IMPROVING THE PROVISION OF PUBLIC TRANSPORT INFORMATION FOR PERSONS WITH DISABILITIES IN THE DEVELOPING WORLD

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ABSTRACT

While transport is a significant enabler for sustaining livelihoods among poor communities, it is clearly also increasingly deemed important to deliver the benefits of greater inclusion of persons with disabilities into society, particularly in developing and transition countries. Throughout the developing world, the existing transport systems fail to serve the needs of the majority of persons with disabilities.

Research undertaken on behalf of the United Kingdom’s Department for International Development (DFID) indicated that access to information in appropriate formats was a significant barrier to travel for people with sensory and intellectual disabilities. Building on this work, another DFID-funded project, completed in 2006, sought to design and test appropriate low-cost technologies for information provision along the entire travel chain in services provided by public transport vehicles in India and South Africa.

The paper scans the existing practice in both developed and developing countries relating to the provision of public transport information to persons with disabilities and provides an overview of the range of issues that need to be taken into account in designing inclusive, robust, easily accessible and practical public transport information for all passengers. It then describes the pilot projects that were conducted in South Africa and India. The results of the demonstration projects will however become the subject of another paper.

RESUME :

Bien que le transport soit un important catalyseur pour soutenir les moyens d'existence des communautés pauvres, il est de plus en plus clairement également jugé important d'offrir les avantages d'une plus grande inclusion des personnes handicapées dans la société, en particulier dans le pays développement et les pays en transition. Tout le monde en développement, les systèmes de transport ne parviennent pas à répondre aux besoins de la majorité des personnes handicapées.

La recherche entreprise au nom du Département du Royaume-Uni pour le développement international (DFID) a indiqué que l'accès à l'information dans des formats appropriés a été un obstacle important à voyager pour les personnes avec handicaps sensoriels et intellectuels. S'appuyant sur ces travaux, un autre projet financé par le DFID, achevé en 2006, a tenté de conception et d'essai appropriées à faible coût les technologies de l'information tout au long de la chaîne de voyage dans les services fournis par les véhicules de transport en Inde et en Afrique du Sud.

1 INTRODUCTION

Whilst transport is a significant enabler for sustaining livelihoods among poor communities, it is increasingly deemed important to deliver the benefits of greater inclusion of persons with disabilities into society, enabling them to participate more fully in every day activities, particularly in developing and transition countries. Intervention strategies (such as employment equity, improved delivery of health care and rehabilitation services, and inclusive education) are typically targeted at specific spatial locations, thus increasing the need and the desire of persons with disabilities to have access to accessible public transport services.

Throughout the developing world, the existing transport systems fail to serve the needs of the majority of persons with disabilities (PWD). Research indicates that access to information in appropriate formats – whether regarding accessibility, services, or fares - is a significant barrier to travel for people with sensory and intellectual disabilities (Venter et al, 2004). Building on this work, a demonstration project aimed at designing and testing appropriate low-cost technologies for information provision in services provided by public transport vehicles in India and South Africa was generated. This project sought to address information provision issues along the entire travel chain, including off-road, at stops/terminals, and on the vehicle, (Mashiri et al, 2006).

Appropriate technologies were developed to take account of the specific needs of passengers with disabilities. The project was guided by the principle of universal design, which, in the public transport sector for example, stems from the notion that passengers represent a continuum of physical characteristics, and that design should be such that it serves a majority of the passengers most of the time. Thus design that meets the needs of passengers with disabilities should be appropriate for all users.

The paper scans the existing practice in both developed and developing countries relating to the provision of public transport information to persons with disabilities. It also provides an overview of the range of issues, technology features and the general environment that need to be taken into account in designing inclusive, robust, easily accessible and practical public transport information packages to facilitate ever-increasing and stress-free travel not only for persons with disabilities, but for all passengers. It then briefly describes the pilot projects conducted in South Africa and India.

2 ISSUES IN THE PROVISION OF ACCESSIBLE TRANSPORT INFORMATION

The design of systems for effectively delivering information to public transport travellers with disabilities needs to take a variety of issues into account. For that reason, both the content and the delivery format needs to be suited to the needs of both user and operator, within the constraints imposed by the general operating environment.
2.1 Information content

Transport information includes information on accessibility features (low steps, ramps, seats, tactile signs, etc.) as well as general transport information. The latter includes routes, ticketing and timetable information that is required by all passengers and which has been produced in an accessible format so that it can be used by passengers with disabilities. Transport information also includes that which enables persons PWD to travel with the assistance of any aid that they use or with a companion if desired.

2.2 Methods of provision

Methods of information provision include the following:
- Information given directly to the disabled traveller (e.g. from speaking signs or a staffed telephone help-line)
- General information, where the person selects relevant information from a public information source (e.g. from timetables, visual signs, and public audible announcements)
- Interactive information (e.g. web pages and public information kiosks).

2.3 Design issues related to user requirements and modes of delivery

Travel information needs to be accessible, useful and useable, and designed so that the traveller can provide adequate information on their requirements to the transport provider. Information delivery is thus a two-way exchange. In designing accessible transport information for PWD it is important to incorporate the following issues and modes, namely, redundancy of information, visual information, audible information, tactile information, non-textual visual information, and travel and staff training (to enable staff to assist disabled passengers through provision of information and enabling PWD navigate the public transport system much more easily and readily).

The particular needs of users with specific disabilities place certain requirements on the content and format of transport information provision. Although a finer classification is possible, the specific needs of four groups of disabled public transport users include the following:

**Physical disabilities:** People with physical disabilities will require information on the physical access to the road transport vehicle.

**Sensory disabilities:** People with sensory disabilities require information in a format that they can perceive and understand, and the same travel information to be provided in a range of different media. Colour-contrast information, under-foot tactile surfaces and audible beeps may be required.

**Cognitive disability:** To assist people with cognitive disabilities, there is a need for standardization in the design of information, stops, vehicles and practice. There may also be a requirement for signs to be written in non-text form using pictograms or other visual representations.

**Multiple disabilities:** People with multiple disabilities may have impairments affecting their ability to receive travel information in a variety of ways. This group includes older adults with age related multiple minor impairments. Thus, it is important that all information is available in a variety of formats.
It is important to note that in the case of all disabilities, staff trained to be aware of PWD and able to communicate with them, in alternative forms if necessary, would be a necessary requirement.

User needs can also be broken down by the stage of the journey, recognizing that passengers need different types of information when considering the decision to travel, and before and during the journey, for example:

**Journey decision:** A person with a disability will need to believe that they will be able to undertake it successfully. This will depend on social and cultural factors, and on the information publicized regarding accessibility of public transport modes.

**Pre-journey information:** This is required to plan a journey and includes information regarding routes, times, facilities, accessibility of vehicles, fares, etc.

**Accessible journey information:** This includes on-trip information. For PWD, such information should include station or stop location, what to do to get the vehicle to stop, payment information, vehicle accessibility and layout, destination arrival, etc.

**Disruption information:** PWD are more likely to find it difficult to receive the travel information they require if something goes wrong or a change to normal service takes place. It is important that their needs are considered when any disruption information is made available to passengers.

2.4 **Design issues related to the operational environment**

Public transport operators work under specific technological, financial and operational constraints, which define the environment within which any technologies for information dissemination/communication are adopted. The suitability of a potential technology to this environment needs to be an important criterion in its evaluation for adoption. In discussions with local bus operators in South Africa and India, the following five criteria emerged as important requirements:

**Affordable:** This is important in terms of the initial capital cost and ongoing operating costs. As most operators have not shown a high willingness to invest in passenger-friendly devices – particularly those operating in a competitive environment – affordability constraints will be relatively tight for accessible information technologies.

**Reliable:** This refers to the technical robustness of the technology. Reliability is determined by the complexity of the technology (e.g. the more moving parts it has, the more easily breakable it becomes) and its appropriateness to the operating conditions (e.g. robust technologies for rural and peri-urban use).

**Fixable:** Any technology will need checking, maintenance, and repair. An attractive technology is one that can be fixed with relative ease, preferably in the operator’s own workshop. Technologies should preferably involve locally sourced components.

**Compatible:** The technology needs to be compatible with other systems and processes being used by the operator. Technology requiring significant change of other related systems or processes is likely to encounter more problems and less acceptance among management and staff, and thus likely to take longer to implement.
Operable: This refers to compatibility with the level of skill, work load and capability of the operator’s staff. New technologies should not put too high extra burdens on staff. If additional training is needed it should be deliverable in a simple manner and not drawn out unnecessarily.

2.5 Design issues related to other social constraints

Literacy levels of public transport users in general, and PWD in particular, has a bearing on the design of appropriate information systems. Many passengers experience difficulties in reading and are unable to understand maps. Such people will also benefit from technologies designed for PWD using multiple media and pictograms.

The spectre of crime and vandalism imposes further constraints that need to be addressed. The need to design robust and cost-effective public transport infrastructure such as shelters and travel information technologies that do not easily lend themselves to vandalism cannot be over-emphasized.

3 ANALYSIS OF EXISTING INFORMATION PROVISION PRACTICES

In order to inform the generation of possible demonstration project ideas, a synthesis of existing practices with regard to the provision of accessible information on public transport broken down into two categories, namely, pre-journey and journey was undertaken. The results are tabulated in six tables below (Mashiri et al, 2004).

3.1 Analysis of existing information provision in developed countries

<table>
<thead>
<tr>
<th>Devices &amp; Design Requirements</th>
<th>Audible</th>
<th>Visual</th>
<th>Tactile</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Devices Used</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Telephone help-line</td>
<td>Printed material such as timetables, leaflets posters, signs</td>
<td>General Braille or Moon information on public road based transport</td>
</tr>
<tr>
<td></td>
<td>Recorded telephone information</td>
<td>Electronic information: Internet, mobile phones, etc.</td>
<td>Tactile maps, including embossed paper maps &amp; diagrams to be taken home by users</td>
</tr>
<tr>
<td></td>
<td>Tape recorded timetables &amp; info</td>
<td>Information via text phone</td>
<td>Access web pages for people with Soft Braille attachments to their computers</td>
</tr>
<tr>
<td></td>
<td>TV or radio broadcast information</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spoken information on the internet via speaking computers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Volume sufficient &amp; able to be increased,</td>
<td>Use of a combination of text, pictograms,</td>
<td>Any Braille or Tactile information will</td>
</tr>
</tbody>
</table>
### Design Requirements for PWD

- especially for hearing impaired users
  - Background noise volume minimized
  - Frequency suitable to hearing impaired persons (usually low)
  - Message short & simple
  - Language & terminology matching that of travellers
  - Option for the message to be repeated, especially for hearing impaired & those with cognitive disabilities
  - Information on accessibility of vehicle for physically disabled persons

- diagrams, maps & pictures to benefit a range of people with disabilities
  - Language & terminology matching that of travellers
  - Clear, non-serif fonts
  - Large fonts for visually impaired persons
  - High degree of colour, & good contrast between text & background colour
  - Layout that is simple and easy to scan through
  - For sign-language users, textual information may need to be in simple format to accommodate differences in spoken & sign language structure.
  - Information on accessibility of vehicle for physically disabled persons

### Table 2: Existing Accessible Journey Information Practices: Developed Countries

<table>
<thead>
<tr>
<th>Devices &amp; Design Requirements</th>
<th>Audible</th>
<th>Visual</th>
<th>Tactile</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Devices Used</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Recorded information broadcast from tannoy or loudspeaker</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Induction loops or infrared systems at information points to reduce background noise</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Information spoken by staff members</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Audible beeps indicating door</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

|                               | ▪ Printed material such as timetables, leaflets & posters |
|                               | ▪ Signs |
|                               | ▪ Electronic displays |
|                               | ▪ Electronic information kiosks |

|                               | ▪ Braille information signs |
|                               | ▪ Tactile maps |
|                               | ▪ Underfoot tactile surfaces |
|                               | ▪ Tactile markings |
### Design Requirements for PWD

<table>
<thead>
<tr>
<th>controls</th>
<th>Speaking signs</th>
<th>Use of a combination of text, pictograms, diagrams, maps &amp; pictures to benefit a range of people with disabilities</th>
<th>Any Braille or tactile information must be produced to designated standards. There are numerous Braille standards (relating to size) around the world. For signage, the two preferred standards are Giant Dot (UK) &amp; Jumbo Braille (USA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Volume sufficient &amp; able to be increased, especially for hearing impaired users</td>
<td>▪ Background noise volume minimized</td>
<td>▪ Language &amp; terminology matching that of travellers</td>
<td></td>
</tr>
<tr>
<td>▪ Frequency suitable to hearing impaired persons (usually low)</td>
<td>▪ Message short &amp; simple</td>
<td>▪ Clear, non-serif fonts</td>
<td></td>
</tr>
<tr>
<td>▪ Language &amp; terminology matching that of travellers</td>
<td>▪ Option for the message to be repeated, especially for hearing impaired &amp; those with cognitive disabilities</td>
<td>▪ Large fonts for visually impaired persons</td>
<td></td>
</tr>
<tr>
<td>▪ High degree of colour, &amp; good contrast between text &amp; background colour</td>
<td>▪ Layout that is simple &amp; easy to scan through</td>
<td>▪ Positioned at a height &amp; in a location accessible to wheelchair users &amp; those with mobility constraints on the vehicle</td>
<td></td>
</tr>
<tr>
<td>▪ Visual displays that refresh or change should allow sufficient time for PWD to read them</td>
<td>▪ Lighting good</td>
<td>▪</td>
<td></td>
</tr>
</tbody>
</table>

#### 3.2 Analysis of existing practices in developing countries: Asia

The main modes of passenger transport in developing countries in Asia are suburban train, bus and other paratransit modes (such as 3-seaters, 6-seaters, taxis, etc.). Except for the publicly owned transport system, there is no definite route network for paratransit modes. In most developing countries, planning the route network, scheduling, etc. for urban public transport are functions devolved to the local level. An informal system exists for the operation of paratransit modes. Hardly any information is available for passengers with disabilities, especially passengers travelling by paratransit modes. Of late, however, there has been a rise in awareness about the problems faced by passengers with disabilities and as a result, most developing countries in Asia are taking steps to
improve accessibility to public transport services. Tables 3 and 4 below summarize the most pertinent existing accessible pre-journey and within-journey information provision practices.

<table>
<thead>
<tr>
<th>Information requirements &amp; Design</th>
<th>Audible</th>
<th>Visual</th>
<th>Tactile</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Existing Information</strong></td>
<td>Public address systems, common at railway stations &amp; major bus terminals</td>
<td>Information boards most common, mostly timetable charts</td>
<td>China &amp; Singapore have some tactile information in rapid transit stations (MRT)</td>
</tr>
<tr>
<td><strong>Gaps in &amp; problems with existing Information</strong></td>
<td>Not used at intermediate bus stops</td>
<td>Information boards not updated regularly</td>
<td>Not much been done to date in Asian developing countries</td>
</tr>
<tr>
<td><strong>Required Information &amp; Information design</strong></td>
<td>Public enquiry system providing information on routes, timetables, fares, availability of reserved seats etc.</td>
<td>Digital displays at bus stops, bus terminals &amp; railway stations</td>
<td>Tactile maps/instructions at all bus stops, bus terminals &amp; railways stations.</td>
</tr>
<tr>
<td></td>
<td>Public address systems in more locations</td>
<td>Signboards, posters &amp; timetable charts should be provided in large font</td>
<td>Under-foot surfaces provide tactile information for direction supply</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The above are cheap &amp; viable options</td>
</tr>
</tbody>
</table>

Table 3: Existing Accessible Pre-journey Information Practices: Asia
Table 4: Existing Accessible Journey Information Practices: Asia

<table>
<thead>
<tr>
<th>Information requirements &amp; Design</th>
<th>Audible</th>
<th>Visual</th>
<th>Tactile</th>
</tr>
</thead>
</table>
| **Existing Information**          | ▪ Conductors requested to announce stop names  
▪ Some buses have manually operated bells | ▪ Digital display quite common in China & Singapore  
▪ Most developing countries: schedule charts | ▪ In China, tickets in Braille  
▪ For Delhi Metro, tactile flooring is used |
| **Gaps in & problems with existing Information** | ▪ No formal “in-vehicle” audio information systems | ▪ Many developing countries do not have digital visual displays | ▪ Other Asian developing countries do not have such provisions for the blind |
| **Required Information & Information Design** | ▪ Audible messages on all buses, providing information on current stop, next stop & time required to reach that stop | ▪ Digital displays are important, & can be operated by the conductor or driver | ▪ Tactile maps & flooring needed, for blind as well as those with both hearing & visual impairment |

3.3  **Analysis of existing practices in developing countries: Africa**

3.3.1  **Accessibility and transport provision**

Disability is a relatively new area of discourse in many developing countries. Figures on the incidence, causes and typology of disability, let alone intervention modalities are rarely available (Mashiri *et al*, 1998; Venter *et al*, 2003; Onasanya, [http://www.pwd-u.org/articles/articles_Jun2001A.asp](http://www.pwd-u.org/articles/articles_Jun2001A.asp)). The discussion that follows below has been informed to a large extent by the work of the Independent Living Institute undertaken in 1996 ([http://www.independentliving.org](http://www.independentliving.org)).

Most African countries do not have special transport arrangements for PWD. To a limited extent, Egypt, Tunisia, Morocco and Ghana had special transport provisions for PWD. In Tunisia, this included special transport for medical treatment and education and in Egypt, special transport was reportedly available for medical treatment, education, employment and recreational purposes. Morocco purported to provide public transport for whatever purposes needed as well as reduced public transport costs for PWD in urban areas, while Ghana provided free transport on road or rail for all purposes.
In addition, this non-provision of an essential service such as transport has been exacerbated by the
dearth of legislation, guidelines, regulation and enforcement mechanisms to ensure accessibility of
the built environment. In a few cases, government strategies towards the promotion of accessibility
of the built environment were reported, including the levelling of pavements, access to public
buildings and accessibility of the outdoor environment. It is of interest to note that apart from
Tanzania, Chad and Egypt, no other countries reported the incorporation of a disability awareness
component in the training of planners, architects and the construction industry in general.

In some countries, such as Eritrea, Namibia, Zambia, Uganda, Benin, Cameroon and Zambia, no
laws, regulations and/or guidelines existed to ensure accessibility of the built environment or public
transport services. The general impression created by this 1996 study is that of a lack of uniformity
in addressing the transport and accessibility needs of PWD in Africa, informed by a welfare rather
than rights-based approach to issues of disability. This approach is also influenced to some extent by
funding considerations as well as the role of stigma around disability especially in the uptake and
implementation of policy initiatives.

In view of the foregoing, the analysis of existing practices in Africa will largely revolve around
South African experiences (given the relative advances it has made in this regard and the dearth of
information from elsewhere on the continent). The three primary public transport modes in South
Africa are minibus taxi, bus and rail. The manner in which each of the modes is operated imposes
certain constraints on the potential for delivery of passenger information.

Buses serve pockets of mostly commuter demand. Bus routes change more frequently than rail
services, and outside the main routes, few routes operate the same service throughout the day.
Routes are complex, penetrating residential areas where passengers are picked up and run non-stop
along the majority of the route. Passengers cannot rely on getting picked up along a route, as the
buses are often full. The way that services currently operate does not encourage occasional users to
access the service, and it is these prospective passengers who benefit the most from detailed service
information. Comprehensive printed service information on current operations would be expensive
due to the sheer volume of routes and the rate of route changes. Detailed network maps would be
misleading since most routes run only a very limited service. Thus bus services themselves need to
undergo significant change to enable information to be presented on them.

Minibus taxi (paratransit) services have come to claim a significant share of the public transport
market in most African countries, and are the primary public transport providers in South Africa.
The service is informal, often without formal infrastructure, vehicle routing or operating schedules.
This makes local knowledge essential for understanding the available services. Comprehensive
service information is not a feasible aim for the minibus taxi mode as it currently operates. Instead, a
realistic option would be to produce information relating to main access points, general information
about fares and service frequencies offered by the mode between main points along main routes.

Rail operates on a fixed, easily understood network with staff available on many stations to provide
some service information. Services are accessed at stations which can be marked on maps. Basic
information such as network maps and a timetable booklet are produced without the need for continual
changes to the reprints, making it cost-effective. Except for a few countries in Africa (such as South
Africa, Tunisia and Egypt) rail is used mostly for long distance travel rather than commuting.

All these systems are financed and operated largely in isolation, for example, tickets must be
purchased separately for each mode and little service integration is apparent. Tables 5 and 6
summarize the existing accessible pre-journey and in-journey information provision practices in South Africa.

<table>
<thead>
<tr>
<th>Modes</th>
<th>Audible</th>
<th>Visual</th>
<th>Tactile</th>
</tr>
</thead>
</table>
| **Bus** | - Few audio systems providing pre-journey information e.g. Metro Transport Information (MTI) in Cape Town
          - PA systems only installed at a few major stations (even here, arrival & departure information is seldom given) | - Not all cities & bus services have overall network maps printed
          - Those that are printed are often not updated regularly
          - Directional signage is generally poor, inhibiting promotion & location of stations & stops | No tactile pre-journey information |
| **Minibus Taxi** | - Generally, no audio information systems
          - Very basic information available from MTI for Cape Town services
          - Most information can only be obtained from taxi marshals & drivers | - No printed information to assist trip planning
          - No visual directional signage for the service | No tactile pre-journey information |
| **Rail** | - Information available from MTI in Cape Town & some audio announcements in some stations | - Metrorail produces & distributes a free weekly publication containing information on upgrades, works carried out, changes to schedules, etc.
          - Metrorail publishes a timetable booklet
          - Directional signage to stations from points of attraction (e.g. shopping places) generally poor | No tactile pre-journey information |

<table>
<thead>
<tr>
<th>Modes</th>
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<th>Tactile</th>
</tr>
</thead>
</table>
| **Bus** | - PA systems only installed at a few major stations (but arrival & departure, & service delay information seldom given)
          - PA sounds often unclear
          - There is usually no audible information on the bus | - Fares are not displayed inside or outside the bus, or at stops, & are often handwritten at terminals
          - Most buses show their destination at the front of the vehicle, but colouring & size make reading it difficult
          - Most bus stations do not have route diagrams
          - Timetables focus on terminal arrival & departure time, specifying very few intermediate | No tactile information systems for public users in SA & other African countries |
<table>
<thead>
<tr>
<th>Minibus Taxi</th>
<th></th>
<th>Rail</th>
</tr>
</thead>
</table>
| ▪ At ranks, officials sometimes assist passengers with trip queries  
▪ Most information is obtained from the taxi marshals or drivers themselves. The size of taxis renders the sharing of information between drivers & passengers (& also among passengers) relatively easy | ▪ Vehicle permit stickers stating licensed routes are affixed to the front, rear & left side of taxis. However, these offer limited information & are difficult to read for PWD  
▪ Vehicles operating illegally provide no information  
▪ No printed fare information is available  
▪ Network & frequency information is not available in print | No tactile information systems for public users in SA & other African countries |
| ▪ Most stations do not make public announcements unless significant delays are experienced | ▪ No fare information on trains  
▪ There are few maps & diagrams, & they are not standardized  
▪ Destination signs are not always displayed on exterior of trains  
▪ Platform signs & indicators of services arriving & departing are common, but delay information is lacking or provided late | No tactile information systems for public users in South Africa & other African countries |

### 4 DEMONSTRATION PROJECTS

#### 4.1 Overview of project

Given that transport is increasingly important to deliver the benefits associated with greater participation of PWD into society, the purpose of the demonstration projects in India and South Africa were to improve the access of PWD in developing countries to livelihood opportunities and participation, by way of improving their access to road-based public transport. The projects focus on developing and disseminating appropriate technologies for information provision in services provided by conventional buses and minibus taxis, based on universal design principles. As shown above, technologies in use to provide information to travellers range from high-cost systems such as, for instance, real-time signage in use in developed countries to handwritten destination signs, employed in many African countries. The research focuses on identifying, combining and evaluating simple practices (e.g. colour-coded routes and hand signals), with relatively higher technologies (e.g. audible and light signals to request a stop).

Project outputs include:
Prototypes of universal design information features for buses and minibus taxis, fitted to demonstration vehicles in India and South Africa
- Detailed design guidelines on the manufacturing specifications, operation and maintenance of the features
- Dissemination of the prototypes and guidelines through various media sources
- A report that captures the lessons from the demonstration project.

In terms of beneficiary disability groupings, while the India-based demonstration project focuses on the visually impaired, the South African edition is largely directed at the deaf and hard of hearing. However, the training components of both will cover the broader disability sector.

4.2 India Demonstration Project

4.2.1 Overview of the project
PWD, like other conventional bus travellers, require certain information before commencing, during and at the end of the journey through easily understandable media of communication, such as for example, audio signals for visually impaired persons and video signals for the hearing-impaired. The information requirements vary from route details of the approaching bus at the bus stop, approaching/required destination while inside the bus, etc, through an easily comprehensible medium.

4.2.2 Main features of the demonstration project

Electronic Route-Destination System (ERDS): An ERDS was mounted on the front of the demonstration bus. The route number and route destination have been made visible from a distance of about thirty metres. PWD (except visually impaired persons) were thus able to identify the destination of the incoming bus from a reasonable distance enabling them to prepare for boarding.

Voice Integrated Electronic Route-Destination Display System (VIERDDS): A VIERDDS was mounted near the entrance door of the demonstration project bus at a reasonable height to facilitate ease of visibility/hearing by PWD waiting for the bus at the bus-stop. While the physical display of route number and destination on the bus assists PWD (except those visually impaired) in identifying the route and destination, the voice messages there from (in two languages) assist the visually impaired persons in identifying their desired bus route and destination.

For the convenience of PWD inside the bus, a VIERDDS was also mounted on the panel behind the driver of the demonstration project bus. The system displays the route numbers, the name of the 'present stop' and the 'next stop', besides other details like driver and conductor names. On this display board, a system of rolling messages for various purposes was incorporated. The 'present' and the 'next' bus-stop names are announced simultaneously through voice messages. These messages – both in display form as well as in audible form, are repeated at each stop.

Electronic Route Number Board Display (ERNBD): An ERNBD system was mounted at the rear of the bus for the convenience of the passengers arriving from the rear side of the bus to enable them to identify the bus route and approach the bus at the stop within the available time, where possible.

Integration of the existing and demonstration systems: The system utilizes micro controllers, memory chips and other hardware and provides easy computer interface for feeding the route
number, stop names and other details of the intended routes. It is also able to accommodate details of six to ten routes depending upon the number of bus stops en-route. The system consists of a control panel on the dashboard in front of the driver to enable the driver to periodically intervene (when he/she observes a display of the next stop on the screen) by way of pressing a button on the control panel to activate the display/message announcement. The system is such that audio and video messages are repeated periodically about the 'current' and the 'approaching' bus stops, once in English and twice in the regional language, Marathi.

4.3 South African Demonstration Project

4.3.1 Overview of project
The demonstration project in South Africa is aimed at serving the needs of the deaf, hard of hearing, speech impaired and cognitively impaired persons using the minibus taxi mode. Specific problems they encounter include:

- Inability to identify the correct vehicle to their destination especially if they are trying to get a minibus taxi in between the origin and the final destination on a busy route
- Conveying to the driver that they wish to board that specific vehicle given that they cannot speak
- Communicating to the driver or even fellow passengers that they wish to disembark, especially before the final destination

4.3.2 Elements of the demonstration project
Formalization of signals/signs: It is germane to note that the taxi industry (the drivers) and the general public (prospective passengers) across South Africa employ a variety of hand signals to indicate the final destination of vehicles. These signals are mostly intuitive and for most urban dwellers, easy to understand and learn. However, for the un-initiated – infrequent visitors from rural areas, the elderly, international visitors, urbanites who have no ties with “township” (relatively high density residential) areas, some PWD who are unable to make the signs, those who have difficulty understanding African languages – understanding the signs and gestures with a view to communicating with the right minibus taxi driver to make an informed response, can be a frustrating and harrowing experience.

In order to improve the level of service, by for example, providing adequate information before and along the journey thereby reducing anxiety and providing peace of mind, it is deemed important to formalize these signs and gestures to ensure that they mean the same thing all the time (and they are understood as such), no matter where one is, especially in relation to major destinations e.g. city centre, major taxi terminal, major shopping location, major inter-modal facility, or hospital.

Formalization also means that the deaf or hard of hearing do not have to rely on other persons to convey their messages to minibus taxi drivers. They therefore become more independent and freer to travel. In other words, they would be able to identify the correct vehicles for their journeys as well as indicate to the driver their wish to board the vehicle. With regard to disembarking, however, a simple device was developed to enable the deaf and hard of hearing to convey their messages to the driver themselves. As of now:
Chosen signals were converted into pictograms displayed on minibus taxis as banners. Information is conveyed both to identify the route being operated by a particular vehicle, and to inform the passenger as to which hand signal corresponds to which destination. In addition, the route destination stickers described above were made from highly retro-reflective materials to make them visible at night or during inclement weather.

- Pamphlets bearing these symbols and their meaning in vernacular languages as well as in English were printed and distributed as part of an awareness campaign.
- Persons with cognitive impairments who require a combination of text and pictorial / visual information to aid their understanding constituted the major beneficiaries of the demonstration project.

**Capacity building and training:** Quite often PWD especially those with physical disabilities are left behind (ignored, avoided) largely because some drivers believe that it takes too long a time to enable them to board – time they would rather utilize in getting more customers and therefore earning more. This is often the case along a route in between an origin and a destination. In many cases, PWD can only get services at off-peak times. To a large extent, this attitude among drivers in the minibus taxi industry has the effect of discouraging PWD from even contemplating to travel/venture outside their immediate environs. The need to dispel through training, the notion that the taxi industry loses potential income when servicing PWD, cannot be over-emphasized. In this project, it involves both awareness and sensitivity training as well as practical and efficient ways of folding and storing wheelchair seats so that they do not take up too much space.

The awareness campaign had two benefits i.e. getting the industry to be aware of what the demonstration project sought to achieve, but also to communicate to PWD who have been shying away from traveling that indeed the minibus taxi industry has begun to improve its level of service supported by a Municipality that is seeking to entrench the ethos of a caring society in its jurisdiction.

The disability awareness and sensitivity training has been targeted at service providers that ply the demonstration project routes. However, general awareness will be heightened by way of press releases from the Mayor’s office, the official launch of the project, distribution of pamphlets on the project and the competition to design both the artwork in schools.

**Supportive visible device:** People who are deaf or hard of hearing have difficulty in communicating with the driver or fellow passengers within the vehicle to indicate, for instance, that they wish the taxi to stop so that they can disembark. To catch the immediate attention of the driver or fellow passengers, a simple “bleeper” activated by a button and simultaneously lighting up a small visual indicator positioned where it is most visible to both the driver and passengers was developed. The bleeper was also made audible to enable blind person, for example, to ask a fellow passenger to press the button on their behalf at the correct destination.

5 **CONCLUDING REMARKS**

The literature reviewed has shown that most developed countries have put in place elaborate systems to provide accessible information for passengers with or without disabilities. Some of their technologies are unlikely to work in developing countries for various reasons including affordability, supportive infrastructure, and to a lesser extent, differences in culture. However, other interventions can readily be adopted with local variations for developing countries, thus circumventing the spectre of mostly unaffordable development costs.
It is important to note that because the minibus taxi sector transports over sixty percent of public transport passengers in South Africa, interventions of this nature in the sector are likely to have far-reaching impacts in terms of improving the level of service to accommodate all passengers. It could also be said that because most developing countries in Africa have yet to put into place policies and interventions in the public transport sector which are PWD-sensitive, the demonstration effect of this work could be enormous given that paratransit (minibuses) are taking over as the main movers of persons and their goods in metropolitan (and increasingly rural) Africa. Although there are variations, the situation described above is remarkably similar to that in Asia and Latin America.

A strand of thought that filters throughout the paper is that interventions should be based on pragmatism underpinned by universal design principles in terms of the choice and hosts of technologies to be employed in developing countries. In this regard, the demonstration projects chosen for India and South Africa subscribe to this notion. Within the African continent, South Africa has generally been at the forefront of seeking to improve public transport level of service to accommodate all passengers. For this and other reasons (such as the unavailability of information), the discussion of the existing practices in Africa largely reflects the work South Africa has been doing over the years. However, it must be noted that the issues are remarkably similar and, as such, solutions to the problems in South Africa could easily be adapted for use in other developing countries. In addition, it is likely that interventions in the South African situation may well lead to significant demonstration effects throughout the continent. Meanwhile in India it is hoped that the relatively hi-tech demonstration project and its findings will lead to significant interest throughout the sub-continent including south-east Asia in alleviating access and mobility constraints of passengers with disabilities.

REFERENCES


