

## **PARTICIPATORY PROCESSES IN THE CONTEXT OF GOOD PRACTICES FOR A SUSTAINABLE PUBLIC TRANSPORT**

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### Abstract

This investigation has been included within the framework of the Project “Mobility chain in the urban environment. Evaluation of the quality of mobility of people with reduced mobility and communication”, addressing a special issue detected in the intersection of pedestrian paths with the access to the road public transport, a controversial situation detected by both users and service operators.

The investigation herein presented, which is included in the aforementioned project, concerned the evaluation, from an ergonomic point of view, of the conditions to execute the process of boarding and alighting a vehicle, with the participation of all the people involved in such process (passengers with functional limitations and drivers) with the aim of proposing the necessary improvements for a qualified and efficient public transport, where the principles of universal design and system sustainability prevail.

The process for detecting the real conditions of the situation of the transport is based on the analysis of the information provided by users when speaking, thinking, or acting at each stage of the activity.

The main methods applied are interviews and observation, selecting the place and the moment to avoid the interference of elements external to the activity.

With the aim of keeping a scientific rigor, all ethnography guidelines have been adopted by selecting the critical cases that comply with the criteria set forth by the methodological categories of each study, so that the results become representative in every space in which similar circumstances and conditions are registered; such conditions have been defined from the same theoretical point of view from which the data is analyzed. As a further step, this information has been examined regarding its utility and reliability to contribute to the improvement of the system.

The investigation demonstrates that there are still some conflicts between the parameters of effort, safety, communication, and mobility of users with functional limitations, when boarding and alighting the vehicle. Therefore, an improvement of the current systems should be considered, particularly the reconstruction of the urban area and the design of public transport stops. Furthermore, during the investigation, a conflict between the drivers' labor activities when operating the manually-operated boarding ramps has been detected.

The application of participative ergonomics, through direct observation and the opinion of users, resulted in a useful tool to determine the deficiency of the current system, detect critical issues, and propose the necessary actions to optimize the system in order to solve the gap between the urban area and the mobile material. The collaboration of the people involved was essential and, at the same time, as this is an issue constantly criticized by disabled people, they felt that their complaints have finally been heard.

Key words: urban mobility - public transport - participative ergonomics - universal design.

## **PAPER**

### **PURPOSE OF THE STUDY**

This investigation was conducted in the Research Center on Architectural, Urbanistic and Transport Barriers (CIBAUT, as per Spanish acronym) of the School of Architecture, Design and Urbanism of the Buenos Aires University, within the framework of the UBACyT A 002 Research Project "Mobility chain in the urban environment. Evaluation of the quality of the mobility of people with reduced mobility and communication", together with the participation of the Industrial Designer Claudia Rojas Rodriguez of the Pedagogical and Technological University of Colombia, acting in her capacity as Intern. This investigation addressed the special issue detected in the intersection of pedestrian paths with the use of road public transport, a controversial situation detected by both users and service operators.

The main purpose was to describe the difficulties encountered by users with reduced mobility while boarding and alighting a vehicle of the road public system of the City of Buenos Aires, by means of a participatory analysis of the elements of the aforementioned system during the execution of such activity.

This experience complements two previous researches, carried out in the same Research Center in 2009, which had the broader purpose of analyzing the quality of the urban mobility by means of the application of two different methods: a survey to disabled people (Apollonio; Urroz, 2009) and a study of the complaints registered in the Argentinean Transport Control Department for the City of Buenos Aires (Apollonio; Benardelli, 2009).

The investigation herein presented concerned the evaluation, from an ergonomic point of view, of the conditions available for disabled people to board, remain, and alight a vehicle from public road, with the participation of all the people involved in such process (passengers with functional limitations, drivers, and designers), with the aim of proposing the necessary improvements for a qualified and efficient public transport, subject to the principles of universal design (International Conference on Universal Design 2004) which are an inherent condition for a sustainable development focused on social aspects at establishing equal conditions of access to and use of the road public transport for the largest possible number of users .

## METHODOLOGY

The process for detecting the real conditions of the situation of the transport is based on the analysis of the information provided by users through their words, their attitude, and their responses at each stage of the activity.

The methods applied are basically interviews and the observation, selecting the place and the moment to avoid the interference of elements external to the activity.

With the aim of keeping a scientific rigor, all ethnography guidelines have been adopted by selecting the critical cases that comply with the criteria set forth by the methodological categories of each study, so that the results become representative in every space in which similar circumstances and conditions are registered; such conditions have been defined from the same theoretical point of view from which the data is analyzed. As a further step, this information has been examined regarding its utility and reliability to contribute to the improvement of the system.

Participative ergonomics is based on the principles of participatory democracy, according to its originator: Henry Sanoff. As opposed to representative democracy in which the adoption of decisions is delegated, participatory democracy is based on the active participation of users for the determination of the project and construction criteria of buildings, equipment, and tools.

The principles of participatory ergonomics (Floría Cortés 2000) set forth the standards which were applied during the examination of the actions executed by users in real space and time in the process of boarding transport vehicles. To sum up, participatory ergonomics criteria are the following:

- Actions are in the hands of users; they have the capacity to control the situation.
- Systems must be as much interactive as possible, easy to comprehend and use, and the risk of accidents must be reduced to the minimum.
- Visual and hearing characteristics must comply with the whole esthetics.
- The design must prioritize simplicity and functionality.
- The information available must be explicit and independent from users' mental, linguistic, and hearing capacity.

## Investigational Framework and Representative Sample.

The road public transport system of the City of Buenos Aires has been taken as reference for this investigation. The test subjects were people with functional limitations, such as the following: wheelchair users, severe semi-ambulants with technical assistance for mobility, people with reduced mobility whether permanent or temporary, elderly, women holding babies in their arms, and people with severe visual impairment. Patients of the National Rehabilitation Service of the City of Buenos Aires were considered for the functional analysis.

## Evaluation of the System

In the first stage, the streets of the system of roads used by the road public transport system have been observed with the aim of describing the main difficulties encountered by disabled users while waiting on the sidewalk, at the moment of boarding the vehicle and circulating along it, when using the ticket vending machine, sitting on reserved seats, requesting the stop of the vehicle, and alighting to the sidewalk in the urban area.

The people surveyed expressed their view about their experience in the public system, including their opinion and explaining both their negative and positive experiences while traveling in the public transport system. A usual situation for people was used in order to know their appreciations, needs, and the possible implementation of the improvements of the design.

## Usability Analysis

In the second stage, tests and simulations were conducted, leading to the detection of the physical and biomechanical efforts of the users from an objective point of view, by means of representations and ergonomic analysis programs (RULA, Rapid Upper Limb Assessment), a task which was performed by the Industrial Designer Claudia Rojas Rodríguez.

The RULA method (Diego-Mas-2006) was developed by Dr Lynn McAtamney and Dr. Nigel Corlett of the University of Nottingham's Institute of Occupational Ergonomics in 1993 to investigate the exposure of workers to risk factors associated with work-related upper limb disorders, such as postures, repetition of movements, forces exerted, and static muscle work.

RULA analyses the postures of the upper limbs (upper arms, lower arms, and wrists), the neck, trunk and legs during the execution of an activity. Using scoring tables the method provides a combination of scores to give a general rating based upon the muscular effort and the force exerted, which results in a grand score representing the estimated risk of injury due to musculoskeletal loading caused by such activity.

The RULA method was applied to determine the critical activities of disabled people in the use of the public transport, as shown in the table below:

People observed	Activity Executed	Critical Movement
Pregnant women holding a baby in her arms	Alighting the vehicle	Leaning against handrails
Older passenger	Alighting the vehicle	Complete alight
Wheelchair user	Use of boarding mechanical ramp	Boarding through the ramp
Wheelchair user	Use of lifting platform	Boarding the vehicle
Wheelchair user	Use of lifting platform	Adjusting handrails
Driver	Activation of the manually-operated boarding ramp	Opening aluminum cover
Driver	Activation of the manually-operated boarding ramp	Loosening the ramp up to extract it
Driver	Activation of the manually-operated boarding ramp	Sliding the ramp out

Table 1 – Critical Activities



Picture 1 – Pregnant women holding a baby in her arms while alighting from the vehicle.\*



Picture 2 – Wheelchair user using the boarding mechanical ramp.\*



Picture 3 – Wheelchair User, boarding with lifting platform.\*



Picture 4 – Driver manually activating the boarding ramp.\*

In the third stage, the observation was focused on the analysis of the moment of boarding and alighting the vehicle, together with the active participation of users, with the aim of establishing the required biomechanical efforts, the degree of approval expressed by the people surveyed, and the subjective components related to the comfort and safety experienced while using the mechanical and manual boarding ramps and the lifting platforms.

This stage included the collaboration of a transportation company which provided the vehicles with different adaptations to carry out the observations of the patients of the National Rehabilitation Service in a protected place.

Analyzed adaptations:

- kneeling bus with a low-floor chassis;
- lifting platform;
- automatic boarding ramp;
- manually-operated boarding ramp;
- public transport stops in urban areas; and
- parking distance standards in stop areas.

As a closing for the activities, the validation and socialization of the needs detected were executed with the participation of the work group composed of users and therapists.

### Activities Performed

In the case of semi-ambulant people, the highest discomfort appeared at the time of boarding a vehicle, due to the gap between the sidewalk and the platform of the vehicle. The critical fact was found in the intersection between the sidewalk and the floor of the vehicle, given that, due to different causes, people are usually forced to

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\* Photographic material of Industrial Designer Claudia Rojas Rodríguez

board the bus directly from the roadway facing an even larger unevenness. This is caused, in most cases, by drivers' apparent reluctance to approach their buses to the curb in order to save time as well as by the presence of vehicles parked in the bus stop aprons obstructing a quick and safe maneuver.

It was evidenced that vehicles have been adapted to facilitate access only to wheelchair users, without including people with other mobility problems such as the elderly, semi-ambulant, and sensory impaired people. As a result of the adaptations performed, difficulties for circulating inside the vehicle and using reserved seats, which are placed approximately 40 cm higher than the walking corridor, were also registered.

People with total blindness and with severe visual impairment encountered difficulties caused by the following: a deficient communication system, scarce to non-existent signposts in both the bus stop and inside the vehicle, the lack of a standardized door opening system, the location of handrails, and the drivers' reluctance to approach the bus to the curb to facilitate boarding.

As for performance, the most important aspect was the complicated system of activation of the boarding ramps.

Users' most frequent comments about the difficulties encountered when executing the activity were the lack of continuous handrails or their inadequate height to ensure a safe circulation inside the bus.

Regarding the automatic boarding ramps, several problems were found due to the complicated safety mechanisms to secure the wheelchair or the lack of knowledge about the operation of such ramps. In several cases passengers mentioned their preference to board through the front door when the bus is near the curb instead of using the boarding ramps.

Manually-operated boarding ramps required additional operations involving the driver and increasing the time destined for the execution of the activity, affecting the rest of the passengers and causing severe biomechanical efforts of the upper and lower limbs of drivers.

Even though that the implementation of kneeling or low-floor vehicles benefited the elderly, the interior design has been criticized due to its unevenness and the seats oriented backward to the traffic, which is a highly ill-advised position for people with severe visual impairment since it may produce confusion.

## RESULTS

The investigation demonstrates that there are still some conflicts between the parameters of effort, safety, communication, and mobility of users with functional limitations, when boarding and alighting the vehicle. Therefore, an improvement of the current systems should be considered, particularly the reconstruction of the urban area and the design of public transport stops. Furthermore, during the investigation, a conflict between the drivers' labor activities when operating the

manually-operated boarding ramps has been detected. Furthermore, the interior design of the vehicles is inadequate for this population, especially for the variety of models, the uneven surface of circulation, and the placement of the reserved seats on a level higher than the walking corridor.

## DISCUSSION

Given the limited number of people and vehicles that participated in this experience, the results herein presented must be corroborated by enlarging the number of experiences in order to validate and correct the interpretations suggested during the work in the field.

## CONCLUSION

The application of participative ergonomics, through direct observation and the opinion of users, resulted in a useful tool to determine the deficiency of the current system, detect critical issues, and propose the necessary actions to optimize such system in order to solve the gap between the urban area and the mobile material. The collaboration of the people involved was essential and, at the same time, as this is an issue constantly criticized by disabled people, they felt that their complaints have finally been heard.

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