

Improvement in Public Transportation Commuter Services: Optimization and Refurbishment of Bus Stops in Parana City

Lautaro Guigliani¹ – Marcos Penon²

*Electronics Engineering Department, Facultad Regional Paraná, Universidad Tecnológica Nacional
1033 Almaguer Av, Paraná Entre Ríos, Argentina*

lautaroguigliani@alu.frp.utn.edu.ar¹

marcospenon@alu.frp.utn.edu.ar²

Summary

The city of Parana is the capital of Entre Ríos and it is a very large city. For this reason, it has a robust number of inhabitants who need adequate public transportation and bus stops in good condition since they are a key element for a better user experience. However, a large percentage of these are not in their optimal state, which causes different problems such as insecurity, deterioration of belongings or loss of time. This project proposal includes the evaluation of existing stops, and the implementation of sustainable designs and advanced technology, such as solar panels and emergency communication systems. As well as this, the strengths and weaknesses of the proposal are analysed. It is expected that this initiative will not only increase the safety and comfort of users, but also become an environmentally friendly proposal. Despite cost and maintenance challenges, this project is expected to transform the quality of public transportation in Paraná and improve the lives of its inhabitants.

Keywords: bus stop - public transport - technological development - social security

Resumen

La ciudad de Paraná es la capital de Entre Ríos y es una ciudad muy grande. Por ello, cuenta con un robusto número de habitantes que necesitan transporte público adecuado y paradas de autobús en buen estado, ya que son un elemento clave para una mejor experiencia de usuario. Sin embargo, un gran porcentaje de estos no se encuentran en su estado óptimo, lo que provoca diferentes problemas como inseguridad, deterioro de pertenencias o pérdida de tiempo. Esta propuesta de proyecto incluye la evaluación de paradas existentes, y la implementación de diseños sustentables y tecnología avanzada, como paneles solares y sistemas de comunicación de emergencia. Asimismo, se analizan las fortalezas y debilidades de la propuesta. Se espera que esta iniciativa no sólo aumente la seguridad y comodidad de los usuarios, sino que también se convierta en una propuesta amigable con el medio ambiente. A pesar de los desafíos de costos y mantenimiento, se espera que este proyecto transforme la calidad del transporte público en Paraná y mejore la vida de sus habitantes.

Palabras clave: parada de autobús - transporte público - desarrollo tecnológico - seguridad social

I. INTRODUCTION

Paraná is the capital of the province of Entre Ríos. It is located in the southwest of the province on the banks of the Paraná river. The capital has an area of 132 km² with a total of more than 100 neighborhoods and a population of 390,000 people (according to the 2022 Census).

Parana has a large number of citizens who need mobilization so bus stops have an important role in the comfort and safety of passengers. The population of this city depends heavily on this type of transport so it is important to ensure the good condition of them.

This project addresses the current state of bus stops for public transport in the city of Paraná. The project seeks to improve the quality of public transport and the user experience.

In order to achieve this objective, this work is organized as follows. First, the context of the city to be developed for the project is described so that the reader is correctly positioned. Next, there is the incorporation of images that can help to critically understand the problematic situation. After this, the causes and consequences directly related to the problem to be treated are raised, in order to know and develop our reasoning based on this. Furthermore, a development model suitable for a solution to this will be proposed, with a planning and implementation method. Finally, the strengths and weaknesses of the proposal to be made will be objectively analyzed. It is expected that this project may generate a discussion about the quality of public transportation and the importance it has. Also, it is expected it may help achieve a real change in the daily lives of citizens since they will be able to travel as they should.

II. PROBLEM DEFINITION AND ANALYSIS

A. Description of the Context

The city of Paraná has a significant size and is connected to neighboring locations through routes 168, 12 and 11. Located to the west of the province, it shares a border with the city of Santa Fe and is separated by the Paraná River (shown in Fig.1). The name of the river comes from Guarani and it means "relative of the sea."

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Fig 1. Paraná River

Paraná is a big city with five distinctive areas: north, east, south (illustrated in Fig. 2.). Therefore, there are many bus lines to explore the different parts of the city. It has, in fact, 23 bus lines. However, the most important line of the city is line 22 since its route crosses most of the city from the east to the center as shown in Fig. 3.



Fig 2. Division of Paraná city



Fig 3. Route of Line 22

In the east there are two access roads: one leads to the city of San Benito, and the other to the city of Colonia Avellaneda (shown in Fig. 4). These are two important cities since in these cities signal the beginning of the line 22 route.



Fig 4. Landmarks in the East Side



Fig 5. National Technological University

In addition, further along this route is the National Technological University (UTN) as shown in Fig. 5, where students from different parts of the city and the province study engineering degrees. Near the UTN is "Las Cinco Esquinas" (as shown in Fig. 6) which receives this name because it is made up of the intersection of 5 avenues and also in this area important landmarks are located: corner 911, the headquarters of the Municipality, the Evangelical Baptist Church and a gas station.



Fig 6. "Cinco Esquinas"

Next, through the route is located a very frequented place which is the San Martín Hospital (Fig. 7) and relatively close is the Alberdi Square and UNER University. Finally, the route of the line culminates in the Government House (Fig. 8), which is a point of great flow of people in Paraná .



Fig 7. San Martin Hospital

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Fig 8. Government House

In addition, near the end of the route there are some important landmarks which are Paraná Pedestrian Street and “1° de Mayo” Square (illustrated in Fig. 9 and Fig. 10). Although these places are not part of the tour, they are important points of the city because there is a large flow of people.



Fig 9. Parana Pedestrian Street



Fig 10. “1° De Mayo” Square

B. Problem Statement

The deficient state of the bus stops entails a problem that has a notorious impact on the movement of the inhabitants of large cities such as Paraná itself, which suffers from this problem. Paraná is a geographical point that has a great economic and industrial development, which leads to a significant flow of cars and buses. However, the quality and condition of many bus stops does not match its progress. The bus stops, many of them without roofs or seats, do not have the necessary infrastructure to provide respite to those who are waiting for their means of transportation.

C. Description of Scenes that Help Picture the Problematic Situation

The state of the bus stops in all of Paraná is an aspect to review and it is important to improve. However, before this

can be done it is necessary to explore the real conditions of these bus stops.

At the entrance to the city, relatively close to UTN there are completely uncovered stops that show the reality of Paraná today. There are obsolete sticks that represent a strategic bus stop that is on a very important avenue to the east of the city as shown in Fig. 11. This place shows the precariousness with which all citizens live day to day.



Fig 11. Unprotected bus stop

On important avenues, places near the Bus Terminal and the Municipality, there are bus stops that basically do not exist and are a phantom point. This leads people to have to wait standing and on the sidewalks as illustrated in Figure 12.

Throughout the line route, numerous bus stops are observed lacking shelters, seating and often proper signage. A notable example of this deficiency can be witnessed in the densely populated 'Cinco Esquinas' area of Paraná. There are bus stops that consist of nothing more than a numbered pole, rather than a designated waiting area. The images reveal a bleak picture: travelers squeezed together in the rain, or under the suffocating sun, without any type of protection.



Fig 12. Bus stop at “Cinco Esquinas”

In the whole city there are many bus stops completely destroyed. The fact that these places are so neglected generates distrust in the regular passenger (as illustrated in Figure 13). Bus stops in poor condition or the case of not having a stop as such causes many problems for the safety and correct use of all the city lines.

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Fig 13. Stop in poor condition

Many stops throughout Parana lack light and accompaniment from any authority such as the police (as shown in Figure 14). Also, these bus stops are generally located on the outskirts of the city. For this reason, many of the regular users who live in these areas and travel very early in the morning or late at night do not feel safe at all about using the transportation service.



Fig 14. Bus Stop with lack of lights

D. Identification and analysis of causes or factors that give rise to the problem:

The poor state of many of the stops in the city of Paraná harm people who normally travel. Among the many factors that generate this problem, there are some that must be seriously considered. The first cause is related to vandalism and lack of public accountability since, if any change is made for the improvement of this situation, a contribution from the population is needed to take care of the new bus stops.

Lack of investment and maintenance is another major cause. The constant use of bus stops means that they need daily maintenance to keep them in good condition. However, this idea does not have a development plan to achieve it.

The final factor is the lack of coordination and inefficient management: there is a lack of coordination between the government agencies in charge of solving this problem. As a result, this implies that no projects are presented for the correct management of the stops.

E. Identification and Description of the Consequences

The state of many of the stops in the city results in some consequences for the population. The first consequence is related to insecurity at bus stops. Their isolated locations and lack of surveillance make them prime targets for robberies,

attacks, or other illegal activities. This, in turn, puts the safety of commuters at risk, as there is little control over people's actions in these areas. The lack of adequate lighting, surveillance cameras, and communication infrastructure exacerbates the issue. Commuters are aware that these locations offer little security, and the absence of a reliable means to alert law enforcement or other individuals in case of an emergency further compounds their concerns.

Another consequence has to do with the impact of adverse weather conditions and damage to belongings. On extreme rainy days and during electrical storms, commuters are left exposed to the elements, leading to the damage of electronic devices and personal belongings. The absence of shelter leaves individuals without a place to take cover and wait in peace and comfort.

Waste of time is another important consequence. The lack of adequate signage at bus stops leads to a significant loss of time for users. Difficulty in locating or identifying them easily not only causes frustration but also results in delays in people's journeys. Users often find themselves frantically searching for the right bus stop, which can lead to missed buses and ultimately delays in reaching their destinations. This lack of effective signage not only impacts the efficiency of the public transportation system but can also have a negative impact on the quality of life for users who rely on it for their daily commutes.

III. THE WAY FORWARD

A. Problem approach

This study proposes a methodology for the design and implementation of bus stops that prioritizes sustainability and passenger safety. It is based on ideas and concepts drawn from successful plans implemented in places such as the city of Córdoba in Argentina, the country of Brazil, as well as in highly technological and constantly developing European countries.

In an effort to improve public transportation infrastructure, this methodology is inspired by global best practices and seeks to adapt them to our local environment. It combines inclusive design, advanced technology and solar energy solutions to create a public transportation environment that meets community needs, improves passenger comfort and contributes to the city's environmental sustainability.



Fig 15. Model for bus stop

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In Argentina, examples to follow regarding these stops have already been implemented (shown in figure 15). When obtaining several implementation models, it is important to take the best aspects of each one to obtain the most optimal and effective one. In order to carry out a project like this, several steps are needed. Below is a description of a course of action.

Evaluation of Current Stops:

-Exhaustive Review of Current Stops: To understand the starting point, it is important to carry out a thorough review of the existing bus stops in the city. This evaluation includes the inspection of their physical condition, safety conditions and comfort for users.

-Passenger Flow Analysis and Specific Demands: Passenger flow studies are essential to identify the busiest stops and understand their specific needs. This information is crucial for the strategic placement of devices such as USB charging stations and panic buttons. In relation to cost, for the implementation of electronics on site, the usual flow at each stop is taken into account. In this way, the same thing is implemented in all of them but more are added in those that are close to the center or places that are too crowded to be able to equalize the use.

Development of Sustainable Design and Planning:

-Inclusive and Accessible Design: Based on international standards of universal accessibility, an inclusive design is developed that guarantees comfort and accessibility for all users. This includes incorporating ramps, wheelchair spaces and tactile signage.

-Integration of Advanced Technology: Note is taken of the technological solutions used in leading countries in transportation infrastructure. Also, the incorporation of advanced technology is implemented, such as real-time information screens and emergency communication systems. Panic buttons are also included, to improve security and user experience as shown in Figure 16.



Fig 16. Bus stop with technological improvement

Selection of Materials and Sustainable Technology:

-Resistant and Sustainable Materials: Successful experiences around the world are adopted and sustainable and vandal-resistant materials are chosen. This includes shockproof glass and anti-graffiti coatings to ensure the durability of the installations and reduce long-term maintenance costs.

-Solar Energy Generation: Inspired by international examples of sustainable bus stops, solar panels are implemented on the roofs of shelters and stops. These panels generate clean, sustainable energy that powers electronic systems. Also real-time information screens, LED lights and USB charging stations are incorporated (shown in Fig. 17).



Fig 17. Bus Stop with renewable energy

Efficient Implementation and Maintenance

-Gradual Implementation Plan: A gradual implementation plan is designed, which prioritizes the busiest stops and those that require urgent improvements. This ensures efficient allocation of available resources and effective implementation.

-Sustainable Maintenance Program: A monthly maintenance program is established for all stops so that they do not deteriorate and their status is correct. In this way, a project of this magnitude can last longer if society is determined to take care of it.

The methodology presented offers a comprehensive solution to the improvement and construction of sustainable and safe bus stops. By combining inclusive design, advanced technology and solar energy solutions, a safe environment and an unforgettable experience can be generated for the user so that they are motivated when it comes to transportation. A public transportation environment that meets the needs of the community is achieved.

B. Strengths and Weaknesses of the Proposal

The implementation of sustainable and safe bus stops offers a number of strengths and weaknesses that must be considered before doing this project. Below are the main strengths and weaknesses of this work:

Strengths:

-User Safety: One of the highlights of these stops is their focus on user safety. The incorporation of advanced technology such as communication systems, emergency and

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panic prevention devices contribute significantly to the safety of passengers by giving them the peace of mind of having help in case of emergency.

-Better Passenger Flow: The design of bus stops helps in reducing congestion at stops and improves the user experience. A well-planned design allows passengers to get on and off the bus in a more fluid and orderly manner.

-Technological Integration: The use of advanced technology, such as real-time information displays for bus information or the fact that USB charging stations provide users with additional space to charge mobile devices and facilitates SUBE card validation in one place.

-Environmental Sustainability: The generation of solar energy through solar panels at bus stops not only reduces environmental impact through the use of clean energy, also ensures the continuity operation of electronic devices even in situations of power outages.

Weaknesses:

-Implementation Costs: The construction and implementation of sustainable and safe bus stops can be expensive because it requires a significant investment in technology, resistant materials and solar energy systems. Therefore, this can represent a financial challenge for municipal authorities.

-Continuous Maintenance: Despite the advantages of durable materials, bus stops will still require periodic maintenance to ensure their proper functioning. This entails additional costs, and, therefore, the necessity of implementing a well-managed maintenance program.

-Material Delivery Logistics: During the construction of bus stops the delivery of materials and logistics can be challenging. The fact of reconditioning so many strategic points entails a great challenge with the transportation of

materials and workers because it implies perfect organization. In any case, even if work is done well and quickly, the construction of stops leads to inconvenience to other lines and their users.

-Lack of Public Information: People in general are not aware of the care and respect of public infrastructure. An organization and awareness campaign must be established for citizens so that their thinking changes and they understand the true purpose of the project. If there is no result, the refurbishing will not have the best acceptance by users and the objective will not be achieved.

IV. CONCLUSION

In conclusion, this project aims to give new life to the heart of Paraná by revolutionizing the infrastructure of its bus stops. With a clear focus on safety, convenience and sustainability, the goal is not only to improve transportation but also to elevate the very essence of urban living.

As these modern, safe and environmentally friendly bus stops become established throughout the city, an increase in the feeling of security among commuters is anticipated. They will no longer face uncertainty in the dark, but will instead find comfort and peace of mind in these stops.

Furthermore, the transformation promises to be a catalyst for better urban connectivity. A smooth flow of passengers, driven by advanced technology, will foster a feeling of efficiency and punctuality. Commuters will feel more in control of their time, and this new convenience could even encourage more people to adopt public transportation. It is not just about taking the bus; it is about catching up with the future.

In essence, this project aspires to be more than a mere update. Its objective is to be a transformative force that reshapes the urban landscape and improves the daily lives of the citizens of Paraná. With brighter, smarter and safer bus stops, not only transportation is being improved: the city itself will be improved.

Marcos Penon is an Electronics Engineering student at UTN FRP: marcospenon@alu.frp.utn.edu.ar. Lautaro Guigliani is an Electronics Engineering student at UTN FRP : Lautaroguigliani@alu.frp.utn.edu.ar . The present project is a skills integration activity in Inglés I at Universidad Tecnológica Nacional, Facultad Regional Paraná, carried out by EFL engineering students. The yearlong project requires students to delve into a problem in the city where they live and to address it by means of a simple project in English. Should the reader have any questions regarding this work, please contact Graciela Yugdar Tófaló, Senior Lecturer, at gyugdar@frp.utn.edu.ar.