

Establishing the Concept of Universal Functionality in Public Transport

Elmar Wilhelm M. Fürst^{1,2}, Christian Vogelauer¹, Peter C. Huber¹

¹ Hilfsgemeinschaft - Austrian Association Supporting of the Blind and Visually Impaired, Vienna 1200, Austria

² Institute for Transport and Logistics Management, Vienna University of Economics and Business, Vienna, 1020, Austria

Abstract This article aims at providing a basic understanding of the important, but often neglected field of accessibility in public transport. Accessibility as an inclusive sustainable concept has the goal to enable all people to use the public transport system independently and self-determinedly. The implementation of accessible public transport directly affects different user groups. People who do not have temporary or permanent impairments will also benefit from simpler and more accessible systems. Consequently, the usability and comfort of public transport systems is raised for all persons. Therefore, the paper points out barriers and solutions for different target groups in public transport and discusses solutions for overcoming them. The paper concludes by showing how the consideration of accessibility already in the planning phase of a project can substantially reduce costs and improve the quality of the services, respectively leading also to better economic results.

Keywords public transport, accessibility, inclusion, European Accessibility Act, mobility, means of transport, stations, stops, vehicles

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1. Introduction

This article aims, first, at providing a basic understanding of the important, but often neglected field of accessibility in public transport. Its intention is not to address or to promote a uniform design of public transport systems, but to establish universal functionality in public transport.

Universally functional solutions provide huge opportunities for all parties engaged in public transport. Solutions not only complying with necessities, but also creating added comfort beyond the required minimum standards, establish a sustainable benefit for all passengers.

Accessibility as an inclusive and sustainable concept has the goal to enable all people to use the public transport system independently and self-determinedly. Only an appropriate implementation of this can achieve the claim of public transport to provide what is often called *mobility for all*. As a consequence, accessibility should be seen as a comprehensive key concept in order to enhance attractiveness of public transport rather than a niche strategy for some smaller groups of stakeholders or even as a means of cutting the creativity of designers, architects or planners. It needs to be understood that accessibility (or universal functionality) is not a burden but rather a guarantee that the basic functions are fulfilled in accordance with the theorem “Form follows Function”. It should rather boost creativity in developing good solutions and not lead to uniform concepts.

2. The Path from „Wheel Chair Accessible“ to „Universal Functionality“

Accessibility evolved from the older and non-inclusive concept of disability justice (Freiraum, 2013). Disability justice only aimed at giving people with disabilities the greatest possible amount of participation in society. The idea of accessibility assumes that barriers, directed regardless against whom, have to be eliminated (Bundeskompetenzzentrum Barrierefrei, 2013). Accessibility is therefore conceptually much closer to the goal of an *overall inclusion* as repeatedly demanded by representatives of people with disabilities.

Additionally, the approach to eliminate barriers is different. Disability justice was intended primarily as a reactive system aimed at omitting existing barriers. Accessibility, however, is a proactive approach in this respect. It always starts beginning with the design and planning phase of projects and it is an integrated and holistic approach not shifted to the edges of the planning phase. Here, possible resulting limitations and the measures taken to avoid all kinds of barriers or even social or technical exclusion must be considered. Consequently, in the field of mobility, it is mandatory to take into account already existing problems, needs and solutions, first in order to create a basis for future concepts and decisions.

3. The Legal Framework

In the process of perceiving persons with disabilities as an important group within society, a growing body of legal framework on all levels developed in recent years and decades to ensure the implementation of accessibility in general and on the domain public transport in particular. These range from international conventions to supranational (community/union) law on to specific standards regulating technical details.

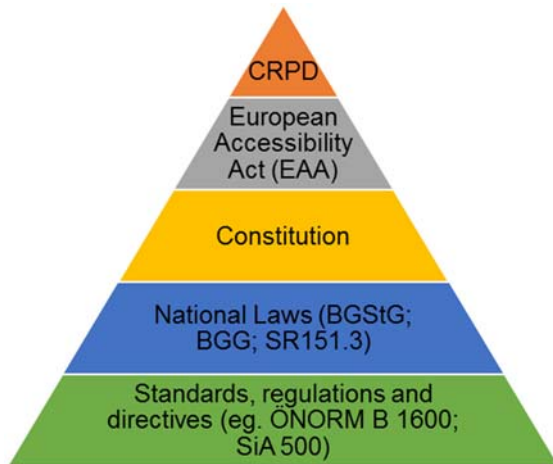


Figure 1. Pyramid construction of the legal system in the field of accessibility

At the top of this legal pyramid is the Convention on the Rights of Persons with Disabilities (CRPD) as formulated by the UN Department of Economic and Social Affairs (DESA) in 2006 and ratified worldwide so far by 147 countries (as of August 2014) complementing and extending the Universal Declaration of Human Rights (UDHR). This convention defines the fundamental rights, non-discrimination bans and social access that a state should set-up in order to integrate persons with disabilities into daily life. One very important point covered by the convention is accessibility (Article 9). Based on this, there is a proposal in the EU to create a binding, concrete implementation of the CRPD across Europe. This was realized by means of the „European Accessibility Act“ (EAA) which will be published in the Union.

On the national level, the inclusion of people with disabilities is also considered at various stages. The constitutions of the respective states form the primary basis for all other legal and normative requirements. In Germany, Austria and Switzerland, the constitutional laws include fundamental rights such as the prohibition of discrimination on grounds of disability, gender, etc. (e.g. Art. 7 B-VG in Austria). The concrete obligation to create barrier-free solutions in public spaces thereby results from legal requirements, such as the Federal Disability Equality Act (BGStG) in Austria, the Disability Equality Act (BGG) in Germany or the Disability Equality Act (BehiG) in Switzerland.

In addition to these legal obligations, numerous standards and guidelines provide mobility suppliers with help, regulations or (more or less clear) definitions for implementing accessible solutions.

4. Interest Groups and their Needs

In addition to the „classic“ groups already covered by the concept of accessibility, such as those with motoric impairments, blind, deaf, with visual and/or hearing impairments, accessible solutions also concentrate on not commonly addressed persons. For example, this includes mothers/fathers with baby carriages, persons with heavy luggage, tourists with limited local knowledge or without local language skills, but also inexperienced passengers.

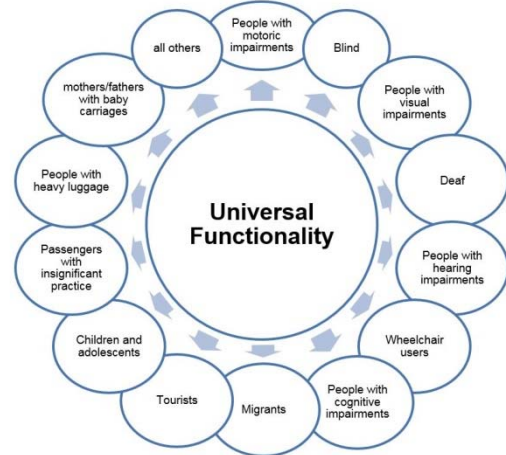


Figure 2. Stakeholders for accessible design in public transport

As the illustration (Figure 2) shows, the implementation of accessible public transport directly affects a large number of different user groups. Equally important and yet another essential key consideration is the fact that people, who do not belong to any of the groups listed above with temporary or permanent impairments, will equally benefit from simpler and more accessible systems. Hence, the usability and comfort of public transport systems is raised for the entity of all passengers.

For each stakeholder group it is important to clearly be aware of:

- which requirements exist in respect to the mobility services (stations, transport, information, etc.),
- what the barriers are and
- what specific measures can be taken to overcome them.

The following table gives an overview.

Stakeholder Group	Characterisation	Requirements	Frequent Barriers	Examples for Solutions	Consideration in Laws and Standards / Reality Check
Wheelchair user	The persons are dependent on a wheelchair for physical movement. They are unable to independently stand/walk and/or use their legs for movement. Sometimes only the head can be moved.	Stair- and gapless access to all relevant areas of infrastructure. Unobstructed areas in the means of transport for (secure) placing and turning of the wheelchair.	Height differences in entrances and exits. Steps in stations and means of transport. Too narrow corridors and doors. Inappropriate sanitary facilities.	Ramps and lifts, elevators. Personnel assisted entry and exit. Minimum width for doors and corridors.	very good / good
Blind	Unable to perceive optical stimuli. Orientation is dependent purely on tactile or acoustic stimuli or by the help of persons or an assistance dog.	Tactile guidance systems with corresponding prior information possibility on relevant areas. Information in braille and tactile writing. Clear and precise acoustic information.	Missing guidance systems. No tactile information available. Obstacles on or over guidance systems (displays, people, signs, garbage bins, etc.). No clear pathways to follow.	Milled or glued tactile guidance strips. Braille on handrails. Tactile environment plans.	good / good
Visually impaired	Perception of optical stimuli (however, restricted) is possible, visual sense is primarily used for navigation and orientation, but is limited. Acoustic information is used in addition. Tactile information is not used, including Braille.	Visual design of the environment, taking into account the relationship between brightness (luminance), contrast (colour), glare and materials used. Corresponding font size or approachable written information.	Badly noticeable obstacles, unmarked glass surfaces. Too undersized or serif fonts. Too dark or too intense lighting situations (especially direct lighting). Reflective surfaces (glass, polished metals). Monitors mounted too high. Signs and plans behind glass panels (with a distance).	Colour-contrasting design of handrails, seats, etc. Contrasting glass surface markings in two differing heights. Approachable information, posters and plans. Matted or anti-glare monitors. Ability to approach individual monitors.	sufficient / satisfactory
Deaf	No perception of acoustic stimuli, therefore dependent on optical information. Tactile information is not used. Ability to communicate mostly via sign language, possibly lip-reading.	No important information on a purely acoustic basis. Ability to fulfil central procedures (ticket purchase, information procurement) without having to speak.	Pure acoustic announcements for changes of platforms or departure gates or warnings in case of malfunctions. Lack of communication possibilities with employees of transport companies (unable to communicate in sign language).	Clear and consistent visual guidance systems (supported by colour components). Staff with sign language skills.	sufficient / satisfactory
Stakeholder Group	Characterization	Requirements	Frequent Barriers	Examples for Solutions	Consideration in Laws and Standards / Reality Check

<p>Hearing impairments</p>	<p>Difficult perception of acoustic information, but possible with a corresponding design or technical equipment. Due to the primary use of visual information, strong focus on this channel. Tactile help is not used. Sign language rarely known/used.</p>	<p>Acoustic information without interference and background noise (static, crackling). Spoken information without local idiom (dialects, language variations, etc.). Announcements/signals in an appropriate volume and without reverberation.</p>	<p>Poor acoustic quality of the loudspeakers (volume, noise), as well as poor alignment (lateral sound cone). Announcements without an initiation and concluding signal. Announcements made in the station/halt simultaneously with incoming or passing through vehicle. Too fast or poorly spoken announcements.</p>	<p>Inductive hearing systems at counters, entrances and exits as well as in vehicles. Specially marked „listening zones“. Acoustic information also visually available (display on monitors). Incoming and outgoing tones to increase attention.</p>	<p>sufficient / satisfactory</p>
<p>People with cognitive impairments</p>	<p>Problems understanding complex sentences/texts. Concentration problems with longer announcements. Primary illiteracy is a very common problem.</p>	<p>Simple and clear information, reduced to the essential.</p>	<p>Numerous options and tariff options when buying tickets. Complex information for online content.</p>	<p>Use of „easy language“. Short and clear sentences without foreign words. Repetition of information. Incoming and outgoing tones in announcements.</p>	<p>not sufficient / not sufficient</p>
<p>People with motoric disabilities</p>	<p>Problems with overcoming longer distances and height differences. Climbing stairs is very difficult to impossible. Reduced strength and flexibility in arms and legs.</p>	<p>Compact design with short paths. Recreation possibilities (benches) set in short intervals. Same level of entries and exits. Low energy effort for opening doors or pushing buttons.</p>	<p>Stations of various public transport possibilities with long connecting routes and without „resting places“ in-between. Coin entry or payment machines placed at head height. Short stops requiring fast boarding and exiting.</p>	<p>Ramps with handrails instead of stairs. Elevators. Buttons at waist level and very sensitive. Non-contact payment options for vending machines.</p>	<p>satisfactory / good</p>

Stakeholder Group	Characterization	Requirements	Frequent Barriers	Examples for Solutions	Consideration in Laws and Standards / Reality Check
Migrants with a lack of local language skills	Often poor or no language comprehension (problem of „functional illiteracy“). Often economically in a more precarious situation. Language acquisition of the national language is frequently only in progress.	Multilingual information. Simple and clear texts.	Complex information and communication problems. Often no access to online content.	Use of „easy language“. Repetition of information. Language courses or training offers.	not sufficient / sufficient
Tourists with a lack of local language skills	Spending only a short stay in the respective country, therefore no need to learn the language.	Information in the respective language/script	Complex tariff systems. Acoustic information incomprehensible. No foreign language information for special events (disruptions, relocation of stops, substitute transports, etc.).	Multilingual texts. Announcements also available in writing on monitors. Online content available in different languages.	Sufficient / good
Children	Limited vocabulary. Attention patterns differ from adults. Joy/fun as a very important factor of use. Only partial self-determined mobility (parental permission). Dependent on public transport (classic „Captive Riders“).	Rapid detectability of the central information. Fun/enjoyment of (public) mobility.	Accessibility to information. Safety aspects.	Child/youth friendly design of means of transport (bright, friendly, coloured).	Satisfactory / satisfactory
Passengers with insignificant practice	Rudimentary knowledge of public transport (tariffs, transfers, etc.). Public transport is often not seen as „fully satisfying“.	Simple uncomplicated use of the system public transport without the necessity of „special knowledge“.	Complex tariff systems. Transition situations (finding the right lines, entry points).	Simple tariff structures. Consistent and uniform control systems across organizational boundaries.	Not sufficient / not sufficient

5. Solutions

Possible solutions for the target groups of universally functional design are as wide-ranging as the target groups themselves. In this chapter, we will describe a few exemplary demonstrations, which should provide a rough insight into the successful designs.

The realisation of accessible mobility in public transport can be subdivided into four fields.

These are:

- Means of Transport
- Stations and Stops
- Pre and Post Travel and
- Staff

There are specific requirements and possible solutions in each of these fields presented in examples below. Also taken into account is the importance of the separate fields, which differ for the diverse stakeholders.

5.1 Means of Transport

A contrasting design of the interior without glaring lighting is of central importance in public transport vehicles. This ensures an accessible finding of entrances and exits, but also of seating or handrails. From the outside of the vehicles, it is necessary to warrant that doors and associated buttons are clearly visible (e.g. full-surface advertisements cause problems) and that displays announcing the destination are not mounted behind reflecting panels. Securing sufficient space for wheelchair users, mothers with pushchairs or even persons with heavy luggage is essential.

Vehicle-bound devices to overcome height differences or gaps in stations are generally preferable over station-mounted auxiliaries. This increases the flexibility of the means of transport for the public transport operator (For example, it does not have to be a certain carriage model tailored to the nature of the station.). It is also important that the systems used in the different (generations of) means of transport are as similar as possible to employ, in order to facilitate the usage for those affected.

5.2 Stations and Stops

Stations and stops in the public transport system have two main foundations for accessible design:

- Primarily, it is the accessibility of entry and exit areas for wheelchair users and motorically impaired persons without the use of stairs and escalators and
- Second, the provision of information and guidance systems.

The accessibility of entry and exit areas is defined relatively clearly by standards. It has already largely been implemented. There is a considerable backlog concerning the provision of information and guidance systems. Information, whether on displays or in printed form, should at least be approachable, rich in contrast and not mounted behind reflective/glaring glass surfaces. This benefits most people with visual impairments, who may also be able to use their individual aids. Correspondently, (visual) guidance systems must take care that colour schemes are clearly different from the rest of the surface structure. This clarifies the information

intended for orientation/navigation and differs which information is meant for other purposes (such as advertising).

Other examples for positive solutions relating to stations and stops are:

- Accompanying tactile guidance systems with optical components increase the benefits.
- Announcements combined with the use of incoming and outgoing tones have shown to be more effective in raising attention.
- For people with hearing impairments, the installation of induction systems at counters or clearly designated areas has proven its worth too.
- A very good method to simplify information for many stakeholders utilizing public transport is „simple language“. Unfortunately, this currently is hardly being used.

5.3 Pre and Post Travel Solutions

Pre and post travel solutions for people with problems collecting (e.g. people with visual impairments, blind) or processing (e.g. people with cognitive problems) information are of particular importance. These groups need to plan their respective routes in advance. Thus, coordinated information on the websites of transport companies, taking into account the specific requirements of these groups, can be of great benefit here. By linking this content to smartphones, additional assistance during and after the trip can be attained. It must be noted, however, that online content can often only be accessed to a limited extent en-route. Having the opportunity to access the corresponding information offline should also be offered.

Moreover, the information provided on the internet should not be taken as a substitute for accessible information available on the premises. It cannot be assumed that all traffic users will obtain information a priori to their trip (frequent problem of passengers with insignificant practice).

5.4 Staff

The staff members of the transport companies make up the fourth field. They often receive very little attention. Unrightly so, as they are by far the most important part of the public transport system for many people with and without disabilities.

An effective and efficient measure to identify requirements of groups with specific mobility needs is training. In addition to theoretical contents (e.g. differences between diverse groups, specific requirements, correct handling/access), practical exercises (e.g. orientation with reduced vision, driving in a wheelchair, information not in the native language) should be provided. The schoolings should be held with the participation of persons with disabilities or other stakeholders. However, the training should not only be limited to employees with direct customer contact. It must also include the decision-making level of the company. This ensures that the appropriate knowledge is available when developing or deciding on new offers.

6. Conclusions

Over the recent years, a constant development and improvement towards more all-inclusive measures can be identified in the field of accessibility of public transport systems. On the one hand, this is due to the availability of systems that provide easy access to information. On the other hand, it is due to the emerging perception that accessibility is not an exclusive concept for a small group of people.

In addition, accessibility slowly is finding its way into the education and schooling of the mobility sector and amongst planners and architects. This is supported by improving enforcement opportunities. But still, there is much room for improvement. Many transport companies have not yet come to realise that the achievement of an effective barrier-free system will not only enable people with disabilities to cover their daily mobility through public transport. All other users will also greatly benefit from the ease of handling and improved comfort and satisfaction. This increases acceptance of public transport as a „main mobility supplier“. Accessible solutions are also generally not or only marginally more expensive than not accessible alternatives. This is provided they are already taken into account in the planning phase and coordinated with representatives of relevant interest groups.

Against the background of increasingly restrictive legal provisions (expensive retrofits), the possibility of claiming compensation for not fully accessible situations as well as the tight budgetary situation in the public sector, this early inclusion of accessibility can lead to economic relief in the early stages. In the long term, additional returns can be generated by increased user traffic.

REFERENCES

- [1] ADAAA (2008). Americans with Disabilities Act Amendment Act. Washington.
- [2] B-VG (2012). Bundes-Verfassungsgesetz; BGBl. Nr. 1/1930 zuletzt geändert durch BGBl. I Nr. 65/2012.
- [3] BehiG (2002): Bundesgesetz über die Beseitigung von Benachteiligungen von Menschen mit Behinderungen (Behindertengleichstellungsgesetz, BehiG), SR 151.3.
- [4] BGG (2007): Gesetz zur Gleichstellung behinderter Menschen (Behindertengleichstellungsgesetz - BGG) veröffentlicht BGBl. I S. 1467, 1468 zuletzt geändert durch BGBl. I S. 3024.
- [5] BGStG (2011): Bundesgesetz über die Gleichstellung von Menschen mit Behinderungen (Bundes-Behindertengleichstellungsgesetz – BGStG) veröffentlicht BGBl. I Nr. 82/2005 zuletzt geändert durch BGBl. I Nr. 7/2011.
- [6] Bundeskompetenzzentrum Barrierefreiheit (2013). Barrierefreiheit. Abgerufen am 24.05.2013 von <http://www.barrierefreiheit.de/barrierefreiheit.html>
- [7] Bundessozialamt (2013). Barrierefreiheit allgemein. Abgerufen am 24.05.2013 von http://www.bundessozialamt.gv.at/basb/Behindertengleichstellung/Barrierefreiheit/Barrierefreiheit_allgemein
- [8] John Clarkson, P., Coleman, R. (2013): History of Inclusive Design in the UK, Applied Ergonomics, <http://dx.doi.org/10.1016/j.apergo.2013.03.002>.
- [9] Department of Justice (2010). 2010 ADA Standards for Accessible Design. Washington.
- [10] Freiraum (2013). Ziele und Definition von Barrierefreiheit bzw. Design for all. Abgerufen am 24.05.2013 von <http://www.freiraum-europa.org/was-ist-barrierefrei.html>.
- [11] Fürst, E., Mallaun, S. (2014). Wie auf Megatrends reagieren? Strategien von ÖPNV-Unternehmen zum Umgang mit Herausforderungen aktueller Entwicklungen. *Der Nahverkehr* 4/2014: 52-59.
- [12] Leitner, B. (2008). Menschen mit Beeinträchtigungen: Ergebnisse der Mikrozensus-Zusatzfragen im 4. Quartal 2007. *Statistische Nachrichten*, 12/2008: 1132–1141.
- [13] United Nations (2007). UN Convention on the Rights of Persons with Disabilities. New York.