

# **EVALUATING MEASURES FOR IMPROVING ACCESSIBILITY OF PUBLIC TRANSPORT SYSTEMS FOR PEOPLE WITH REDUCED MOBILITY**

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## **Abstract**

The importance of accessible public transport has grown significantly in the last few years and will continue to grow due to current demographic changes. Measures to improve accessibility for people with reduced mobility are often undertaken without an ex-ante assessment of available alternatives. The goal of this paper is to present a tool that evaluates measures to improve the accessibility of public transport systems. The name of the approach is OBS (Opportunities, Behavior, Satisfaction) and can be described as follows:

The first component “Opportunities” (O) addresses the “option benefit” of the transport system. People benefit from the existence of the transport system even if they do not actually make use of it or only use parts of it. The second component “Behavior” (B) describes all aspects related to the actual usage of the transport options as described above in O: The spatial system perspective addresses the utilization of the available destinations (spatial supply); the transport system perspective addresses the utilization of the transport system (transport supply); and the individual perspective covers the impact of the measures on people’s travel behavior. The third component “Satisfaction” (S) represents the subjective perception of quality of life and describes how people perceive the transport system. Changes in perception might even appear for measures that do not affect the transport system described in O (e.g., mobility training).

The three components O, B and S are described and specified with indicators including costs and benefits for each component. Based on this, a framework for synthesizing the different indicators into a consistent assessment method is developed. Finally, the evaluation tool is applied to four case studies: the “Barrier Free” campaign in Berlin; the BAIM project (an extensive Internet information service for barrier-free public transport connections); the “Mobil Plus” concept in Zurich; and mobility training for people with disabilities. The case studies demonstrate that the evaluation tool is flexible and can be adapted to different real-world situations.

# 1 INTRODUCTION

Today, the goal of providing all people with access to various functions is becoming increasingly accepted within the fields of science and politics.

In many countries this goal is even regulated by law (AMOR, 2007; EuCAN, 2003; Tennøy, 2008)<sup>1</sup>. On one hand, there are still many deficits and much discussion about the actual requirements for anti-discrimination but on the other hand many activities are undertaken to improve the situation for disabled people.

Within these many considerations, this paper focuses on the transport system and here especially on measures for improving public transport systems' accessibility for people with disabilities. It can be stated that different public and private institutions are increasingly engaged with this issue and are spending significant sums of money on making the spatial and transport system accessible for all people. Costly measures such as constructing lifts or purchasing low-floor vehicles are being implemented. However, it must be stated that evaluation of these activities is almost non-existent. In many cases measures are implemented without determining and comparing the costs and benefits of the project<sup>2</sup>.

Even the documentation of costs is often fragmentary or completely missing. Ex-ante estimations and impacts are documented in only very few cases (TU Dresden, 2008). Ex-post monitoring is mainly done by directly involving the affected stakeholders in the planning process and thus facilitating feedback for the next planning cycle.

The European Conference of Ministers of Transport (ECMT, 2006, p. 6) states: *"In some countries that have already enacted national disability legislation in some form, or that have in place a policy framework setting out accessibility requirements, there is sometimes a lack of or insufficient monitoring of implementation of the legal and regulatory requirements. Evaluation is at an early stage – if practiced at all – in many countries, and as a result, there is often inadequate understanding of the impacts of policies on improving accessibility."*

The problems of these deficits in evaluation are obvious: Without evaluation it is neither possible to establish whether the planned and implemented measures help towards the defined goals nor whether the measures are efficient. Public institutions in particular are often required to prove efficient expenditure of public money. Additionally, evaluation provides an opportunity for benchmarking, to share experiences gained and to increase the knowledge base for future projects.

This lack of evaluation is the starting point for this paper. The goal is to develop an evaluation tool for measures to improve public transport systems' accessibility for people with reduced mobility that allows for identifying preferable solutions for specific applications from society's perspective.

Hence, the goal of this paper is not to assess the degree to which a transport system is barrier-free. Rather, we intend to develop and apply a tool that assesses those measures which aim to improve accessibility to public transport for people with reduced mobility; specifically, to examine efficiency, suitability for achieving pre-defined goals and effectiveness in comparison to other alternatives<sup>3</sup>.

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<sup>1</sup> See <http://ec.europa.eu/social/main.jsp?catId=423&langId=en>, 24/01/2010 for EU anti-discrimination directives.

<sup>2</sup> See TU Dresden (2008) for a detailed discussion of reasons for evaluation deficits in this field.

<sup>3</sup> See TU Dresden (2009) for a detailed discussion on functions of evaluation.

We postulate the goal of barrier free public transport as a given starting point, include a wide range of measures (see section 2) and develop methods that can be applied for the ex-ante and ex-post assessment of measures. The developed tool serves as a framework for evaluation including exemplary indicators. The final set of indicators can only be defined together with the stakeholders and for concrete applications.

The project *PTaccess* (Public Transport Systems' Accessibility for People with Disabilities in Europe)<sup>4</sup> forms an important basis for this paper, especially for the exemplary applications. In this project we have identified and analyzed good practice and innovation in making public transport accessible, and enhanced the scientific base of policy by providing a sound assessment of the costs and benefits of making public transport accessible.

The structure of this paper is as follows: The paper starts with a discussion of some basic concepts in Section 2: Which measures are available for improving public transport systems' accessibility for people with disabilities and which type of measures are to be included here? How do we define "people of reduced mobility" for this paper?

In Section 3, an overview of existing assessment methods in the transport sector is given. Based on this, the assessment tool is developed in Section 4. In Section 5, initial applications of the tool are presented. The paper ends with conclusions and recommendations for policy and for further research in Section 6.

## **2 SETTING THE STAGE – SCOPE AND DEFINITIONS**

Mobility restrictions might result from a wide range of reasons. The International Classification of Functioning, Disability and Health (ICF)<sup>5</sup>, published by the World Health Organization (WHO) provides a sound basis for discussing health and disability at both individual and population levels. In ICF, disability and functioning are viewed as outcomes of interactions between health conditions (diseases, disorders and injuries) and contextual factors. The latter include external environmental factors (such as social attitudes, characteristics of the build environment, legal and social structures and climate); and internal personal factors (such as gender, age, coping styles, social background, education, profession, past and current experience, overall behavior pattern, character and other factors that influence how disability is experienced by the individual)<sup>6</sup>.

This paper is focused on public transport. Consequently, we consider all kinds of deficits that might restrict people's ability to access the destinations of their choice. We divide them into person-related factors that mainly correspond to system-related factors and to the ICF-health conditions (but also include subjective aspects such as knowledge and attitudes).

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<sup>4</sup> See <http://www.ptaccess.eu>, 24/01/2010.

<sup>5</sup> See <http://www.who.int/classifications/icf/en/>, 24/01/2010.

<sup>6</sup> According to WHO, "disabilities is an umbrella term, covering impairments, activity limitations, and participation restrictions. An impairment is a problem in body function or structure; an activity limitation is a difficulty encountered by an individual in executing a task or action; while a participation restriction is a problem experienced by an individual in involvement in life situations. Thus disability is a complex phenomenon, reflecting an interaction between features of a person's body and features of the society in which he or she lives." (<http://www.who.int/topics/disabilities/en/>, 04/07/2008) The European Disability Forum defines: "Disability is therefore understood as the result of the interaction between the individual's impairment and the barriers created by society (be social, environmental and attitudinal)." see [http://www.edf-feph.org/Page\\_Generale.asp?DocID=12535](http://www.edf-feph.org/Page_Generale.asp?DocID=12535), 24/01/2010; see EC (2002) for a comparative analysis of definitions of disability across Europe.

The following person-related mobility restrictions are considered<sup>7</sup>:

- Physical disabilities: motor impairments (walking impairments, standing impairments, picking impairments, overweight); sensual impairments (visual, hearing); speaking impairments; small/tall people; chronic diseases (e.g., allergies, tinnitus) and seizure disorder
- Mental and learning disabilities: mental restrictions (illiteracy, permanent cognitive and intellectual restrictions); psychic disabilities (claustrophobia, anankastic personality, addiction).

For this paper, we additionally include person-related disabilities in the wider sense:

- Restrictions related to age: children and elderly people
- Short-term impairments including people who are: sick, injured, inebriated, pregnant, carrying bulky items, accompanying children, unable to speak the local language, unfamiliar with the area.

The question about the main barriers for people with reduced mobility is closely related to the question of measures for improving public transport systems' accessibility – the main barriers should be the main points for action. Thus, these two questions will be discussed together.

Disabled people are not a homogenous group, and the access requirements vary depending on the type and severity of impairment. Designing a public transport system according to the principles of design-for-all or universal design<sup>8</sup> would satisfy access requirements for various groups of disabled people and also improve the quality of transport services for other people. We group the variety of measures in the three groups that are shown in Figure 1. Each group contains financial measures such as financial support for new technology, for providing and maintaining infrastructure and for public transport services.

The evaluation tool developed in this paper must be applicable for all types of measures. The case studies will cover all three groups in order to demonstrate its applicability.

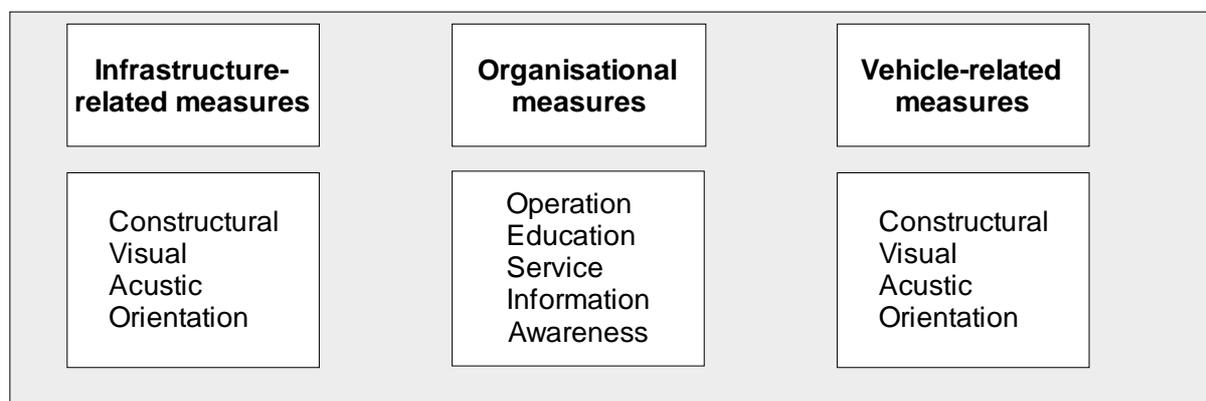


Figure 1: Classification of measures for improving public transport's accessibility for people with reduced mobility

<sup>7</sup> See e.g. Arndt (2005).

<sup>8</sup> See <http://www.design4all.ch/>, <http://www.design.ncsu.edu/cud/index.htm>, <http://www.designforall.org/>, 24/01/2010.

### **3 OVERVIEW OF EXISTING ASSESSMENT TOOLS IN THE TRANSPORT SECTOR**

Decisions in the transport sector are characterized by high complexity: The transport system is linked to numerous sectors of society and the environment, meaning that measures implemented in the transport sector have impacts on almost all sectors of society and vice versa. Assessment procedures were developed to reduce this complexity and to rationalize and standardize decision-making. Thus, they serve to develop value judgments concerning complex issues in order to facilitate political decisions (Schnabel, 1997).

Assessment procedures that are currently applied within transport planning differ:

- in the stage of the planning process the assessment procedure is designed for
- in the number and type of aspects and effects to be included in the assessment procedure (qualitative and/or quantitative indicators)
- in the way to synthesize the included indicators
- in the questions that might be answered by the assessment procedure.

The following Table 1 provides an overview of the main assessment methods that are currently used to evaluate measures in the transport sector<sup>9</sup>.

Non-formalized methods should only be used when a proper quantitative impact assessment is not possible; when the limited scope of the measure does not justify costly assessment procedures; or when the results of (semi-) formalized methods need to be supplemented or summarized for a final assessment.

Elimination methods and compatibility analysis as part of the semi-formalized methods serve to exclude unacceptable alternatives and can be an important precursor to formalized methods. An MCA should be part of any assessment procedure in order to achieve high transparency of the assessment.

Formalized methods can also establish a clear, prioritized ranking for a large number of alternatives. This is the only group of methods that is able to assess the efficiency of alternatives. However, these methods are costly and can conceal information due to the single indicator that is achieved.

For large projects, a combination of methods seems to be the best way:

- Elimination methods for decreasing the number of alternatives to be considered
- Formalized methods (often necessary for proving efficiency)
- Qualitative discussion of effects that cannot be quantified
- Argumentative overall picture and weighting.

The use of formalized methods becomes very important when: many alternatives need to be considered; many criteria need to be included; the impacts are complex; the available data is very good; and when accountability and transparency are important. In the transport sector, these methods are used almost exclusively for assessing investment in transport infrastructure, with CBA as the most frequently used assessment method.

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<sup>9</sup> For a detailed description of the methods, see Cerwenka (2007); Kindl (2007); Odgaard (2005); for a discussion on opportunities and risks of introducing strategic environmental assessment for transport projects see Hanusch (2009); Köppel (2003).

	Advantages and disadvantages	Fields of application
<b>Non-formalized methods</b>		
Intuitive methods, common sense-based methods, Delphi-procedures, public discussion	<ul style="list-style-type: none"> <li>+ easy to apply and to understand</li> <li>+ low-cost</li> <li>+ consideration of all effect types possible</li> <li>- mainly qualitative statements</li> </ul>	Elimination of unacceptable alternatives, in addition to (semi) formalized methods
<b>Semi-formalized methods</b>		
Multicriterial impact analysis (MCA), compatibility analysis, strengths and weaknesses profile	<ul style="list-style-type: none"> <li>result: ranking of alternatives under consideration</li> <li>+ all types of effects can be considered</li> <li>+ no compensation of impacts</li> <li>- no overall ranking</li> <li>- challenging for decision makers as they need to compare different alternatives and to do final weighting</li> </ul>	Comparison of impact profiles (with requirement profiles), rough evaluation, identification of unacceptable alternatives, support of argumentative weighting
Elimination methods	<ul style="list-style-type: none"> <li>+ all types of effects can be considered</li> <li>+ good traceability</li> <li>+/- active involvement of stakeholders necessary</li> </ul>	Identification and elimination of (un-)acceptable alternatives
Weighting and ranking methods	<ul style="list-style-type: none"> <li>+ good traceability</li> <li>- compensation of impacts</li> <li>- pairwise comparison is costly</li> <li>- only possible for a low number of alternatives</li> </ul>	Comparison of alternatives, priority setting
<b>Formalized methods</b>		
Cost-Benefit-Analysis (CBA)	<ul style="list-style-type: none"> <li>result: cost-benefit-ratio or cost-benefit-difference</li> <li>+ comparison of costs and benefits for efficiency analysis</li> <li>- compensation of impacts</li> <li>- no consideration of non-monetary effects</li> <li>- information loss due to one single final indicator</li> </ul>	Efficiency analysis, Comparison of alternatives, priority setting
Value-Benefit-Analysis (VBA)	<ul style="list-style-type: none"> <li>transformation of monetary and non-monetary effects into point scales depending on the degree of goal achievement</li> <li>result: value of benefit</li> <li>+ consideration of monetary and non-monetary effects possible</li> <li>- no prove of efficiency but instead comparison of the effects with goals</li> <li>- information loss due to one single final indicator</li> <li>- compensation of impacts</li> </ul>	Comprehensive assessment with regard to goals, comparison of alternatives, priority setting
Cost-Effectiveness-Analysis (CEA)	<ul style="list-style-type: none"> <li>comparison of costs (in monetary units) and benefits (in physical units), consideration of benefits similar to VBA as value of benefit</li> <li>result: amount of achieved effect per unit of cost</li> <li>+ consideration of monetary and non-monetary effects possible</li> <li>- information loss due to one single final indicator</li> <li>- compensation of impacts</li> </ul>	Comprehensive assessment of monetary and non-monetary effects, efficiency analysis (achieved benefit per cost), comparison of alternatives, priority setting
Combinations	<ul style="list-style-type: none"> <li>use of results of single assessment methods as independent criteria and supplement by additional criteria</li> <li>result: list of qualitative and quantitative indicators that are partly aggregated</li> <li>+ allows for comprehensive analysis</li> <li>- costly method</li> <li>- challenging for decision makers as they need to do final weighting</li> </ul>	Comprehensive assessment including efficiency analysis

Table 1: Current assessment methods in the transport sector.

As far as we are aware, there are only very limited instances of transport sector measures being monitored and evaluated other than those related to infrastructure<sup>10</sup>. However, there are many case studies (often done as part of research projects) that show methodological approaches which might also be successfully used for assessing the wide range of measures to be considered for public transport accessibility for people with disabilities<sup>11</sup>.

The Encyclopedia for Transportation Demand Management (TDM Encyclopedia), established and maintained by the Victoria Transport Policy Institute, provides a comprehensive overview of measures for travel demand management and approaches for their evaluation<sup>12</sup>. The evaluation toolkit MOST-MET was designed to effectively plan, implement and evaluate such mobility management projects (Finke, 2003; Hyllenius, 2004). It is composed of different levels of evaluation ranging from indicators describing the external conditions for the measures through to people's satisfaction with the travel options and indicators describing the system impact.

Our research on the evaluation of measures for improving public transport accessibility for people with reduced mobility yielded the following two main results (TU Dresden, 2008):

- Firstly, there is almost no systematic evaluation of measures to improve public transport accessibility for people with reduced mobility.
- Secondly, the main evaluation method for measures to improve public transport accessibility for people with reduced mobility is to engage stakeholders.

Without doubt, the involvement of different stakeholders is a vital prerequisite for successful planning and implementing measures, and it is an important part of the evaluation process. However, participation alone is not sufficient to comprehensively evaluate measures. Additional variables and effects must be monitored in order to comprehensively evaluate the measures undertaken<sup>13</sup>.

## **4 DEVELOPMENT OF THE EVALUATION TOOL**

### **4.1 The OBS-Approach: Opportunities – Behavior – Satisfaction**

Our research of current assessment practice in transport has shown that:

- there is a wide range of measures to be considered that deal with improving public transport accessibility for people with reduced mobility;
- there is a wide range of effects resulting from the measures; and

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<sup>10</sup> For examples of evaluation activities in other sectors of society, see Hogrefe (1999); Sedlacek (2004); Stockmann (2006).

<sup>11</sup> This research is mainly undertaken within analyses on travel behavior; see Axhausen (2007) for an overview of the current status of this field; see also <http://www.max-success.eu/> (Successful Travel Awareness Campaigns and Mobility Management Strategies – MAX); <http://www.midas-eu.com/> (Measures to Influence transport Demand to Achieve Sustainability - MIDAS); <http://www.epomm.org/> (European Platform on Mobility Management).

<sup>12</sup> See Litman (2008). For more information, see <http://www.vtpi.org/tdm/index.php>, 07/01/2010.

<sup>13</sup> One of the rare examples for evaluation in this field is the ex-ante evaluation of measures for improving public transport systems' accessibility for people with disabilities done by the Zurich public transport provider; see ZVV (2002) and Section 5.3.

- there is a wide range of beneficiaries who profit from the measures and not only people of reduced mobility<sup>14</sup>.

We have not found any comprehensive assessment tool that might be directly used for assessing public transport accessibility for people with disabilities. However, we have found various approaches that serve as valuable input and a basis for the assessment tool developed in this paper.

Currently, assessment methods in transport focus mainly on infrastructure investment and here on CBA. CBA is without doubt an important and meaningful instrument to demonstrate the efficiency of projects. The methods for quantifying the costs of measures seem to be beyond dispute and well established. There is broad consensus that internal and external costs must be included in the assessment. Some of the cost components are difficult to monetize with some discussion resulting about the question of how to make these effects manageable for evaluation.

The benefit side, however, seems to be quite open and undeveloped from a methodological point of view. In most currently applied assessment methods, no benefits are considered other than cost reductions which are interpreted as benefits. This is not ideal since the optimal solution in these cases would be zero travel costs. Nobody would suggest that this is really an optimal solution. There must be a balance. We call it here an efficient transport system: a system that achieves the highest benefits with a given amount of resources (maximum principle) or a system that meets the goals with the least amount of resources (minimum principle).

The approach we wish to present aims at comprehensively including costs and benefits of measures. It can be called an OBS approach with OBS standing for the three main components of this approach: Opportunities, Behavior and Satisfaction. In the following, the three basic pillars of this approach are briefly described before specific indicators and methods for the three pillars are developed in Section 4.2. In Section 4.3, a method for synthesizing the indicators is discussed.

The following main components are considered in the OBS approach:

- Opportunities (O): This first component addresses the spatial and transport options people face: Which people can reach what quality and quantity of destinations under what conditions and at what costs? Which people can carry out what quality and quantity of activities under what conditions and at what costs? This group of indicators represents the objective quality of life and describes the “option benefit” that the transport and the spatial system provide. The OECD defines option benefits as: “*those derived from the continued existence of elements of the environment that may one day provide benefits for those currently living*”<sup>15</sup>. People benefit from the existence of the transport and the spatial system even if they do not actually make use of it or only use parts of it. This benefit should be considered in the evaluation and is described by indicators in this first evaluation component “Opportunities”. It covers quality and quantity of the spatial and transport supply and its efficiency: How much money and resources are spent on the provision of transport infrastructure and spatial destinations?

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<sup>14</sup> The overall share of disabled people is difficult to determine, especially for temporary mobility restrictions. TU Dresden (2009) estimates a share of 30% of the whole population including all types of impairment but also persons with baby carriages, luggage or bike.

<sup>15</sup> See <http://stats.oecd.org/glossary/detail.asp?ID=6530>, 24/01/2010.

- Behavior (B): This second component for evaluation describes all aspects related to the use of the spatial and transport supply described in O. The line between components O and B is drawn by taking the transport user's perspective. For public transport, the O component covers the infrastructure supply as well as the provision of public transport services (purchase, operation and maintenance of vehicles, personal costs, etc.) as these services are part of the public transport supply. However, the use of infrastructure by individuals belongs to B and forms the transport demand.

The B component consists of three parts:

- Spatial-system perspective: These indicators address the utilization of available destinations, that is, of spatial supply. How many of the available destinations are actually utilized? What changes in the number of users and visitors resulted from the implemented measures? If the offers provided are not used, they yield zero value (other than the option benefit that is to be considered within the first component "Opportunities") and only generate costs.
- Transport-system perspective: These indicators describe the utilization of the transport supply with regards to the spatial-system based indicators. How many trips do people make with public transport in comparison with the number of trips on offer? How well utilized are the various forms of public transport? The efficiency of individual trips in private motorized transport must also be considered here: What are the costs? How many resources are used? What environmental and safety effects result from the use of the infrastructure per trip and activity undertaken?
- Individual perspective – (travel) behavior: This third group of indicators addresses the impacts of the measures to be evaluated on people's travel behavior. What changes in the (travel) behavior of people with reduced mobility can be observed as a result of the measures? Do they make more trips, different types of trips or longer trips<sup>16</sup>? Do they use more active, healthier or environmentally friendlier transport modes?
- Satisfaction (S): This third group of indicators represents the subjective quality of life and describes changes in the situation of people with reduced mobility that might occur even if there is no change in the objective conditions (of the transport and spatial system). Do people know the transport and spatial offers being made? How satisfied are they with the transport and spatial options they have, both in general and for specific measures?

The following Figure 2 summarizes the three components O, B and S.

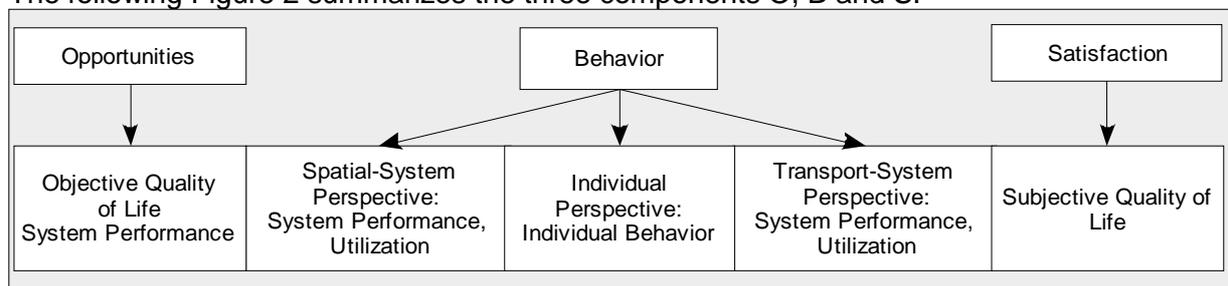


Figure 2: The OBS approach as an instrument for evaluating measures to increase public transport accessibility for people with reduced mobility.

<sup>16</sup> People with reduced mobility make fewer and shorter trips than the general population. In particular, they travel much less on foot, by car (as the driver) and by rail. Hence, it could be interpreted as a benefit if, as a result of a measure, people of reduced mobility make more trips than before and vice versa; see TU Dresden (2009).

## 4.2 Indicators

We now want to develop indicators describing costs and benefits within the three components OBS, knowing that the final set of indicators can only be defined by a societal discussion and for real-life applications. However, we will provide examples of possible indicators describing the components.

### 4.2.1 Opportunities – Objective Quality of Life

This group of indicators represents the things people can do, that is, the destinations they can reach and the activities they can do. These depend on:

- Personal characteristics: Which mobility tools do they have - Do they have a bike or a car or a monthly ticket for public transport? Which abilities do they have - Are they able to move around on their own or do they need an accompanying person; are they able to climb stairs, etc.? How much money does the individual have at their disposal? What time restrictions do they have (for example, flexibility of working hours, coordination of activities between household members)?
- The transport system: Which transport means are available in a specific region at which costs, at which speed, and at which frequency? Which transport means can be used by people with reduced mobility? What information is available about transport supply?
- The spatial system: What quality and quantity of destinations are available in a specific region? What barriers do the destinations and the built environment have?

The three aforementioned points can be described by the term “accessibility” which can be defined as “*the ease of reaching goods, services, activities and destinations (together called opportunities)*” or in other words as the “*potential for interaction and exchange*” (Litman in Becker and Gerike, 2008). There is a wide range of accessibility measures available ranging from simple distance measures to sophisticated utility concepts<sup>17</sup>. Depending on the type and complexity of measures to be evaluated, all of these accessibility indicators might be suitable for evaluating the available opportunities as the first component of the assessment approach to be developed in this paper.

The set of indicators finally chosen must be adapted to the target group of the measure being evaluated and to its goals. Especially when aiming to improve the opportunities for disabled people it is necessary to work with detailed micro level indicators<sup>18</sup>.

The component O includes cost and benefit indicators. On the cost side of the opportunity component all costs must be considered that arise from providing the “option benefit”<sup>19</sup> of the transport and spatial system:

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<sup>17</sup> See El-Geneidy (2009); Gerike (2007); Levine (2009); Miller (2008) for an overview.

<sup>18</sup> Macket (2007) included accessibility indicators on a very micro level in their analysis with indicators such as access to buildings, obstacles such as width restrictions and lack of dropped kerbs, the distance from car parks and bus stops to reach facilities, etc. The result of this analysis is that even in an apparently accessible city like the one being studied (the city centre of St Albans in Great Britain) there are many barriers for people of reduced mobility, which can only be identified in a micro level analysis; see also Colclough (2009).

<sup>19</sup> See section 4.1 for the definition of the term “option benefit”.

- Investment costs: This point covers all costs that arise from the provision of the transport system. Infrastructure costs are the main factor for private transport, whereas for public transport the costs for providing the transport services also must be considered, for example, construction costs for dedicated public transport roads, tracks, stations; costs for purchasing new vehicles; costs for developing service and information (e.g., for developing a barrier free internet presence); and costs for providing mobility training. For the spatial supply, similar indicators must be considered, for example, costs for constructing new facilities such as schools or public parks.
- Maintenance costs: This category represents all costs for maintaining the spatial and transport infrastructure (e.g., costs for repairing and cleaning) with the same categories as above. Example indicators are costs for maintaining infrastructure and public transport vehicles (regularly or irregularly, e.g., due to vandalism) and maintenance costs for the spatial supply, for example, costs per place in pre-school, costs per square meter of public green space.
- Operating costs: Operating costs include all costs related to the actual operation of infrastructure and public transport vehicles, for example, personnel costs for bus drivers, guards, ticketing staff, for the administration of transport infrastructure but also for the administration and operation of spatial infrastructure (e.g., personnel costs for teachers, for operating swimming pools). Example indicators for operating costs are costs for fuel consumption; mileage dependent costs for depreciation, wear, repair, maintenance, lubricants; costs for information material; labor costs; costs for special services for disabled people; concession levied public transport; and also costs for administration and police.

Environmental and safety costs must be included for all of the above components.

Hence, we consider here only the costs related to the pure provision of facilities and not the costs related to their usage. Indicators in this “Opportunities” component do not consider whether a transport or spatial supply is actually used, that is, whether there are any public transport riders or people visiting parks and attending public schools. A typical public transport indicator for O might be money and resources spent per seat kilometer offered. However, the passenger kilometers per seat kilometer belong to the category B in this system.

The qualitative assessment for this component O can be formulated as a yes/no-variable: Can changes be expected in the transport and spatial supply people have as a result of the measure to be evaluated? For which groups of people, for which destinations, for which transport links and for which transport means do these changes occur? An increased quality and quantity of spatial and transport offers can be interpreted as benefit. Also the costs can be assessed qualitatively, for example, by using categories such as high/medium/low costs for the measure to be evaluated.

Quantitative assessment of the component O mainly builds on accessibility analysis. Geographic Information Systems (GIS) provide a suitable platform for documenting and visualizing accessibility measures. However, it is often consuming in terms of time and money to collect the data needed for detailed accessibility analysis.

We recommend continuous monitoring of accessibility in the region being assessed because the “option benefit” of the transport and spatial supply is the central benefit of O and is a very important benefit of any policy in this sector.

#### **4.2.2 Behavior: System Performance, Utilization of the Transport and the Spatial System; Individual Behavior**

This component consists of system performance (efficiency) and actual usage of the spatial and transport supply as described in the opportunity component O discussed above. The following example indicators can be applied to B:

- Spatial-system perspective: This perspective covers all indicators describing the utilization of spatial offers. Examples include: the number of visitors/users of public facilities such as theatres, libraries, parks, and swimming pools; economic indicators for all private services; economic indicators for shops (e.g., turnover, profit), public facilities (e.g., number of visitors) or companies (e.g., turnover, profit)<sup>20</sup>.
- The transport-system perspective distinguishes between two efficiency levels:
  - The utilization of public transport offers (e.g., pax-km per seat-km; number of additional public transport users (particularly people with reduced mobility), payments for compensation, costs for reduced fares)
  - The efficiency of individual motorized transport (e.g., number of vehicle passengers, parking charges, municipal tax revenues).
  - Example indicators for public transport and individual motorized transport include: the number and severity of accidents; environmental effects (e.g., energy consumption, noise, air pollutant emissions, and green house gas emissions); travel time and costs; employment effects from implementing the measure and from maintaining and operating the system. These can be absolute values or per passenger/ton kilometer.
- Individual perspective – (travel) behavior: These indicators focus on individual activity patterns (type and number of activities) and travel behavior (number, time and distance of trips) with indicators such as number, purpose and length of trips per person. Indicators for the whole population might describe the impacts of the current travel behavior on people's health with the assumption that more or longer trips with public transport/bike/foot are better for people's health and thus can be interpreted as a benefit component in the evaluation method (possible indicators for people's health: mass, height)<sup>21</sup>. Knowing people's preferences for different trip purposes, it would also increase benefits if people had more trips of higher value (e.g. leisure trips) even if the overall number of trips remains stable<sup>22</sup>.

#### **4.2.3 Satisfaction – Subjective Quality of Life**

In contrast to the behavior component discussed above, particularly the system performance indicators, the indicators considered in the satisfaction component are dominated by benefit components. These indicators describe how different groups of people perceive the offers made and how satisfied they are with them. The underlying concept is that subjective quality of life can be conceptualized "*as the person's experience of life*". This is in contrast to objective quality of life which is addressed in the opportunity component and can be defined

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<sup>20</sup> Efficiency indicators can be derived by combining these indicators with indicators from the O component, e.g. costs per utilization.

<sup>21</sup> See Berrigan (2009).

<sup>22</sup> See Hess (2008); Tseng (2008) for value of travel time analysis.

as “*the objective living conditions of an individual*” (Steg, p. 56, in Becker and Gerike, 2008). For example, noise exposure is an objective indicator of quality of life; whereas, the extent to which individuals are concerned about this exposure is a subjective indicator. Objective conditions might differ significantly from their subjective perception, with the result that measures which are believed to increase quality of life do not necessarily improve people’s perception of quality of life (and vice versa).

Researchers from the University of Groningen developed and tested a comprehensive list of quality-of-life aspects which includes, among others, the following indicators (Steg in Becker and Gerike, 2008): health, partner and family, social justice, freedom, safety, education, identity/self-respect, privacy, environmental quality, social relations, work, security, nature/biodiversity and money/income. People were asked to weight the different indicators and to state how they perceive their current situation in terms of the indicators. In addition, the changes which people expected to their subjective quality of life as a result of planned measures were analyzed.

Of course, these indicators are highly subjective. People’s opinions and perceptions are influenced and formed by external circumstances, by comparisons to other people and regions, and by public opinion (e.g., media). However, in combination with the other indicators they provide valuable assistance for evaluation since planning for people’s needs is not possible without involving the people affected. Human needs are variable and constantly changing, so it is vital that people are asked about their needs. Only they know what these are.

The indicators considered here are difficult to model and to forecast; however, it might be possible to estimate changes in satisfaction through analogy if this is based on a sufficient number of comparable case studies.

### **4.3 Synthesis**

The previous sections provide an overview of the indicators to be considered in the different components as a result of the discussion above. Each of the three components O, B and S cover a wide range of effects and must be specified by indicators including costs and benefits in each of the components.

After carefully weighing up the advantages and disadvantages, we decided to use an extended CEA for synthesizing the final indicators. The following reasons were pivotal for this decision:

Efficiency considerations are important for any measure which is to be implemented by public authorities. However, it is obvious that there are indicators which need to be considered but which cannot be expressed in monetary terms. CEA allows these non-monetary benefits, which are often expressed in point scales as degrees of goal achievement, to be compared with monetary costs. The final result and indicator is the ratio of benefits/effectiveness to costs.

Examples of benefit components to be considered are: increases in accessibility including indicators describing the degree to which basic mobility is guaranteed (in O); the number and type of completed activities including the needs that are satisfied by those activities and the trips undertaken (in B); and changes in the perception of and satisfaction with the transport and the spatial system (in S). Costs are mainly found in O and B with two main components:

costs for running the transport and the spatial system; and costs for using these systems, that is, for the actual transport activities. An example of an effectiveness-cost-ratio that considers only one benefit component is the number of additional users due to the measure under consideration per changes in cost<sup>23</sup>.

The decision to use an extended CEA was made so that additional indicators and effects could be included in the evaluation:

- Cost effects that cannot be monetized (e.g., fragmentation)
- Benefits that cannot be transferred to point scales and thus cannot be considered in a CEA but can be included in a qualitative and descriptive way.

The results of the evaluation are summarized in the evaluation table shown in Figure 3. This figure begins with some general remarks on the project in Point One and on the methodology used for the evaluation in Point Two. In Point Three, there is a short verbal evaluation of the project. This point highlights some important characteristics of the project which are further listed in either Points Four or Five<sup>24</sup>. In Point Four, the main results of the CEA are summarized. The indicators included in the CEA originate from O, B and S. Therefore, in Point Five, only effects for the three components that are not considered in the CEA are described.

The actual type and number of indicators to be considered for evaluation depend on:

- the type of measure implemented: for example, infrastructure investments result in other cost categories than just measures for improving service and information; and
- the expenditure related to the implementation of the measure: preparing a booklet for disabled public transport users requires less elaborate evaluation than measures for making all metro stations of a city accessible for wheelchair users.

Hence, it is important that the final list of indicators for the CEA and its extension are specified for each application in conjunction with the local stakeholders.

All components should be considered in every evaluation but this does not need to be done extensively in every case. It is sufficient to concentrate on the most appropriate ones. However, a comprehensive picture would not be provided if any of the three components O, B and S were left out. The indicators that should be examined in greatest detail are those that are highly relevant for the decision makers or those which are expected to change the most following implementation of the measure.

Ex-ante and ex-post evaluation is vital for establishing a continuous planning and evaluation process. In principle, any kind of indicator can be predicted. However, the forecasts for some indicators might be consuming in terms of time and money. For some indicators, methodological difficulties in forecasting them might arise (for example, indicators for satisfaction); however, a conclusion can be drawn by analogy. For these effects, it is especially important to undertake long-term monitoring as changes in travel behavior might appear with a significant time offset. Alternatively, there might be short term effects that disappear after a certain time because the experimental behavior does not change into permanent behavior.

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<sup>23</sup> These effects were monitored for the Zurich case study; see section 5.3; see Behindertenkonzept MobilPlus. (de), <http://www.zvv.ch/de/service/handicap/mobil-plus.html> (20/01/2010) for further information.

<sup>24</sup> This information is also contained in the NISTRA-tableau which is used for evaluating Swiss transport infrastructure projects; see ASTRA (2003).

The weighting for the three components O, B and S should be decided in close cooperation with all relevant stakeholders for every specific application. A qualitative discussion on changes that are to be expected due to the measures being considered is better than no discussion at all. The qualitative evaluation of the components O, B or S should be based on expert knowledge or on arguments of analogy. The task of the experts (in close cooperation with the decision makers and relevant stakeholders) is to determine the final set of indicators to be considered and to qualitatively discuss the impacts of the measures on the indicators based, for example, on experiences with similar measures. This kind of evaluation is suitable for evaluation components that are not the focus of the intervention and for evaluation components where major changes are not anticipated because of the measure.

However, quantitative analysis should be viewed as the only possible way to provide well-founded information about impacts of measures. The quantitative evaluation should be based on empirical analysis. The task of the experts is to design a suitable evaluation for empirically quantifying the effects described qualitatively above. Quantitative evaluation is recommended for components which the intervention focuses on and for components which are expected to change substantially as a result of the intervention. Although quantitative analysis might not yet be standard practice, it is the only means of achieving sound evaluation of measures for people with reduced mobility and for drawing reliable conclusions for further work.

Figure 3 shows the general structure of the evaluation template for evaluating measures with the OBS approach.

<b>OBS Evaluation: Opportunities – Behavior - Satisfaction</b>	
<b>Title of Measure</b>	
<b>1. Short description of the project</b>	
<b>2. Short description of the methodology used for evaluation</b>	
Which model was used to estimate the effects of the measure?	
<b>3. Short verbal evaluation of the project</b>	
Central strengths	
Central weaknesses	
Verbal overall evaluation	
<b>4. CEA</b>	
Net present value costs	
Benefits/Effectiveness	
Ratio Effectiveness/Cost	
<b>5. OBS Evaluation – Central indicators</b>	
<b>Opportunities</b>	
- Option value: accessibility measured by qualitative or quantitative accessibility indicators [points]	
- Degree of goal achievement for guaranteeing a basic transport and spatial supply [points]	
- Costs for spatial and transport supply [Euros]: investment, maintenance, operation (including services for people with reduced mobility)	
<b>Behavior</b>	
<i>Transport system perspective</i>	
- Transport performance [tkm/pkm], utilization of public transport, number of additional public transport users, additional revenues and employment effects at the public transport operator, environmental effects: noise exposure [dB(A)], air pollutant emissions [t], GHG emissions [t], land consumption and fragmentation [km <sup>2</sup> ], traffic safety [number and severity of injuries], energy and resource consumption [t]	
<i>Spatial system perspective</i>	
- Economic indicators (e.g., profit) [Euros], utilization of destinations, employment effects at destinations	
<i>Individual behavior</i>	
- Activities realized/needs satisfied [number and type], trips realized [number, distance, time, trip purpose]	
<b>Satisfaction</b>	
- Indicators of subjective quality of life [points], participation [points]	

Figure 3: Structure of the evaluation template for the OBS approach.

## 5 EXAMPLES OF THE EVALUATION TOOL IN APPLICATION

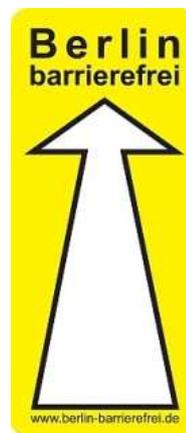
The goal of this section is to demonstrate the applicability of the evaluation tool. Each case study has a short description with the basic approach for evaluation and a completed evaluation template. Comprehensive quantitative analysis was not possible due to a lack of available data and the fact that collecting data fell outside the scope of this project. However, we have quantified the relevant effects that are necessary for the OBS-approach whenever the data was available. For other effects, we added a qualitative assessment, mainly by discussing what data would be necessary, which indicators seem to be suitable, and which tendencies can be expected for these indicators as a result of implementing the measure under consideration. Thus, the following section provides a conceptual picture of how to use the OBS-approach: Which indicators are suitable for which type of measures? What data is necessary to quantify those indicators?

## 5.1 Labeling accessible infrastructure: “Barrier Free” certification in Berlin

### *Description*

The “Barrier Free” label in the city of Berlin<sup>25</sup> is awarded when certain quality standards are met. In the case of public transport, this means that, for example, stations must have stair-free access with elevators or ramps; elevators need to have a voice system; there must be a tactile operating system approximately 85 cm high; and there must be a navigation system with contrasting, optimized and tactile guidance for visually impaired people at all platforms, exits and elevators. In addition to public transport, certification is also awarded to various types of buildings, for example, retail facilities and public institutions. The goals of initiating this scheme were threefold: raise awareness; motivate retailers and public institutions to remove barriers; and make the identification of accessible locations easier for people with reduced mobility. One issue of setting up these schemes is determining the standards. In the case of Berlin, it was decided not to set standards too high in order to encourage a strong uptake.

“Barrier Free” certification was selected as an example of good practice and for application of the assessment tool as it shows a successful holistic approach to promoting accessible infrastructure, including public transport facilities.



### *Ideas for evaluation*

“Barrier Free” is purely an organizational measure. It can only have an impact on the objective accessibility of people with reduced mobility if it motivates local stakeholders to improve the accessibility of their facilities in order to receive certification. These effects can be quantified by surveying the affected stakeholders. In addition, the label has the potential to improve subjective accessibility and satisfaction (S) by making people with reduced mobility aware of the opportunities they have. Thus, it can also change the behavior of the affected people (B). These effects in B and S can also be quantified with the help of surveys. All of the effects to be considered are summarized in the following evaluation template.

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<sup>25</sup> See <http://www.berlin-barrierefrei.de/> (15/01/2010) for more information about the label.

<b>OBS Evaluation : Opportunities – Behavior - Satisfaction</b>	
<b>“Barrier Free” certification in Berlin</b>	
<b>1. Short description of the project</b>	
Certification of accessible facilities which aims to: raise awareness; encourage the removal of barriers; and improve orientation for people with reduced mobility	
<b>2. Short description of the methodology used for evaluation</b>	
Qualitative assessment as data was not available for most of the effects; requirements of quantitative evaluation: regular survey of certified institutions, their users and of the travel behavior of people with reduced mobility; monitoring the cost of running the system; and of costs for transport and spatial supply including its usage	
<b>3. Short verbal evaluation of the project</b>	
<i>Central strengths</i> Boosts awareness and has the potential to drastically increase subjective (and to a lesser degree objective) accessibility; easy to introduce in other locations	
<i>Central weaknesses</i> Accessibility criteria differ from sector to sector and are therefore not easy to recognize; implementation strategy unclear (dissemination depends on financial and personal resources)	
<i>Verbal overall evaluation</i> Strengths outweigh weaknesses as these can be avoided by adequate planning with stable financial and human resources	
<b>4. CEA</b>	
Net present value costs: implementation/running costs in Euros (500,000 Euros /200,000 Euros p.a.)	
Benefits/Effectiveness: qualitative assessment, see below	
Ratio Effectiveness/Cost Not possible to determine without additional data	
<b>5. OBS Evaluation – Central indicators</b>	
<b>Opportunities</b> - statistical evaluation, interview with operator	
<ul style="list-style-type: none"> <li>- Option benefit: only small changes in transport/spatial supply and objective opportunities [number and type of certified institutions; building enhancements to gain certification]; enhanced perceived and guaranteed accessibility at labeled institutions to be monitored</li> <li>- Meeting standards for basic needs: verifiable with label criteria</li> <li>- Costs for spatial and transport supply [Euros]: investment and running costs for staff and material (rental, technology, advertising); costs to visit and assess locations to be certified; costs for producing the label; on-site costs for meeting the requirements of certification</li> <li>- Low environmental costs (use of resources for trips and production of the label)</li> </ul>	
<b>Behaviour</b> - written interviews in the label equipped institution and oral interviews with customers	
<i>Transport system perspective</i> <ul style="list-style-type: none"> <li>- Number of additional public transport users including distance covered and number of trips [pkm], additional revenue/secondary employment effects for the public transport operator</li> <li>- Decrease of environmental effects and individual costs due to modal shift (induced public transport has to be considered here); increase in traffic safety</li> </ul>	
<i>Spatial system perspective</i> <ul style="list-style-type: none"> <li>- Rising utilization of spatial supply (labeled shops, schools, health services, etc.) by people with reduced mobility [points]</li> <li>- For labeled destinations rising tendency for economic indicators (e.g., profit); utilization of destinations; employment effects at destinations [points]</li> </ul>	
<i>Individual behavior</i> <ul style="list-style-type: none"> <li>- Rising numbers of realized activities/satisfied needs [number, type], realized trips [number, distance, time, trip purpose] [points]</li> </ul>	
<b>Satisfaction</b> - surveying, interviews with customers	
<ul style="list-style-type: none"> <li>- Rising tendency for number and type of satisfied needs and for indicators of subjective quality of life (to be surveyed): How many accessible institutions do people with reduced mobility know? How satisfied are they with the transport and the spatial supply?</li> </ul>	

Figure 4: Evaluation of “Barrier Free” certification in Berlin.

## **5.2 Internet information about barrier free connections: The BAIM project**

### *Description*

People who are motor or visually impaired are reported to use public transport more often if information services are improved and increased. This applies even if the transport supply remains the same<sup>26</sup>. This indicates that information services are highly beneficial. The aim of the German project “BAIM”<sup>27</sup> (Barrier Free Information for People with Reduced Mobility) was to support people with reduced mobility to actively and independently participate in the public transport system with the help of a broad, integrated, Internet-based information system. Both before and during the trip, relevant information is provided in a comprehensive form to meet the needs of mobility-reduced users. The information is provided by different mobile and stationary information media including new technologies such as the Internet, PDAs and voice recognition systems. In addition to the “normal” input of start and end stops with the desired timing, mobility reduced users have the possibility to enter details about their specific conditions which are used for planning the route.

During the project, “BAIM Plus” commenced. This expanded the target group, combined travel information with real time information, and provided pedestrian navigation between stops.

### *Available evaluation data*

It was determined that a combination of expert and user tests in a multi-stage evaluation approach was the most successful research method in the BAIM project. Any deficiencies that might have been missed or given a different weighting by the experts can be pinpointed. In addition, negative evaluations by the experts can be revised by end-users so that the overall evaluation is well-balanced.

Tests showed that the speech dialog system was not clear for 13% of users, was clear with some limitations for 40%, and was clear immediately for 47%.

Although benefits were not assessed sufficiently to complete the OBS-evaluation template, the cost side was relatively well estimated within the BAIM-project as shown in the following evaluation.

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<sup>26</sup> See Wahlster (2008).

<sup>27</sup> See <http://www.baim-info.de> (24/01/2010).

OBS Evaluation: Opportunities – Behavior - Satisfaction
BAIM - Internet information service for people with reduced mobility
<b>1. Short description of the project</b>
A broad integrated information system for barrier free travel information provided by different mobile and stationary information media
<b>2. Short description of the methodology used for evaluation</b>
Very complex to evaluate; not possible to evaluate with data collected so far; additional surveying of BAIM (Plus) users required once the system has been running for a longer time
<b>3. Short verbal evaluation of the project</b>
<i>Central strengths</i> Provides information about accessibility as a precondition for the start of a journey; constant updates assure latest information about the accessibility of the public transport system
<i>Central weaknesses</i> Implementation only reasonable if there is an accessible public transport system available; complicated data collection at the beginning
<i>Verbal overall evaluation</i> Provided that there is an accessible public transport system available, the Internet information service creates the precondition for a barrier-free journey and the use of the available accessible public transport system
<b>4. CEA</b>
Net present value costs: implementation costs: not yet known; running costs: 40% higher than before
Net present value benefits: not possible to evaluate quantitatively as there is no relevant data yet
Ratio Effectiveness/Cost Not possible to determine without additional data
<b>5. OBS Evaluation</b>
<b>Opportunities</b> – statistical evaluation, interviews with operators
<ul style="list-style-type: none"> <li>- No change in transport/spatial supply and objective opportunities; improved perceived accessibility of public transport, increasing number of potential users</li> <li>- Costs for spatial and transport supply [Euros]: investment costs for material: hardware system (new servers, installation), 10 working days; costs for operating and updating the system: 8h/week; costs to visit locations and collect/enter data: between 45 min (simple stop) and 1,500 min (complex connecting building); costs for collecting/entering data of vehicle (type, attributes, sketches): 2-4 working days/vehicle; update vehicle data: 20% of origin; costs for testing the program</li> <li>- Low environmental costs (resources for trips and producing the program)</li> </ul>
<b>Behavior</b> - interviews with operators/online interviews with customers
<i>Transport system perspective</i>
<ul style="list-style-type: none"> <li>- Transport performance [tkm/pkm] – tendencies: PT increasing, IMT decreasing; additional public transport users lead to additional revenue/secondary employment effects for the public transport operator</li> <li>- Positive environmental effects (less car rides due to increased usage of accessible public transport), notably less air pollutant emissions [t] and GHG emissions [t],</li> <li>- Increased traffic safety (fewer and less severe injuries)</li> </ul>
<i>Spatial system perspective</i>
<ul style="list-style-type: none"> <li>- Destinations increasing: economic indicators (e.g., profit) [Euros], utilization of destinations, employment at destinations</li> </ul>
<i>Individual behavior</i>
<ul style="list-style-type: none"> <li>- Rising number of realized activities/satisfied needs [number, type], realized trips [number, distance, time, trip purpose]</li> </ul>
<b>Satisfaction</b> - (online) interviews with (potential) customers
<ul style="list-style-type: none"> <li>- Number and type of satisfied needs – estimated to rise but depends on the level of infrastructure accessibility of the public transport system and recognition of the service</li> <li>- Indicators of subjective quality of life [Points], participation [Points] – estimated to increase due to improved and guaranteed accessibility</li> </ul>

Figure 5: Evaluation of BAIM - Internet information service for people with reduced mobility.

### **5.3 Upgrading accessibility of an urban agglomeration public transport system: The Zurich “Mobil Plus” Project**

#### *Description*

In May 2001, the council of Zurich Canton in Switzerland decided to gradually improve access for people with reduced mobility within the canton and to expand its public transport facilities in such a way that it enables people with disabilities to travel independently and without assistance<sup>28</sup>. In particular, it set out to guarantee: free access to stations, platforms, stops and vehicles; the availability of relevant travel information before, during and after trips; accessibility of services (timetables, seat reservation, etc.); and improved visibility of ticket counters and information desks for passengers.

The goal was to implement the measures by 2014. Four options (from basic supply to full upgrade) were developed in advance and assessed by using cost benefit analysis tools. The cost benefit analysis revealed that only two options generated benefits that outweighed the costs. Option 2 (“Mobil Plus”) was chosen as the preferred option because of the higher benefits predicted. However, the canton has set itself the goal of implementing Option 4 measures (maximum/full upgrade - XL) by 2024.

#### *Ideas for evaluation*

The expenses factored into the cost benefit analysis done in 2002 were: outlay for creating barrier-free stops, for rolling stock with barrier free accessibility and usability; and for changes made to passenger related services.

Factors considered on the benefit side were: added revenue generated from more trips by people with reduced mobility; added revenue generated from higher demand due to greater convenience and shorter travel times for other passengers; and lower running costs for transporting disabled passengers.

In our assessment tool, the basis of the Opportunities evaluation in O is the evaluation of statistics to determine which services are offered, how many customers might profit from these services and how much are the investment (and operating) costs for the options.

The Behavior component is evaluated with a questionnaire for operators regarding how many new (mobility-reduced) customers are expected in which of the scenarios and how the benefits are calculated: What benefit is calculated per trip/new passenger? Surveying users can clarify how they perceive the upgrading and the services offered and if the adapted system influences their decision to use public transport services.

To establish changes in satisfaction, people with reduced mobility might be asked how satisfied they are with the accessibility of the reconstructed public transport system and if there is any change in their general satisfaction.

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<sup>28</sup> See Studiengesellschaft für unterirdische Anlagen e. V. (STUVA e. V.) (2008), Züricher Verkehrsverbund (ZVV) (2002).

<b>OBS Evaluation: Opportunities – Behavior – Satisfaction</b>
<b>The Zurich “Mobil Plus” Project</b>
<b>1. Short description of the project</b>
Evaluation and implementation of a barrier free urban agglomeration public transport system
<b>2. Short description of the methodology used for evaluation</b>
Mostly qualitative evaluation as quantitative evaluation for most effects not possible with the available data; comprehensive data collection planned for 2014
<b>3. Short verbal evaluation of the project</b>
<i>Central strengths</i> Integrated approach to assess and improve the entire regional public transport system instead of single measures; modern and attractive image
<i>Central weaknesses</i> Subprojects only include new infrastructure and vehicles (no “soft measures” such as information campaigns)
<i>Verbal overall evaluation</i> Very ambitious goals and master plan (accessible public transport by 2014) sets new standards
<b>4. CEA</b>
Net present value costs : 13.5 million CHF p.a. (approx. 8.4 million Euros p. a.), 196 million Euros in total (option 2)
Net present value benefits: 16.4 million CHF p. a. (approx. 10.3 million Euros p. a.)
Ratio Effectiveness/cost: Not possible to determine without additional data
<b>5. OBS Evaluation</b>
<b>Opportunities</b> - statistical evaluation, interview with operators
- Enhanced barrier free mobility in Zurich region possible - Change in transport/spatial supply (every stop and vehicle accessible) and thus in objective opportunities - Costs for spatial and transport supply [Euros]: investment (and running) costs for accessible public transport infrastructure and services: Outlay for creating barrier-free stops: reconstruction of platforms for urban railways and tramways; reconstruction of curbs for buses; creation of ramps at tram doorways; station and stop information for urban railways, trams and buses; creation of barrier-free modes of access to platforms; and conversion of footbridges for ferries Outlay for rolling stock with barrier-free accessibility and usability: conversion of urban railways, trams and buses (e.g., retrofitting ramps); and purchase of new low-floor buses, trams and urban rail vehicles Outlay for changes made to passenger related services: barrier free timetable information provided on the Internet, by phone (toll-free lines), email, SMS and WAP; acoustic and visual dynamic operating information at platforms, stops and on board vehicles; improved visibility and usability of ticket outlets (counters, machines), and the optimization of tickets themselves; improved visibility and usability of toilet facilities and waiting rooms; and easier passenger orientation in complex interchange facilities and at major stations - Lower running costs for special transport services for disabled passengers - Medium environmental cost during the reconstruction (resources), low environmental costs in use
<b>Behavior</b> - interviews with operators and customers
<i>Transport system perspective</i> - Transport performance [tkm/pkm] – PT expected to rise due to rising number of passengers, especially people with reduced mobility, IMT expected to fall, additional public transport users lead to additional revenue for the public transport operator; added revenue generated from higher demand due to greater convenience and shorter travel times for other passengers; - Positive environmental effects (less car trips due to increased usage of accessible public transport), notably less air pollutant emissions [t] and GHG emissions [t], - Increased traffic safety (fewer and less severe injuries)
<i>Spatial system perspective</i> - For destinations: positive effects for economic indicators (e.g., profit) [Euros], utilization of destinations, employment at destinations
<i>Individual behavior</i> - Rising number of realized activities/satisfied needs [number, type], realized trips [number, distance, time, trip purpose]
<b>Satisfaction</b> - additional questions in interviews with customers
- Number and kinds of needs satisfied – expected to rise - Indicators of subjective quality of life, participation – expected to increase due to improved and guaranteed accessibility - Rising number of autonomous satisfied mobility needs, especially of people with reduced mobility

Figure 6: Evaluation of the Zurich “Mobil Plus” Project.

## **5.4 Mobility training for people with disabilities**

### *Description*

One of the most promising approaches in the field of awareness raising or “soft” measures is mobility training for people with disabilities offered by public transport operators or by experienced private providers.

Participants receive instruction in the handling of auxiliary attachments and different control elements of the vehicles including the safety light barriers of the vehicle doors, the intercom phone in the trams, or the emergency installations. In some cases a free training DVD is provided.

A more personalized approach can be provided by training from experienced private organizations and individuals. These are conducted, for example, by wheelchair users. The training aims to give people with reduced mobility the courage to use public transport on their own and to discover a kind of freedom that specialized transport services are not able to offer. Whereas public transport operators often focus on wheelchair users, private training takes into consideration all kinds of disabilities including people with cognitive disabilities. They are encouraged to undertake new activities and explore their potential.

### *Ideas for evaluation*

Mobility training is very new and has only emerged in recent years. Unfortunately, its success has not yet been assessed with a holistic evaluation. We made contact with public transport operators in the German cities of Berlin, Hanover and Bielefeld and surveyed some mobility training courses<sup>29</sup>.

Running costs for mobility training are very difficult to calculate as it is normally not surveyed separately. The costs per training course vary, depending on the type and number of vehicles in operation.

The evaluation of the Opportunities component can be done by analyzing statistics with a view to the costs of organizing and conducting mobility training. There is no direct effect on the objective spatial and transport structure.

To evaluate the Behavior component, operators could be asked how many participants take part in the training, what experiences they report and how they assess any benefits resulting from mobility training. Participants of mobility training might be asked how the mobility training influences their decision to use public transport.

An indicator for change in the Satisfaction component could be a noticeable decrease in complaints about the transport provider following mobility training. Participants might be asked how satisfied they are with the training and if there is any change in their general satisfaction, for example, because they now know about the widespread supply of accessible public transport services in their city/region.

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<sup>29</sup> In TU Dresden (2009) results and conclusions are summarized.

OBS Evaluation: Opportunities – Behavior - Satisfaction
Mobility training for people with disabilities
<b>1. Short description of the project</b>
Training course of one or two days to teach people with disabilities how to use accessible public transport services
<b>2. Short description of the methodology used for evaluation</b>
Complex to evaluate, long term dose-response relationship, participant surveys (change in attitudes to use public transport and in mobility behavior)
<b>3. Short verbal evaluation of the project</b>
<i>Central strengths</i> Boosts awareness, the first and vital step for people with disabilities to overcome insecurities or fear of using barrier-free public transport services; easy to introduce in other places
<i>Central weaknesses</i> Is only of help when public transport infrastructure is accessible; training environment is different from the real world; difficulties in identifying the target group (disabled people who are able to use public transport but have not used it so far)
<i>Verbal overall evaluation</i> If the public transport service already offers a high level of accessibility, then mobility training provides people with reduced mobility the possibility to use public transport on their own, to practise without any time pressure and to discover a kind of freedom that special transport services are unable to offer
<b>4. CEA</b>
Net present value costs: implementation and running costs: 500 Euros per day
Net present value benefits: not possible to evaluate quantitatively because relevant data has not been collected (e.g., number of additional users)
Ratio Effectiveness/cost: Not possible to determine without additional data
<b>5. OBS Evaluation</b>
<b>Opportunities</b> - statistical evaluation, interview with provider of mobility training
- No change in transport/spatial supply and objective opportunities; enhanced perceived accessibility of public transport - Costs for spatial and transport supply [Euros]: investment and running costs for staff and material regarding organizing and conducting mobility training (rent, technology, advertising). For example: Berlin – vehicle costs plus one or two drivers per vehicle (depending on the number of registered participants) and one representative for disabled people from the operator Hanover - costs per training day are estimated at 500 Euros Bielefeld - ten work hours per month are needed for one training course; costs for the DVD were approximately 4,000 Euros including the costs for the staff and material for the design of the film, not including reproducing the film - No relevant environmental costs
<b>Behavior</b> - written interviews with provider of mobility trainings and written/oral interviews with participants
<i>Transport system perspective</i> - Transport performance [tkm/pkm] – PT expected to rise, IMT expected to fall, additional public transport users lead to additional revenue/secondary employment effects for the public transport operator - Positive environmental effects (less car trips due to increased awareness and usage of accessible public transport), notably less air pollutant emissions [t] and GHG emissions [t], - Increased traffic safety (fewer and less severe injuries)
<i>Spatial system perspective</i> - For destinations expected to rise: economic indicators (e.g., profit) [Euros], utilization of destinations, employment effects at destinations
<i>Individual behavior</i> - Rising number of realized activities/satisfied needs [number, type], realized trips [number, distance, time, trip purpose]
<b>Satisfaction</b> - additional interview questions with public transport provider
- Decreased costs for customer complaint management - Number and kinds of satisfied needs – expected to rise - Indicators of subjective quality of life [Points], participation [Points] – expected to increase due to improved and guaranteed accessibility

Figure 7: Evaluation of Mobility training for people with disabilities.

## 6 CONCLUSIONS AND POLICY RECOMMENDATIONS

Our research has shown that there is a variety of measures to increase public transport accessibility for people with reduced mobility and that all of these measures yield benefits not only for people with reduced mobility but for all transport users, for example, elderly people. We have also identified deficits in evaluation practice. Few measures are evaluated in an ex ante manner; insufficient data is collected; and ex post monitoring of implemented measures is almost non-existent.

A comprehensive evaluation tool has been developed in this paper. The approach used is called the OBS-approach with OBS standing for the three main components of the tool: Opportunities, Behavior, and Satisfaction. The evaluation tool is based on an extended CEA in order to allow consideration of all type of effects as well as monitoring the efficiency of the projects.

This tool is flexible, powerful and can be adapted to most real world situations. However, a thorough quantitative application of the methodology in the case studies discussed was not possible in this paper because of the lack of data for most measures. A simplified and qualitative version, however, could be applied at low cost.

The following recommendations have been found to be the most relevant for future public transport accessibility evaluation processes.

<b>Recommended action</b>	<b>Comment</b>
<b>For specific measures ex ante</b>	
<i>Involve relevant stakeholders and/or survey</i>	<ul style="list-style-type: none"> <li>• Find out the real needs/participation indicators</li> </ul>
<i>Define goals for measure, evaluation and target group</i>	<ul style="list-style-type: none"> <li>• Measureable and realistic goals for qualitative estimation of opportunities</li> </ul>
<i>Discuss different alternatives</i>	<ul style="list-style-type: none"> <li>• Collect data describing the situation "before"</li> <li>• Document the direct costs of the measure(s): investment, maintenance, operating costs, environmental costs, etc.</li> <li>• Model the effects of the measures (quantitatively or qualitatively)</li> <li>• Create an evaluation template of any measure or program</li> </ul>
<b>Implementation</b>	
<i>Implement measure</i>	<ul style="list-style-type: none"> <li>• Realization (including pre testing, improvement, etc.)</li> </ul>
<b>For specific measures ex post</b>	
<i>Involve stakeholders and/or survey</i>	<ul style="list-style-type: none"> <li>• Use feedback to establish potentials and problems for the next planning cycle</li> </ul>
<i>Monitor effects for OBS</i>	<ul style="list-style-type: none"> <li>• Compare actual developments with ex ante figures (additional revenue, additional public transport users, costs, etc.)</li> </ul>
<i>Report results publicly</i>	<ul style="list-style-type: none"> <li>• Document all activities and report results to policy makers and the wider public to improve awareness</li> </ul>

Continuous action	
<i>Maintain land–use/transport model (if applicable)</i>	<ul style="list-style-type: none"> <li>• Study the ex ante and ex post effects of the planned and implemented measures (type and location of destinations, system performance, transport and environmental indicators, sophisticated accessibility indicators), including dynamic feedbacks</li> </ul>
<i>Survey travel behavior</i>	<ul style="list-style-type: none"> <li>• Conduct surveys on travel behavior (including questions for identifying people with reduced mobility): number of disabled passengers who requested information, number of public transport trips, number of tickets sold,</li> <li>• Periodic counts of public transport users</li> <li>• Survey user satisfaction (might deliver valuable input for selection and design of future measures)</li> </ul>
<i>Monitor developments in the transport and the spatial system (accessibility)</i>	<ul style="list-style-type: none"> <li>• Determine interaction of supply and travel demand</li> </ul>
<i>As an absolute minimum: basic evaluation of Opportunities, Behavior and Satisfaction</i>	<ul style="list-style-type: none"> <li>• Consider OBS qualitatively even if quantitative analysis is not possible</li> </ul>
<i>Ongoing report of evaluation results</i>	<ul style="list-style-type: none"> <li>• Document evaluation results in periodic reports</li> </ul>

Figure 8: Recommendations for future evaluation of measures concerning people with reduced mobility

Introducing the OBS Tool would provide decision makers with the ability to decide how best to use their budgets. In all cases, evaluation of the effects together with monitoring should be obligatory. However, there is frequently a lack of funding for monitoring effects or even for evaluating the measures at all. It is always recommended to save a part of the total budget for evaluation purposes.

In general, all public transport measures should provide access for people with disabilities. To integrate them, and not to isolate or segregate them, is the key to successfully developing transport and spatial systems that serve not only people with reduced mobility but also the entire society.

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