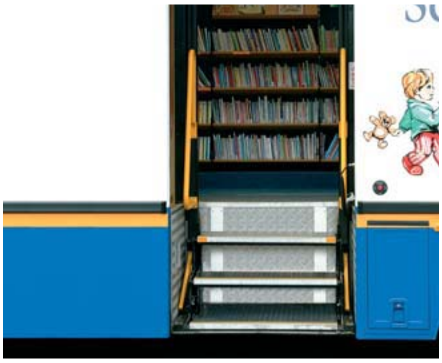
Source: http://www.u-lift.se/pdf/U-lift_Produktbroschyr_lifts_ramps.pdf

Pic. 94: Cassette Lift, long distance bus

Source: http://www.dhollandia.be/foto/rb_de_web.pdf

6.5.4 Stair-Cassette Lift (stair & lifting-column version)

This lift-type, similar to stair lifts in the building business, is mounted into the vehicle at the entrance-doors which requires an opening in the flooring section, in which the lift-platform is moved up- and downwards by two hydraulic lifting-columns. When in operated the platform is unfolded, providing access in combination with the lift-integrated stair. There are also semi-automatic versions available. See Pic. 95.



Pic. 95: Stair Cassette Lift Designs (Ratcliff Palfinger, left; Braunlift UVL right*)

Pic. 96: Stair Cassette Lift Design "UVL – BraunCorp."

Source: http://www.braunability.com/commercial/uvl.cfm

In addition to under-floor vehicles, there are also under-floor versions available which are usually applied for Minibuses (up to 9 passengers).

Pic. 97: Cassette Lift, scissor-arm design (UVL, Braun Corp)

Source: http://www.braunability.com/uvl.cfm

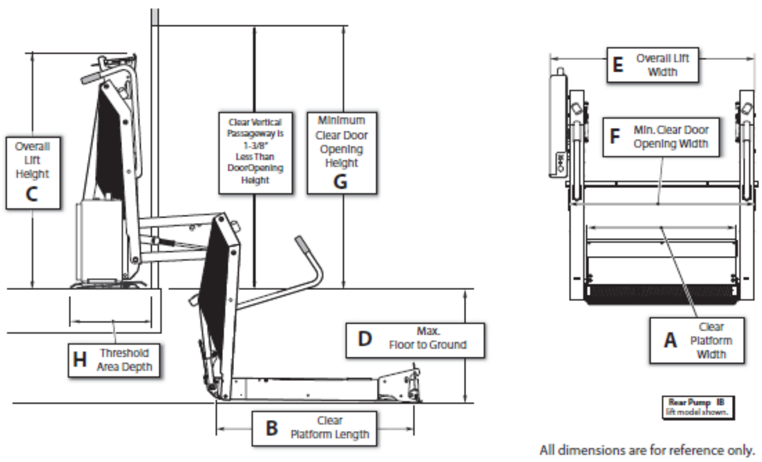
6.5.5 Linear Lifts (DPA Lifts)

Linear lifts and especially the Dual Parallel Arm Lift (DPA Lifts) version is the most common lift worldwide for the transportation of wheelchair users, and possibly represent more than 80% of this particular market worldwide. This lift type is vehicle based, and mounted on its base-plate right in-between the door entrance area, with its control-tower usually available left- and right-sided, depending on the door and interior specifications. In general this lift-type is operated electro-mechanical. Its 2 parallel arms incorporate 2 main cylinders operate the platform, by either pulling or pushing hydraulic oil though the system, and operating the platform downwards, an electric motor-unit operating the pump-module runs the upward operation.

The platform is stowed in a vertical position parallel to the doors, and unfolded (gravity-down operation), stops automatically at floor-level (managed by control switch), then the platform moves downwards and usually stops when hitting an unforeseen obstacle (managed by emergency-control switch), and stops automatically at ground level and unfolds the roll stop, which prevents the wheelchair occupant from rolling over the edge of the platform end while lifted up or down.

For safety-reasons the wheelchair-occupant boards the platform so that the backside of the wheelchair faces the vehicle (backwards operation when boarding the vehicle, forward-facing operation when alighting the railway). An additional device, either operated by a small cylinder or mechanically, is the above mentioned roll-stop, an important safety-device as described above.

Another safety device is the so called bridge-plate, preventing the wheelchair user to touch the vehicle when moved up- and downwards on the lift-platform; its main function is to bridge the gap between the platform and vehicle, hence its name.



Lift Weight lbs	Lifting Capacity lbs	Clear Platform Width	Clear Platform Length	Overall Lift Height	Max. Floor to Ground	Overall Lift Width	Min. Clear Door Opening Width	Min. Clear Door Opening Height	Threshold Area Depth
317	800	30"	51"	56.25"	48"	42.25"	39"	57.375"	18"
356	800	33"	51"	56.25"	48"	45.25"	42"	57.375"	18"
369	800	34"	51"	56.25"	48"	46.25"	43"	57.375"	18"
408	800	37"	51"	56.25"	48"	49.25"	46"	57.375"	18"

Pic. 98: Side & Front View Typical Linear- Lift, Type DPA Dual Parallel Arm and installation and operational specifications

Source: http://www.braunability.com/commercial/ebrochures/Millennium-2.pdf

Pic. 99: Linear Lift, horizontal/vertical split-platform (left: AMF-Bruns, right: BraunCorp,)

"Gas spring activated outer barrier detects roll stop occupancy as the platform leaves the ground. Integrated dual handrails provide added security for wheelchair users and standees. Visual and audible warnings alert both passengers and attendants to unsafe conditions.

(Source: http://www.braunability.com/commercial/vista-2.cfm)

Pic. 100: Automatic Mechanical Roll-stop (far left), Safety Handrails for wheelchair occupant and companion (left), thresh-hold plate locating wheelchair (right), hand-held remote-control for companion (far right)

Source: http://www.braunability.com/uvl.cfm

6.6 Kneeling Systems

Kneeling Systems are mainly used in combination with low-floor vehicles and enable the vehicle to kneel down on the door-entrance side in order to reduce the height-difference between the station platform and the buses floor-level. For this operation the air-bellows of the vehicle's suspension are emptied until it has reached the required level. After closing the doors at air-bellows are pumped up again so that the bus reaches its original floor-level.

Kneeling-Systems are a contributing factor for accessibility in public transportation, and have the major advantage over other systems, that its operation is done fully automatically and needs no extra time for operation which could lead to delays in the time-schedule. The usage by all passenger groups, PRMs and Non-PRMs, is another advantage over other solutions.

6.7 Sliding Bridge-Plate

In order facilitate the access of special transportation vehicles for wheelchair-occupants through its side- or back-doors sliding-bridge plates are very welcome by attending personnel as shown in Pic. 101.

Pic. 101: sliding bridging device for mini busses

Source: http://www.acdeos.com/start%20en.html (left), www.biermanab.nl/index.php?mid=234(right)

6.8 Permanently installed Ramps

Similar to the railway-sector, also the bus section is using permanently installed ramps at stations. Pic. 102 is showing an example from South-Africa. The ramp is installed permanently, the bridge plate is stowed below the platform, and is manually attached by the driver.

Pic. 102: Permanent Platform-Based Ramp for Buses – South-Africa

Source: http://www.globalride-sf.org/phtos.html

7 Systems to overcome vertical distances in the building-business

In the building-construction sector there is a great variety of Boarding Assistance Systems in use. According to the specific design of the building and the height differences that need to be overcome, the occupancy rate and design-limits, the most appropriate system is used.

This section is providing an overview of systems which could potentially also applied as BAS in the railway sector.

7.1 Ramps

Ramps are used as an alternative for stair-based solutions and can be used for overcoming small height-differences. Their application is limited therefore due to their maximum usable length based on the allowed declination-rate.

Ramps can be applied completely independent from power-supply or mechanical solutions, and usually operate without any difficulties or mal-function. They can be used by all persons and are very welcome amongst elderly people, see Pic. 103.

Pic. 103: Ramo in the Construction Business

Wheelchair-accessible ramps are allowed a maximum declination of 6% Along its longitudinal axis in order to be overcome by wheelchair-occupants independently. They are not allowed any form of tilt sideways. After a length of 6m, intermediate horizontal sections with a minimum length of 2,5m are required for pausing reasons. The required minimum width is 1,5m, and additional handles need to be equipped. [Sandra Wimmer, Barrierefreie Gestaltung von Verkehrsanlagen, Krems, 2003]

There are also telescopic ramps available, usually made from aluminium, which consist of 2 independent telescopic sections. They are mobile, can be carried along and used when needed, see Pic. 104.

Pic. 104: Manual Mobile Telescopic Ramps

Source: http://www.guldmann.de/Default.aspx?ID=3677&GroupID=GROUP5

7.2 Lifting devices in the Building Construction Business

They are applied in building when more economic than elevators, which is the case for application that deal with overcoming small height differences only, see Pic. 105. Most cases are retro-fits, Their versions are depending on the local design-requirements. These lifting devices in buildings can often be used by all visitors.

Pic. 105: Lifting-device "Garaventa" (Kleindienst & Reha-Lift GmbH)

They are powered either electrically or hydraulically. The regular stairs can be used without being hindered when the device is not in use. When in use, the stairs are building a platform which can be used by the wheelchair-occupant. After its use it goes back into "stair-position" as shown in Pic. 106.

Pic. 106: Hebebühne – Stufenlift (CAMA Flex Step)

Some solutions that are used in daily-life situations, are also applied on trains, as shown in Pic. 107 as shown by devices of the Mirolift company.

Pic. 107: Miro- Stair-Lift Device – Access via a short staircase

Source: http://www.miro-lift.ch/

7.3 Stair-Lifts

Stairlifts are an economic alternative in a family-home as compared to an elevator, and are usually retro-fitted. It enables transportation and is integrated and installed into the existing stairway. Two common types are in use: platform versions which are mounted at the handrails, and ceiling versions.

A platform moves along a track which is designed around corners as shown in Pic. 108.

Pic. 108: Stairlift (Garaventa Kleindienst & Reha-Lift GmbH)

An installation can also be done on the ceiling along the stairway as shown in Pic. 109. It has no platform and the seating-unit is directly mounted on ceiling-based belts.

An alternative is a seating unit that is permanently attached to the lift. This version can also be used by other persons than wheelchair-users.

Pic. 109: Ceiling-Lift (Abtei Stairlifts)

7.4 Stair Climber

Stair-climbers are a mobile device for overcoming stairways. Wheelchair-occupants can be moved effortless inside their wheelchairs from one level to another. They are powered electrically and can be applied to almost all types of stairs. See Pic. 110.

Pic. 110: stair crawler (Garaventa Kleindienst & Reha-Lift GmbH)

7.5 Outdoor Stairlift

In gardens, as in houses, so called outdoor-stairlifts are used. Their design is similar to stairlifts and very resistant against all weather conditions. The design is also made for the transportation of luggage and prams (see Pic. 111).


Pic. 111: Outdoor Stairlift (Garaventa)

Source: http://www.garaventalift.de/03Produkte/033Aussentreppenlifte/03331ATLds.htm

8 Other Systems

In order to provide a broad overview, systems that are used in other areas of transportation are mentioned herein. Many basic systems are very similar as applied for the train sector. E.g. in India there are rickshaws available for example that are adapted for wheelchairs. A ramp that has been permanently installed is simply unfolded, and the wheelchair-occupant is pushed on the rickshaw. See Pic. 112.

Pic. 112: Accessible Rhickshaw in India - India

Source: http://www.globalride-sf.org/phtos.html

Accessible helicopters are using sliding seats, which operate sideways. The wheelchair-occupant needs to transfer on such a seat, is then lifted up to the helicopter, and then needs to transfer on the regular passenger-seat (see Pic. 113).

Pic. 113: Accessible Helicopter

Source: http://wheelchairescapes.com/alaska.htm

Within the field of aircraft transportation there are various different systems in use, depending on the size of the aircraft. Smaller aircrafts are using lifting-devices as shown in Pic. 114.

Pic. 114: Lifting Device in Air-Transportation

Source: http://www.adaptivelifts.com/wheelchair_lifts_ax.html

Ships are using devices similar to forklifts, lifting the wheelchair-user on a platform up to the ship's door-entrance. See Pic. 115.

Pic. 115: Mobilift AX

Source: http://www.worldonwheelz.com/Travel%20Reviews/australia-hawaii%202000.htm#pearl

9 Assessment of Systems

In the following chapter all devices are listed that could potentially be used as a Boarding Assistance System on railways, based on the criteria as described in Deliverable 2.1. In addition the feasibility of installation is assessed. Detailed information in regards to their adaptability for railways and feasible installations is described in Deliverable 3.1.

9.1 Useability for various User-Groups

Tab. 3 is showing the basic usability of various systems for different user-group. The assessment was performed by the following scheme:

- 1 …… usability: very good
- 2 ……. Good useability
- 3 ……. Merely usable
- 4 ……. Not useable
- 1!, 2! …used in real life for applicable user-group

Only the basic usability is assessed by the scheme. In theory many solutions are usable for all passenger groups, in real-life they are mainly used by wheelchair-occupants only though. Systems that are designed and also used for other passenger-groups than wheelchair-occupants, are marked with “!“. Many devices that are usable by a variety of user-groups need adaption such as handrails to give an example.

User-Groups / System	System Description	Wheelchair	Walking-Impaired Person	Person with minor Disability(is)	Elderly Person	Pram	Person with Luggage	Pregnant Women	Small People	Overweight People	Children	Hearing-/Visual Impairments	Outsize luggage (e.g. bicycle)
	manual Ramp	1	2	2	2	1	2	2	2	2	2	2	2
	manual Ramp	1	2	2	2	1	2	2	2	2	2	2	2
	mobile Ramp	1!	2!	2!	2!	1!	2!	2!	2!	2!	2!	2!	2!
	rail - Ramp	3	4	4	4	4	4	4	4	4	4	4	3
	Platform ramp	2	2	2	2	2	2	2	2	2	2	2	2

User-Groups / Systems	**System Description**	Wheelchair	Walking-Impaired Person	Person with minor Disability(is)	Elderly Person	Pram	Person with Luggage	Pregnant Women	Small People	Overweight People	Children	Hearing-/Visual Impairments	Outsize luggage (e.g. bicycle)
	Parallel Ramp	2	2	2	2	2	2	2	2	2	2	2	2
	Swing lift	1	3	3	3	2	3	3	3	3	4	4	3
	Pivoting/Swing-Lift, One Arm	1	3	3	3	2	3	3	3	3	3	3	3
	Linear Lift, One Arm	1	2	2	2	2	3	3	3	3	3	3	3
	DPA Linear Lift	1	2	2	2	2	3	3	3	3	3	3	3

User-Groups / Systeme	**System Description**	Wheelchair	Walking-Impaired Person	Person with minor Disability(is)	Elderly Person	Pram	Person with Luggage	Pregnant Woman	Small People	Overweight People	Children	Hearing-/Visual Impairments	Outsize luggage (e.g. bicycle)
	Cassette-Llift	1	2	2	2	2	3	3	3	3	3	3	3
	Lift - Regina	1!	1!	1!	1!	2!	2!	1!	1!	1!	3	2!	3
	Lift - SJ	2	2	2	2	3	3	3	3	3	3	3	4
	Platform-based Lift	1	2	2	2	2	3	3	3	3	3	3	4
	Platform-based Lift	1	3	3	3	2	3	3	3	3	3	3	4

User-Groups / Systeme	**System Description**	Wheelchair	Walking-Impaired Person	Person with minor Disability(is)	Elderly Person	Pram	Person with Luggage	Pregnant Woman	Small People	Overweight People	Children	Hearing-/Visual Impairments	Outsize luggage (e.g. bicycle)
	Platform-based Lift	1	2	2	2	2	3	3	3	3	3	3	4
	Stairlift	1	2	3	3	3	3	3	3	3	3	3	4

Tab. 3: Usability for various User-Groups

9.2 Assessment based on Evaluation Criteria

Tab. 4 is a matrix comparing all systems with the evaluation criteria. It tests compares if a criterion is fulfilled and to which extent (the criteria are not weighted amongst themselves in a rating). The operators´assessment is based on satisfaction level based on their experiences. The assessment is based on the following scheme:

Performed by the following scheme:

- 1 …… usability: very good
- 2 ……. Good useability
- 3 ……. Merely usable
- 4 ……. Not useable

Criteria / Systems	System Description	Reliability of BAS	Operational Quality	Operational Efforts	Management of Mal-function	Versatility	Costs	Manufacturing Cost / Installation	Safety-Risks	Warning Devices	Maintenance Cost	Envrironmental-friendly	Design/ Aesthetics
	manual Ramp	2	2	1	1	2	2	2	2	1	2	2	2
	manual Ramp	2	2	1	1	2	2	2	2	2	2	2	2
	mobile Ramp	2	2	1	2	2	2	2	2	1	2	2	2
	rail - Ramp	3	2	2	2	3	2	2	2	2	2	2	3
	Platform ramp	2	2	2	2	2	2	2	2	2	2	2	2

Kriterien / Systeme	System Description	System Description	Reliability of BAS	Operational Quality	Operational Efforts	Management of Mal-function	Versatility	Costs	Manufacturing Cost / Installation	Safety-Risks	Warning Devices	Maintenance Cost	Envrironmental-friendly
	Parallel Ramp	2	2	2	2	2	2	2	1	2	2	2	2
	Swing lift	2	2	1	2	2	2	3	3	3	2	2	2
	Pivoting/Swing-Lift, One Arm	2	2	1	2	2	2	3	3	3	2	2	2
	Linear Lift, One Arm	2	2	1	2	2	2	3	3	3	2	2	2
	DPA Linear Lift	2	2	1	2	2	2	3	3	3	2	2	2

Kriterien / Systeme	**System Description**	Reliability of BAS	Operational Quality	Operational Efforts	Management of Mal-function	Versatility	Costs	Manufacturing Cost / Installation	Safety-Risks	Warning Devices	Maintenance Cost	Envrironmental-friendly	Design/ Aesthetics
	Cassette-Llift	2	2	1	2	2	2	3	3	3	2	2	2
	Lift - Regina	2	2	2	2	2	2	2	3	2	2	2	2
	Lift - SJ	1	1	1	1	2	1	2	2	2	2	2	1
	Platform-based Lift	2	2	1	2	2	1	2	2	2	2	2	2
	Platform-based Lift	2	2	1	2	2	1	2	2	2	2	2	2

Kriterien / Systeme	**System Description**	Reliability of BAS	Operational Quality	Operational Efforts	Management of Mal-function	Versatility	Costs	Manufacturing Cost / Installation	Safety-Risks	Warning Devices	Maintenance Cost	Envrironmental-friendly	Design / Aesthetics
	Platform-based Lift	2	2	1	2	2	1	2	2	2	2	2	2
	Stairlift	2	2	1	2	2	2	3	3	3	2	2	2

Tab. 4: Fulfilment-Rate of particular CriterionTechnical and Operational Requirements and Limits

9.3 Main technical and operational requirements

Tab. 5 shows the main technical and operational requirements and limitations, e.g. time-consumption, resiliance, etc. Data was obtained on site or provided by operators. This information serves as an overview and basis for the forthcoming work in Deliverable 3.1. At this stage no assessment is made whether criteria are fulfilled or not.

Criteria / Systems	**System-Description**	Time-consumption for Operational cycle [sec]	Time-consumption for preparation [sec]	Time-consumption for stowing [sec]	Duration of blocked entrance [sec]	Maximum Capacity [kg]	Required Platform-Width [m]	Max. Floor to Ground Difference [mm]	Min. Door-Width [mm]
	Manual Ramp	~50-60	~20	~20	~10-15	~350	~3	~190	~80
	Manual Ramp	~60	~20	~20	~10-15	~200-300	~3	~400	~80
	Mobile Ramp	~50-60	~20	~20	~10-15	~200-300	~3	~200	~80
	Track Telescopic Ramp	~50-60	~25	~25	~10-15	~200-300	~3	~500-600	~80
	Platform-bound Ramp	~60	~20	~20	~10-15	~300	~3	~600	~80

Criteria / Systems	System-Description	Time-consumption for Operational cycle [sec]	Time-consumption for preparation [sec]	Time-consumption for stowing [sec]	Duration of blocked entrance [sec]	Maximum Capacity [kg]	Required Platform-Width [m]	Max. Floor to Ground Difference [mm]	Min. Door-Width [mm]
	Parallel Ramp	~60	~20	~20	~20	~300	~2	~600	~80
	Schwenklift	~120	~45	~45	~120	~200-300	~2	~300	~80
	Pivoting/Swing-Lift, One Arm	~120	~45	~45	~120	~200-300	~2	~800	~80
	Linear Lift, One Arm	~50	~15	~15	~50	~200-300	~2	~800	~80
	DPA Linear Lift	~60	~25	~25	~60	~200-300	~2	~800	~80

Criteria / Systems	System-Description	Time-consumption for Operational cycle [sec]	Time-consumption for preparation [sec]	Time-consumption for stowing [sec]	Duration of blocked entrance [sec]	Maximum Capacity [kg]	Required Platform-Width [m]	Max. Floor to Ground Difference [mm]	Min. Door-Width [mm]
	Cassette-Llift	~60	~25	~25	~60	~200-300	~2	~800	~80
	Lift - Regina	~50	~25	~25	0	~200-300	0	~500	~80
	Lift - SJ	~50	~5	~35	~50	~125	~2	~600	~80
	Platform-bound Lift	~120	~30	~30	~40	~250-350	~3	~1000	~80
	Platform-bound Lift	~120	~30	~30	~40	~250-350	~3	~1000	~80

Criteria / Systems	System-Description	Time-consumption for Operational cycle [sec]	Time-consumption for preparation [sec]	Time-consumption for stowing [sec]	Duration of blocked entrance [sec]	Maximum Capacity [kg]	Required Platform-Width [m]	Max. Floor to Ground Difference [mm]	Min. Door-Width [mm]
	Platform-bound Lift	~120	~30	~30	~40	~200-350	~3	~1000	~80
	Stairlift	~50	~25	~25	~50	~200-300	0	~800	~80

Tab. 5: Technical and Operational Requirements and Limitations

9.4 Assessment of Feasibility

Tab. describes the feasibility of various vehicle-types, and is assessed within a framework of technical conditions and limits. The assessment of the usability is based on the scheme as follows:

- 1 …… very well useable
- 2 ……. Well useable (acceptable effort for retro-fit)
- 3 ……. Merely usable (high effort for retro-fit)
- 4 ……. Not usable/inappropriate

Feasibility / System	Description of System	UIC-Wagon / Rear-Entrance	UIC-W./Entrance towards center	UIC-Wagon/Entrance centred	Height-Difference up to 30cm	Height-Difference up to 70cm	Height-Difference up to 110cm	Usability Up-to Track Surface	Door width of 800mm	Door width of 900mm and more	Platform Width up to 1.6m	Platform Width up to 2.5m	Platform Width over 3m
	Manual Ramp	2	2	1	1	3	4	4	4	1	4	3	1
	Manual Ramp	2	2	1	1	3	3	4	1	1	4	3	1
	Mobile Ramp	2	2	1	1	3	3	4	4	1	4	3	1
	Telescopic Track Ramp	2	2	1	1	4	4	4	2	1	4	3	1
	Platform-based Ramp	2	2	1	1	3	4	4	1	1	4	3	2

Feasibility / System	Description of System	UIC-Wagon/Rear-Entrance	UIC-W./Entrance towards centre	UIC-Wagon/Entrance centred	Height-Difference up to 30cm	Height-Difference up to 70cm	Height-Difference up to 110cm	Usability Up-to Track Surface	Door width of 800mm	Door width of 900mm and more	Platform Width up to 1.6m	Platform Width up to 2.5m	Platform Width over 3m
	Parallel Ramp	1	1	1	1	2	2	3	1	1	1	1	1
	Schwenklift	2	2	1	1	1	1	1	3	1	4	3	1
	Pivoting/Swing-Lift, One Arm	2	2	1	1	2	2	2	3	1	4	3	1
	Linear Lift, One Arm	2	2	1	1	2	2	3	3	1	4	3	1
	DPA Linear Lift	2	2	1	1	2	2	3	3	1	4	3	1

Feasibility / System	**Description of System**	UIC-Wagon/Rear-Entrance	UIC-W./Entrance towards centre	UIC-Wagon/Entrance centred	Height-Difference up to 30cm	Height-Difference up to 70cm	Height-Difference up to 110cm	Usability Up-to Track Surface	Door width of 800mm	Door width of 900mm and more	Platform Width up to 1.6m	Platform Width up to 2.5m	Platform Width over 3m
	Cassette-Llift	3	2	1	1	1	1	2	3	1	4	3	1
	Lift - Regina	3	3	1	1	3	4	4	-	-	-	-	-
	Lift - SJ	4	2	2	1	1	2	3	1	1	2	1	1
	Platform-based Lift	1	1	1	1	1	1	3	1	1	3	4	4
	Platform-based Lift	1	1	1	1	1	1	3	1	1	4	3	1

Feasibility / Systems	**Description of System**	UIC-Wagon/Rear-Entrance	UIC-W./Entrance towards centre	UIC-Wagon/Entrance centred	Height-Difference up to 30cm	Height-Difference up to 70cm	Height-Difference up to 110cm	Usability Up-to Track Surface	Door width of 800mm	Door width of 900mm and more	Platform Width up to 1.6m	Platform Width up to 2.5m	Platform Width over 3m
	Platform-based Lift	1	1	1	1	1	1	3	1	1	3	2	1
	Stairlift	3	2	1	1	1	2	3	1	1	2	1	1

Tab. 6: Usability for Retro-Fit

10 Conclusio

In order to provide a barrier-free scenario, technical aids are used in the railway sector as well as in all other areas of transportation, and also within in daily-life. Relevant aids for the PubTrans4All area all devices that are applied in the railway sector and all other areas if adaptable for railway appliance.

The large number of various systems amongst the train-sector shows the need for a standardised solution. Many specific solutions which need a high amount of development-efforts are very costly. A standardised solution offers secured planning for both manufacturer and operator.

In railway transportation there are two main-categories of devices that manage to overcome vertical barriers. Those solutions are ramps and lifts, both applied as platform- and vehicle-based solutions. Both systems are available in a variety of designs.

Ramps operate automatically or are manually applied, depending on their length, and offer the advantage that they can be used by all passengers, and mean an improvement for the boarding and alighting process on trains for most passenger groups, in particular PRMs.

If the maximum tilt along the longitudinal axis is given, wheelchair-occupants, walking-impaired, people with luggage, and persons with prams can use a ramp. There is no logic hurdle that prevents passenger groups from its usage.

Most countries use ramps to manage small differences in height and to bridge gaps between the train and platform. There are also versions available which manage higher vertical distances and are used accordingly. Due to their nature of a considerable length, difficulties in regards to space on the platform are being faced.

Ramps are used for wheelchair-occupants only in many countries. The UK for example shows that it can be used by all groups of passengers and are quite welcome by the customers. Ramps are often applied for the use of all passengers - that includes people with luggage, prams and walking-disabilities.

Lifting devices are either permanently integrated into the vehicle, or permanently integrated into the vehicle, otherwise they are platform based. Usually their design is more complicated, hence more expensive, and subject to a higher failure-quota as compared to ramps.

Favoured systems in general are solutions that operate fully automatic, or are operated by the users themselves. Both operators and users are satisfied with lift-solutions. A potential hazard is vandalism and misuse of course, which is a fact that needs to be considered in this connection.

Due to the satisfaction-levels amongst operators and users, it seems to make sense to think about the possibility of a combination of both worlds. On one hand a lift handles large vertical distances, and a ramp can be used by all passengers on the other hand. Even if a ramp cannot handle the whole height-difference, surveys are showing that the great part of passengers experiences an advantage and improvement of their journey.

11 tables

11.1 table of tables

11.2 table of pictures