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Mobility Experience of Persons with Visual Impairments in Indian Railway Station Environments

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Abstract. Mobility for persons with visual impairments in Indian railway stations poses multidimensional challenges for access to an inclusive travel experience. India is a home to about twenty million persons with diverse disabilities out of which about five million are persons with visual impairments. Diversity of passenger movements on a railway station including persons with visual impairments requires a Universal Design approach to respond to the accessibility issues in these contexts. This research study is based on a series of live on-site experiences conducted along with persons with visual impairments at New Delhi Railway Station. It also includes the generic studies carried out with other diversities of railway passengers including aging, gender and diverse physical abilities. It employs research methods like ethnography, focus group interactions and trace study to develop a deeper understanding of human and spatial parameters of mobility in railway station environments. A Universal Design perspective with a holistic understanding remains critical to the foundation of this research study. While it deals in specific requirements of persons with visual impairments, it also brings an illustration of handling diversity on a railway station from a unique Indian perspective. It concludes by highlighting and reinterpreting the Universal Design India Principles integrating the needs of persons with visual impairments in railway station environments. Brief recommendation for an inclusive mobility experience on railway station forms a vital part of this grounded research study.

Keywords. Universal Design, Indian context, railway station environment, persons with visual impairments, accessibility.

1. Introduction

Railways, a national lifeline in India forms one of the most critical transportation systems in making an inclusive impact on mobility for diverse population groups. The diversity presents opportunities and challenges in terms of age, abilities, socio-economic and cultural backgrounds. These railway station environments thus need to integrate and support the movements and inclusive usability experiences of these diverse population groups including persons with disabilities. India is a home to about twenty million persons with diverse disabilities out of which the highest is persons with visual impairments (PVIs) accounting to about five million in total [1]. This figure

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supported by the fact that many elderly persons above the age of 60 years also face many types of visual impairments adds to the total affected population with a similar kind of issues. With these changing demographics of effected population and lack of inclusive built environment, it is observed that every year in India there is a sharp increase in the number of fatalities reported on railway station of PVIs. This highlights the risk a PVI takes every day while using the railway facilities without a certainty of reaching the destination unharmed and uninjured. Mobility in Indian railway stations for the PVIs, therefore, poses multidimensional challenges for access to an inclusive travel experience. Accessibility for these people majorly involves wayfinding and information gathering. These two activities become a complicated task in the overly crowded environment of a railway station. This makes the component of independent travel, an illusion for a PVI. Since there are no precedent studies available, this research is an attempt to lay a foundation for the knowledge of the on-ground issues faced by a PVI while moving in a railway station environment. New Delhi Railway Station is chosen as the study area owing to its large scale handling capacity of approximately 50,000 passengers per day and being a major station in the capital city of the country.

2. Status of Mobility of Persons with Visual Impairments in Railway Stations

The people with 'normal' vision perceive first the totality of the room and then the individual elements within it [3]. Whereas this process is opposite for a PVI i.e. individual elements are perceived first, and then a perception is formed of how the individual elements are linked together. The opportunity to perceive the totality will depend on the clarity, contrasts, lighting and the complexity of an image to a great extent. The PVIs and all others rely on information and architectural cues to navigate the built environment [4].

Railway station environments in India are often associated with terms like "crowded" and "confusing" commonly for mega stations in urban areas. The main issue arises in spatial orientation, navigation and destination identification for PVIs [5]. In order to achieve these tasks a PVI undergoes mobility and orientation training along with the training of assistive devices developed for them. Assistive devices such as the white cane and smart cane facilitate in mobility of a PVI whereas other devices such as portable tactile maps, remote infrared audible signage (RIAS) facilitates [6] wayfinding inside a built environment.

2.1. Accessibility Policies and Standards for Railway Stations

Globally many nations have developed their own accessibility guidelines using Universal Design as the foundation core. Universal Design as a strategy and a guiding philosophy acts as a solution to resolve the complex perspectives of handling diversity in a given railway station context. It is an evolving concept and requires contextual references for its successful implementation. Universal Design inculcates the culture of incorporating the design for persons with disabilities from the beginning of conceptual design stage. India too has recognized the significance of this tool and has developed certain guidelines for a barrier-free built environment.

India has enforced the legal rights of Persons with Disabilities 20 years ago which is further followed by ratification of the UNCRPD ((United Nations Convention on the

rights of Persons with Disabilities) policy in 2007. The recently launched 'Accessible India' Campaign is the extension of the existing framework which informs that India supports and seeks to provide universally accepted built environment for all. Indian railway authorities in their document 'Manual for Standards and Specifications for Railway Station' (2009) has also established the need for special guidelines for persons with diverse disabilities [7]. However, there are limited specifications focusing on the needs of PVIs.

2.2. Best Practices for an Inclusive Railway Station Environment

The accessibility policies and standards are the first steps towards creating an inclusive environment for all. A number of countries worldwide have successfully implemented these guidelines proving beneficial to the society at large. One such example is the St. Pancras International Station in London. It provides facilities such as wide accessible ticket gates, identical help points at regular intervals on every platform, mobility assistance points and tactile warning – guiding paths making it universally acceptable and easy to navigate by the majority of PVIs [8]. Another example is the Kyoto Railway Station in Japan. A unique feature of Braille stickers on the handrails of a staircase facilitates in providing perceptible directional information without any assistance to the passengers with visual impairments. Contrasting tactile tiles and legible signage are some of its other accessible features which make this station inclusive especially with respect to mobility requirements of a PVI [9]. These stations exhibit the state of the art solutions to the concerns of all the passengers irrespective of their physical abilities. The similar effort is made in the research to first understand and identify the fundamental concerns and fears of the passengers while using the railway station facility in order to address them successfully on the field.

3. Research Methodology

New Delhi Railway Station has being chosen for the research as the main study area. It is a mega station of the capital city with a handling capacity of approximately 350 trains and 50,000 passengers on daily basis. It is located between the Ajmeri Gate and Paharganj area of Delhi. The 'Accessible Indian Campaign' has one of its prime objectives to make railway stations of this mega scale accessible and barrier free as a part of its accessible transportation component. This research is an attempt towards providing professional inputs and applied design interventions in achieving this vision.

The study focuses on knowledge construction of the main issues faced by a PVI in Indian railway stations. In order to understand this complex paradigm the study employed detail research framework. This human-centric research focuses on ethnographic approach in the given context of a railway station. Figure 1 illustrates the steps followed in the research methodology.

The study is conducted from the perspective of physical, sensory and social components of a railway station environment. These components incorporate the access to infrastructure, information and services on a railway station.

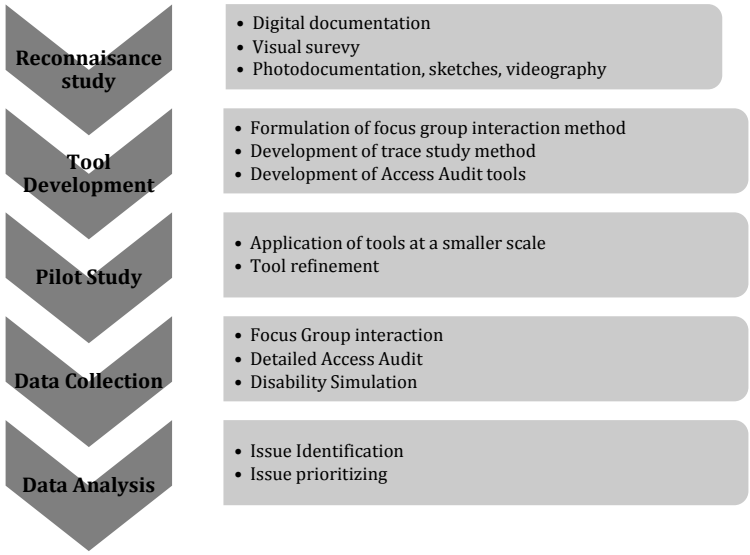


Figure 1. The five steps followed by the study. (Source: Authors)

3.1. Sampling Strategy

Snowball sampling technique is adopted for the study with a sample size of 30 for focus group interactions. The selection criteria are based upon these following four points:

a. A person should have a visual impairment
b. Age of the person should be above 18 years
c. He/she should have an independent travel experience via train
d. He/she has travelled through New Delhi Railway Station

Out of this 30 people, 20 had vision impairment of complete blindness and remaining 10 had vision impairment of partial blindness. A 60-40 male-female ratio was observed in the group. The age variation was between 25-65 years; thereby the study incorporated the issues of elderly passengers as well for a deeper understanding of the concerns in the context of a railway station environment.

3.2. Pilot Study

The pilot study is conducted to test the validity and feasibility of research model prepared for the main study. Two stations comparatively smaller in scale than of New Delhi Railway Station are selected. One is Roorkee Railway Station which has only 3 platforms and another one is Alwar Junction with 2 platforms located 160 km south of Delhi. With the help of a PVI volunteer, an access audit is conducted for these two stations. The outcome of the pilot study is the identification of certain parameters against each zone for evaluating the accessibility of a railway station.

3.3. The Study

The pilot study is followed by refinement of research tools. These research tools are then used for collecting both qualitative and quantitative data which is later analysed for identification of issues. Total three research tools are used which are described in the following sections.

3.3.1. Focus Group Interactions

A sample of 30 participants having visual impairments was asked a set of open-ended questions regarding the issues faced while boarding or de-boarding a train from New Delhi Railway Station. A rapport building exercise is done to build a trust among the participants delving deeper into their fears and concerns. This tool was used in order to understand the needs of a PVI with respect to a railway station.

3.3.2. Access Audit

It is a tool to measure the accessibility of a given system. In technical terms, it can be defined as the detailed diagnostic exercise to assess and evaluate the status of physical, sensory and social environment for a human through a rigorous ground check of built environments. The access audit of New Delhi Railway Station involves zoning of the entire station complex into two main zones of an external and internal environment. The external environment has two sub-zones of Paharganj side and Ajmeri Gate side of the station complex. On the other hand, the internal environment zone has four sub-zones of Platform 1, Platforms 2 to 15, Platform 16 and the foot bridges. With the help of volunteers with diverse disabilities in terms of mobility, hearing and vision; simulations are done as a part of the access audit at New Delhi Railway Station. This tool was used in order to identify the key barriers in a Railway Station.

3.3.3. Trace Study

It is a method which analyses the environmental cues derived from the observation and offers inferences [10]. Trace study offers a means to overlay an analytical structure over visual traces to identify issues of environmental nature and analyse them to gain insights into the meaning and use of environments by people. Observing traces means systematically looking at physical surroundings to find reflections of previous activities that narrate stories of how environment impact human behaviour and vice-versa [11]. This method involves digitization of the New Delhi Railway Station complex and with the help of PVI volunteers mapping the issues after analysing the visual traces between the volunteer and the Railway Station environment. Four volunteers were selected for the trace study with different types of visual impairments:

a. Volunteer A has complete loss of vision owing to a recent accident.
b. Volunteer B has complete loss of vision by birth
c. Volunteer C has partial vision
d. Volunteer D has normal vision

The volunteers A, B, and C use a white cane as the assistive device. Each of them was asked to perform certain activities on different zones of the New Delhi Railway Station. These activities are then recorded visually which is later analysed for

identifying the key issues. The volunteer D performs all the activities as performed by the rest of the volunteers. The focus of this method is ethnographic in nature; thereby observations are made for the activities of a PVI in the natural setting of a railway station. The two main activities are discussed in the paper.

3.4. Mapping the Activities

In Zone 2 of Ajmeri Gate side external environment, the bus stand is connected with the station building through a dedicated pedestrian path. However, the pedestrian path is not continuous leading to the passenger cross the vehicular drop off area in order to reach the station building. The vehicular drop-off area has four lanes with kerbs of varying heights creating a physical barrier for all the passengers in their movement. Volunteer B was given the activity to move along this pedestrian path and reach the station building (see Figures 2 and 3).

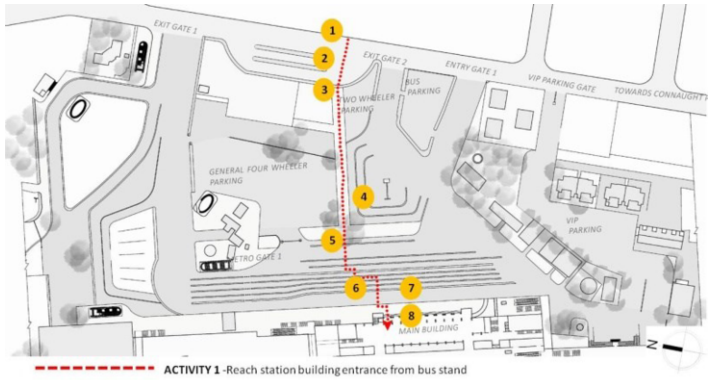


Figure 2. Activity mapping at Ajmeri Gate side external environment of New Delhi Railway Station.

The same activity was performed by volunteer D and some comparative observations are made as described in Table 1.

Table 1. A comparative observation between the movement of Volunteer B and D in Zone no.2 of New Delhi Railway Station

	Spatial Orientation	**Ease of Navigation**	**Destination Identification**
Movement of Volunteer B	Not able to identify the pedestrian entry route independently from the bus stand	Collides with luggage kept on floor, tries to perceive the height of kerbs, seeks personal assistance	Verbally confirms with fellow passengers, sound of steps of the crowd
Movement of Volunteer D	Identifies the pedestrian path route	Avoids any vehicular or other pedestrian collision	Signage, built environment & crowd movement

In Zone 4 of Platforms 2 to 15, Volunteer C was given a number of activities to perform. One of the activities was to identify the location of the toilet facility on Platform 8 and reach the destination. The train was about to arrive at the time the volunteer performed this activity. The platform was therefore crowded with passengers sitting on the floor and some were standing with their luggage on the floor. There were loading unloading luggage carts which were also kept along the edge of the platform thus creating an unsafe zone for the barrier-free movement for all the passengers.

1. The volunteer B tries to cross the road in order to reach the station entrance

2. The volunteer negotiates the entrance steps of the pedestrian entry route to station building

3. The pedestrian path leading to the main station building

4. The volunteer negotiates the down step

5. The volunteer tries to cross the passenger drop off lane via

6. The volunteer finally reaches the entrance steps to the main

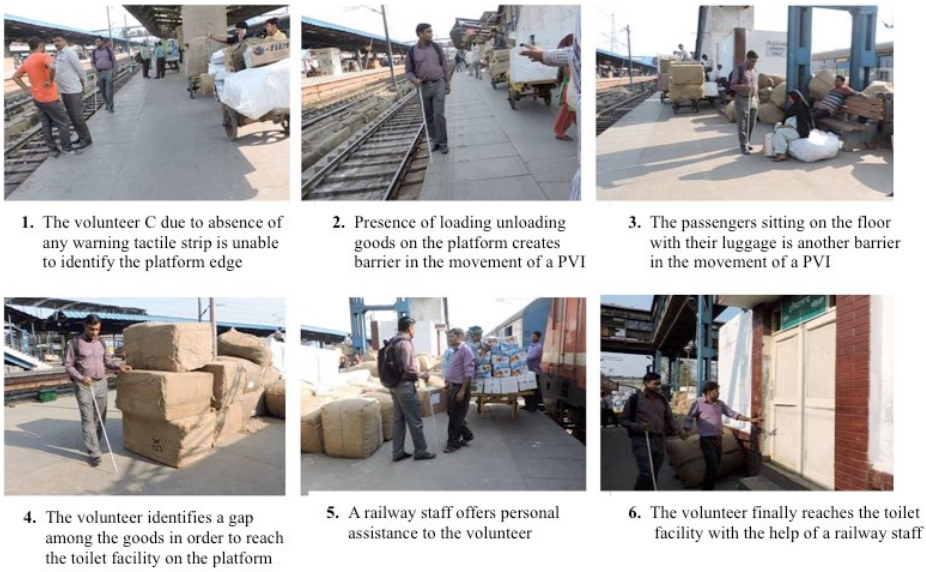
Figure 3. Video-screen shots of the activity performed by the volunteer B at Ajmeri Gate side of New Delhi Railway Station

The volunteer was unable to identify the platform edge. This was due to the fact that there was no warning tactile strip. Concrete blisters with size 1100mm X 540 mm were present which have weathered with time. Therefore, at one point the volunteer was about to fall on the tracks. He was saved by fellow passengers on the platform. The toilet facility was located under the staircase to the foot over bridge. To reach this facility one has to find his way among the enormous sized goods and wheeled carts along with passengers sitting on the floor with their luggage. The volunteer, however, found a gap between the good packages and tries to negotiate his way towards the toilet facility. He was eventually assisted by a railway staff along the narrow space which was left after the goods were placed to be loaded on the train. Finally, he reaches the toilet facility which was again in a poor condition and has a stepped entry with no ramp facility.

The same activity was again performed by volunteer D and comparative observations are made as described in Table 2.

Table 2. A comparative observation between the movement of Volunteer C and D in zone no.4 of New Delhi Railway Station

	Spatial Orientation	Ease of Navigation	Destination Identification
Movement of Volunteer C	Not able to identify the direction - seeks personal assistance	Hazardous situation created due to difficulty in identifying the edge of platform & the space left after the luggage	Seeks help from fellow passengers
Movement of Volunteer D	Identifies the direction for toilet block	Avoids the route blocked with loading unloading luggage	Built structure & signage



1. The volunteer C due to absence of any warning tactile strip is unable to identify the platform edge
2. Presence of loading unloading goods on the platform creates barrier in the movement of a PVI
3. The passengers sitting on the floor with their luggage is another barrier in the movement of a PVI
4. The volunteer identifies a gap among the goods in order to reach the toilet facility on the platform
5. A railway staff offers personal assistance to the volunteer
6. The volunteer finally reaches the toilet facility with the help of a railway staff

Figure 4. Video-screen shots of the activity performed by Volunteer C on Platform 8 at New Delhi Railway Station

Table 3. Issues identified in the External Environment (zone A) of New Delhi Railway Station

Railway Station Environment Component	Issues Identified		
	Focus Group Interactions	Access Audit	Trace Study
Physical	Passenger services like ATM, toilet cubicle, food plaza etc. are not accessible to persons with disabilities	Absence of any accessible parking space The counter heights for all the services are 1230 mm which is inaccessible.	Absence of pedestrian crossing
Sensory	Location of passenger services not known to	Directional & information signage	Absence of sensory guiding system for passenger

	many Persons with Disabilities	about the services available like airport metro gate, provision for escalators is missing for passengers using pedestrian pathway	services
Social	Lack of awareness about other entrance gate options Lack of awareness about 'assistance counter'	Auto-rickshaws parked in between passenger drop off lane block the entire path.	Passengers sitting on the entrance steps with luggage of the current reservation ticket counter area

4. Findings

The data collected from the study provide with some useful insights into the needs, concerns and barriers in the movement of a PVI in a Railway Station Environment. A number of issues were found out to be overlapping with respect to each zone of the New Delhi Railway Station. The issues were therefore prioritized on the basis of their repetitive occurrence and are listed in Table 3 and 4.

The issues identified in the both the tables covers both the external and internal environment of New Delhi Railway Station.

Table 4. Issues identified in the internal environment (zone B) of New Delhi Railway Station

Component of a Railway Station Environment	**Issues Identified**		
	Focus Group Interactions	**Access Audit**	**Trace Study**
Physical	Unable to identify the layout of the foot over bridges without assistance Absence of any accessible toilet or drinking water facility on the platforms	Lack of seating space for all the passengers Absence of designated seating space for persons with disabilities Absence of any accessible passenger service on the platform	Absence of handrail for support at the entrance of station building
Sensory	Majority of times the platform edge is unidentifiable Not able to identify the location of the coach	Signage for platform numbers are not legible and clear on the foot over bridges	Unable to identify the arrival of nearest staircase or escalator on the platform leading to the foot over bridge.
Social	Lack of awareness about the location of cloak room , 'May I Help You' counter and Jan Ahaar facility on platform number 16	Passengers standing or sitting against the railing of the foot over Bridges	Luggage placed on the edge of the platform end blocking the path for passengers and way towards the toilet block

5. Discussion

The mobility issues of a PVI in many respect overlaps with the generic concerns of almost all other diverse population groups. Universal Design as a strategy and a guiding philosophy can become a panacea to resolve the complex perspectives of handling such diversity in the given railway station context. The seven Principles of Universal Design offer a strong foundation base to address the convoluted dynamics of this issue. On the other hand, Universal Design India Principles (UDIP) further complements the UD principles adding a unique Indian perspective to it. The UDIP respects the socio-cultural diversity of India thereby contextualizing the solutions [12].

The first principle termed as 'Equitable' refers to the design solution to be fair and non-discriminating to the diverse users. In terms of a railway station environment; provision of accessible parking and passenger amenities such as accessible drinking water facilities, toilet facilities and food/ books stall facilities to all irrespective of their physical abilities can lead to achieving equity. A prior announcement about the location of the coach for persons with disabilities of the arriving train is another solution.

The second principle termed as 'usable' suggests that the design should be operable by all users in an Indian context. Successful integration of design elements like an accessible ramp with handrails on both sides, table top crossings at passenger drop-off areas, lower counter heights, Braille stickers, menus and signage implies a meaningful achievement of usability factor of the design.

The third principle termed as 'economy' address an important aspect of Universal Design in the Indian context i.e. affordability. An economically feasible design solution is more likely to be accepted and appreciated universally. In the context of a railway station sensitizing the railway staff and training them in handling diverse population groups equally is a very efficient and economically strong solution.

The fourth principle of 'aesthetics' suggests promoting social integration among the users. The aesthetic dimension in a railway station can be addressed by the application of an adequate colour contrast of the built environment maintaining the light reflective values for PVIs. The wayfinding signage should be well integrated into the visual fabric of the railway station environment thereby fostering the culture of maintaining the functional aspect of the aesthetics.

The fifth principle of 'cultural appropriateness' encourages the design solution to be respectable towards the cultural past and the changing present assisting all the users. Respecting the cultural diversity of India signage should be available in multilingual options and staff should be trained with multilingual skills catering to larger population groups. Provision of priority seating options for elderly passengers and persons with disabilities in waiting halls, restaurants and platforms are practical solutions appreciating the socio-cultural past of the country.

6. Conclusions

The mobility experience of a person with a visual impairment (PVI) with respect to a railway station depends on the access to infrastructure, information and services. The research suggests that nationally there has been a lot of improvement and efforts done for removing the structural barriers in built environments especially for those encountered by persons with mobility impairments. However, a little progress is done in removing functional barriers for all other types of disabilities, especially for PVIs.

A customized research methodology was adopted in this study through which it is observed that the needs and concerns of the PVIs need to be addressed by providing more guiding cues and spatial information for their accessible mobility. The focus group interactions provided with certain information which were not easily perceived by an access audit of a railway station. The interactions with the PVIs also revealed that the sensitization and training of staff and security adds a critical dimension to the support system of accessibility .The study concludes by providing evidence that a PVI require mobility support at all levels of physical, sensory and social dimension of a railway station environment.

This paper supports Universal Design as a key philosophy to intervene into the existing Railway Station system for making them accessible not only for PVIs but to the majority of other population groups as well.

References

[1] Ministry of Home Affairs: India, Census data on disabled population 2011, 2015.
[2] Ministry of Social Justice and Empowerment: India, Persons with Disabilities (Equal Opportunities, Protection of rights and full Participation) act, 1995.
[3] Norberg-Schulz C., Architectural theory based on perception, Oslo: Buggeskunst, 1991.
[4] Downey C., Design with the Blind in mind, TED Talk, San Francisco, 2013.
[5] Subryan H., Tactile maps as navigational aids, Center for Inclusive Design and Environmental Access (IdeA) University of Buffalo, 2010.
[6] Marston J., Golledge R., Towards an accessible city: removing functional barriers for the blind and vision impaired: A case for auditory signs, University of California Berkeley Transportation Center, 2000.
[7] Ministry of Railways: India, Manual for Standards and Specifications for Railway Stations, 2009.
[8] Network Rail, Disable access at St. Pancras International station http://www.networkrail.co.uk/st-pancras-international-station/disable-access/
[9] Japan Accessible Tourism Center, Wheelchair accessible Kyoto station guide, http://www.-japan-accessible.com/transport/metro/kyoto.htm
[10] Kar G., Mullick A., Learning from people: A human centred approach to Universal Design of workspaces, RENSA Annual Conference 2012, 2012.
[11] Zeisel J., Inquiry by design, Environment/ behaviour/Neuroscience in Architecture, Interiors, Landscape and Planning (2006), 191-201
[12] Khare. R., Mullick. A., Raheja. G., Universal Design India Principles @ 2011; A Collaborative Process Of Developing Design Principles, 13th International Conference on 'Mobility and Transport for Elderly and Disabled Persons' TRANSED 2012, 2012.