Available online at www.sciencedirect.com

ScienceDirect

Transportation Research Procedia 00 (2018) 000–000

Transportation Research Procedia

www.elsevier.com/locate/procedia

World Conference on Transport Research - WCTR 2019 Mumbai 26-31 May 2019

# Pedicab as sustainable and complementary mode of transport for journeys in the first-last mile of the TransMilenio System of Bogotá

Laura Daniela Ramirez Leuro[a], Ximena Carolina Velandia Villamil[b]

[a]*Student Master, National University of Colombia, Bogotá, Colombia*
[b]*Student Master, National University of Colombia, Bogotá, Colombia*

**Abstract**

The objective of this research is to propose the guidelines for the implementation of an intermodal system, in which the pedicabs can be a sustainable and complementary way for the demand of first-last mile that are not covered currently by the massive Transmilenio system in the city of Bogotá. For this, the Transmilenio system and points where the Pedicabs works in Bogotá were georeferenced, users of Pedicabs and the Transmilenio were characterized, Pedicabs service conditions in Bogotá and comparison of case studies worldwide were devolopmented, and coverage of the Transmilenio system on first-last mile were analyzed. Consequently, a proposal was made based on the analysis of the current infrastructure available in the stations and terminals of Transmilenio, legislation for the circulation of pedicabs and guidelines for the operation and rate integration. The implementation of this proposal from the demand analysis of the current system of Transmilenio is proposed in four phases, in the Phase I is to implement the Pedicab as a feeder mode in the 9 terminals of the system, Phase II refers to the 9 major stations demand or entries registered by the Transmilenio system, the next phase is recommended in 9 stations where the rickshaw currently operates informally and according to respondents are the Pedicabs points that have the greatest demand. Finally, a phase IV is recommended with 9 stations identified as areas of travel attraction for shopping, tourism and intermediate connectivity with the stations of phases I. II and III.


Peer-review under responsibility of WORLD CONFERENCE ON TRANSPORT RESEARCH SOCIETY.

*Keywords:* first-last mile; intermodal; conection; informal transport; pedicab (bicitaxi); Transmilenio.

## 1. Introduction

The pedicabs called “Bicitaxis” in Bogotá is very like the way mobility has evolved in the city. The first pedicabs which there is registration in the city appear in the year of 1997 used in the political campaign of the then candidate for Carlos Moreno de Caro district mayoralty. Since then and the middle of the first decade of this century there are no records of the use of this type of vehicle in the city (Bogotá, 2012).

The population of Bogotá for the year 2000 was 6.3 million people, that same year, Phase I of the Transmilenio system began operation. Nowadays the population reaches a little more than 8 million inhabitants. The increase in population has gone hand in hand with a segregation of public space. This means that today there are more neighborhoods in


Peer-review under responsibility of WORLD CONFERENCE ON TRANSPORT RESEARCH SOCIETY

what are called peripheral sectors of the city. The increase in population has required that there is an increasing need to move to other places in the city and consequently has brought about a significant increase in the use of public transport.

On the other hand, given the difficulty of public transport to meet the growing demand of the population for a better and more efficient mobility, has resorted to the use of alternative means of transport. This is where a fertile ground for the use of pedicabs appears as economic and efficient vehicles from the user's perspective.

Already for the year 2004, 4 years after the start of operations of Transmilenio, about 450 pedicabs were counted, and since then their number has been increasing almost exponentially until reaching, according to unofficial data, about 5400 for the year 2012 and currently around 10,000 pedicabs circulating around the city, distributed mainly in the towns of Suba, Bosa and Kennedy (Bogotá, 2012).

This significant increase in the number of pedicabs circulating in the city has generated the prevailing need to regulate this service used by some 150,000 people per day, however, "the legalization of pedicabs as public transport vehicles is still in arrears to become a reality, because (although) since mid-2013 the Constitutional Court issued a guardianship ruling in which it recognized the rights of the union "to equality, due process, work and freedom of enterprise", (...) the district authorities have said that they can not generate norms that regulate the bicitaxismo if the Ministry of Transport does not homologate the vehicles and this, in turn, says that it needs studies of each territorial entity to be able to homologate " (Carvajal, 2014).

The implementation of a regulation that manages to regulate bicitaxism in Bogotá has been thought of since 2012 when, through the draft Agreement 260 of 2012, it was proposed to create a regulation for the provision of non-automotive urban public land transport service for passengers in the District. Capital. Such an agreement arose in response to the Constitutional Court decision C-981 of 2010 (Bogotá, 2012). The implementation of a regulation that regulates the use of pedicabs, although it poses great challenges given the large number of pedicabs circulating, the appearance of numerous associations of pedicabs and an apparent mafia that is behind the operation of pedicabs in certain areas of the city (Reyes, 2016), it is necessary and fortunately can be based on what has been done in other cities around the world that have faced the same challenges.

Article 32 of Law 1753 of 2015 of the Republic of Colombia states: "The national government may support solutions for public transport of passengers in urban, conurbated or regional areas that are integrated into the system of cities that are being structured, implementing or operating in the country, as long as they understand actions aimed at increasing and regulating the use of non-motorized and clean energy modes (understood as the journey on foot, bicycle or tricimóvil, among others), integration with other modes and modalities especially in last mile zones, and measures against illegality and informality".

The Ministry of Transportation of Colombia in its second version for approval in July 2018 intends to regulate the service of Bicitaxi by means of a resolution: "By which it is regulated and authorizes the provision of the public service of transport of passengers in tricycles or non-motorized tricycles and tricycles assisted pedaling, to provide efficient, safe, and timely, taking advantage of the use of information technology and communications, and other provisions are issued "Additional, Article 132 of Law 1450 of 2011, modified by Article 32 of Law 1753 of 2015, states that "the National Government may support solutions for public transport of passengers in urban, conurbated or regional areas that are integrated into the system of cities that are being structured, implemented or operating in the country, provided they understand actions aimed at increasing and regulating the use of non-motorized and energy modes ías clean (understood as the journey on foot, bicycle or tricimóvil, among others), integration with other modes and modalities, especially in areas of first or last mile, and measures against illegality and informality.

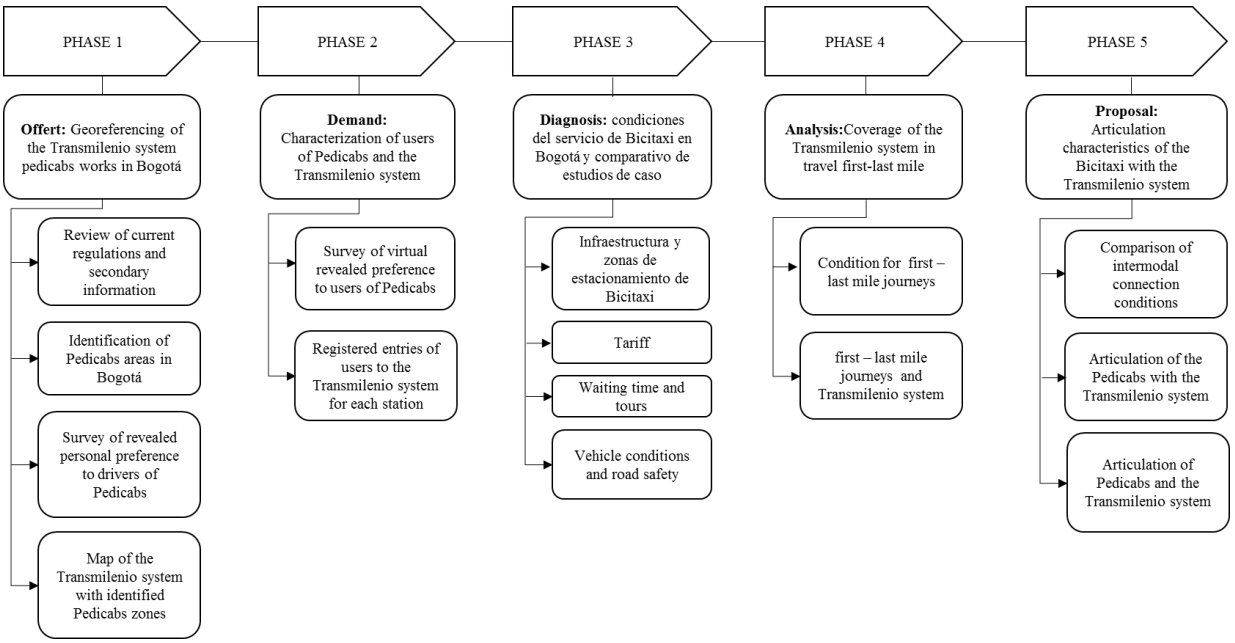
Results in others part of the world in city as Dhaka (Rahman, 2013) and Bangalore (Sreehari, 2012) show that Pedicabs could provide effective feeder services to BRT if the following points are addressed. The physical design of BRT stations should accommodate spaces for Pedicab for dropping off and picking up passengers, ensure not more than 200 m or 3 minutes of walk for modal interchanges between Pedicabs and BRT, with better walking facilities and environment. Pedicabs should be well organised in terms of queuing at BRT stations. A pre-determined fare structure for Pedicabs should be implemented. Above all, design of the new system should involve active involvement of the Pedicabs-pullers and the public in the planning and decision- making process. Moreover, a 3-D physical model of the proposed BRT station helped effective participation during public consultation.

According to the characterization of the Pedicab service and the operational design of feeder and complementary routes, it can be said that the demand for Pedicabs corresponds to trips that must be made on foot or by bicycle, but simply when the means of transport is on foot and on bicycle, users prefer other means of transport, especially in the morning hours where it is urgent to get to work. The SITP in its different vehicle typologies for cost-efficient conditions is not designed to cover small routes and areas with very low demands, which gives space to the rickshaw to enter to cover these areas. The service is vulnerable to traffic accidents, which can be mitigated by training drivers to comply with traffic regulations and sensitizing the community so that it respects and coexists with the Pedicab service. Additionally, the Pedicab being a means for advertising installation, can generate resources for the construction and adaptation of infrastructure for circulation. Being a vulnerable service, it is recommended to use it by users, which could be an impedance when using the service, however, drivers should be the spokespersons for its advantages. (Velandia, 2012)

## 2. Methodology

The methodology in this investigation is composed of five (5) main phases that are shown in Figure 1: 1) Offer; 2) Demand; 3) Diagnosis; 4) Analysis and finally 5) Proposal.

Fig. 1 Methodology of the investigation by phases



Each of the phases is detailed below:

*2.1. Phase 1. **Offer:** georeferencing of the Transmilenio system and points where the Pedicabs works in Bogotá*

It consists of the review of the studies carried out regarding the way of the service of Pedicabs for the last five (5) years both by researchers and by related state entities. A sample design and revealed reference survey was developed for pedicabs drivers that was conducted in person. The above in order to identify the service areas of Pedicabs near the massive transport system Transmilenio in the city of Bogotá and characterize the service offer.

*2.2. Phase 2 **Demand:** characterization of users of Bicitaxi and the Transmilenio*

A survey of preference revealed in virtual mode to users of Pedicabs was developed and the entries of users registered by the mass transport system Transmilenio were analyzed on an average daily day according to statistics of 2017 (Transmilenio S.A., 2018); this in order to analyze the demand of users of the two modes of transport to identify the needs of users and demand conditions.

*2.3. Phase 3 **Diagnosis:** Pedicabs service conditions in Bogotá and comparison of case studies worldwide*

According to a visual inspection; the answers of the surveys of revealed preference of the users and drivers of rickshaw; and a comparative diagnosis of case studies of the rickshaw service with international case studies. This with the aim of having a diagnosis of the existing conditions and possible criteria to improve the service by proposing the intermodal connection proposal and legalization of the transport mode of rickshaw.

*2.4. Phase 4. **Analysis**: coverage of the Transmilenio system on first-last mile trips*

An analysis was made of the conditions that define which trips correspond to the first-last mile in Bogotá and according to this, the coverage of the Transmilenio mass transit system was specified through a map of the stations and their respective travel coverage.

*2.5. Phase 5 **Proposal:** articulation characteristics of the Bicitaxi with the Transmilenio system*

In order to evaluate the articulation conditions of the Pedicab mode with the Transmilenio mass transport system, a comparative analysis was carried out with case studies of intermodal connection with non-motorized modes of transport worldwide with cities from different continents. According to this and the results of the four previous phases, the proposal of articulation for the city of Bogota of the service of rickshaw with the massive transport system Transmilenio is presented and some conditions for the optimal implementation of the intermodal connection are indicated.

## 3. Results and Discussion

The analysis and results are presented below according to the methodology of 5 phases of this investigation.

*3.1. Phase 1**. Offer:** georeferencing of the Transmilenio system and points where the Bicitaxi works in Bogotá*

Currently, the Transmilenio system has 112.9 km of trunk road in operation, 11 trunk lines in operation, 134 stations, 9 portals and 9 patio garages. In addition, the System has 16 cycle parking garages with 3578 seats in total. Safe, comfortable and easily accessible spaces for all people who use the bicycle as a formal transportation alternative for daily mobility. In the different terminals that are held, the following are counted: Portal Suba, Portal Eldorado, Portal Americas, Portal Sur, Portal de la 80, Portal 20 de julio, San Mateo (outside Bogotá in the municipality of Soacha), Bicentenario, Ricaurte, Pradera, Marseille, Mundo Aventura, Bandera, Av. Rojas, Quinta Paredes and

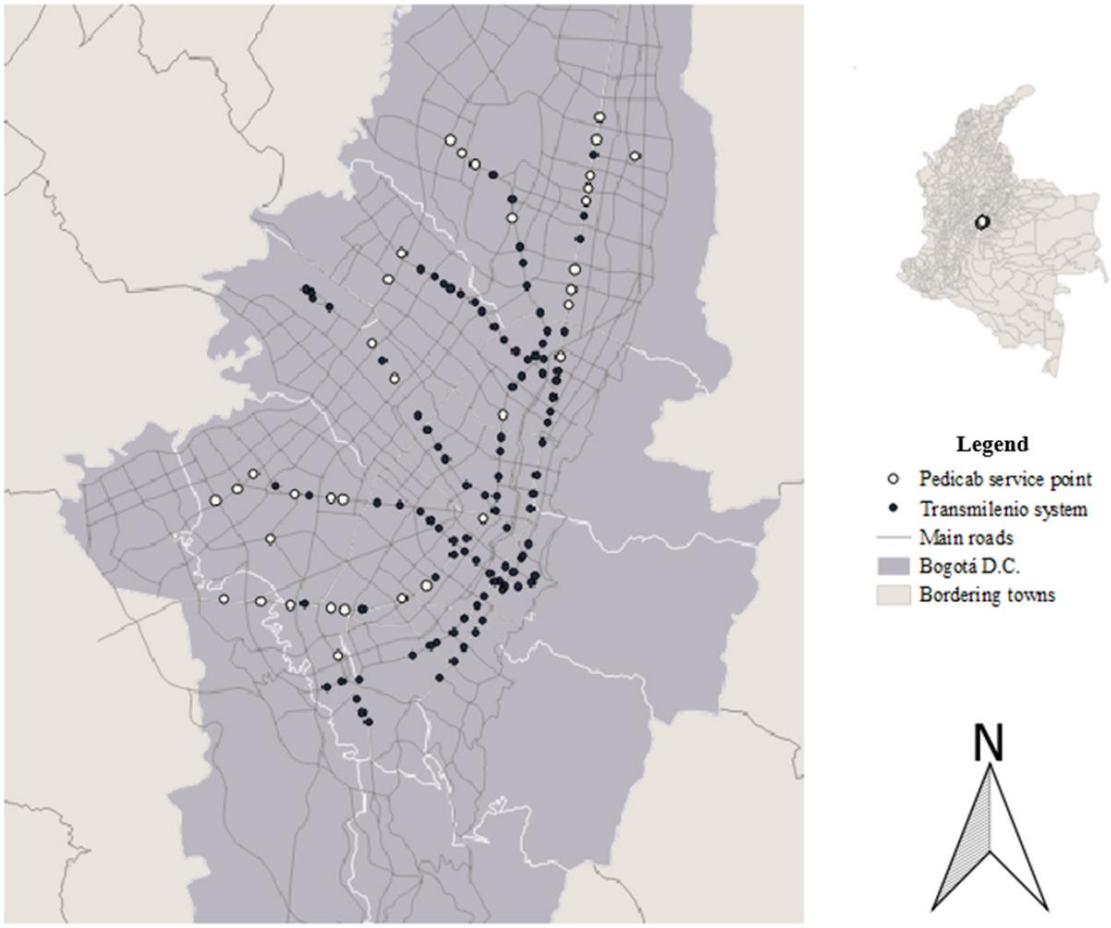
General Santader. This system allows to solve the long trips of the city, nevertheless it does not solve the short trips (Transmilenio S.A., 2013)

The short trips are understood as First-last mile trips, that is a term used in supply chain management and transportation planning to describe the movement of people and goods from a transportation hub to a final destination in the home. (Mineta Transportation Institute, 2009)

First-last mile have been used to describe the difficulty in getting people from a transportation hub, especially railway stations, bus depots, and ferry slips, to their final destination. When users have difficulty getting from their location to a transportation network, the scenario may alternatively be known as the "first mile problem".

It can be seen in Figure 2 that 39 points of operation of the pedicabs are located near stations or portals of the Transmilenio system, this is a clear sign of the importance acquired by bicitaxism for those short trips (last mile) that they are not covered by the system. (Ojeda, C., 2013)

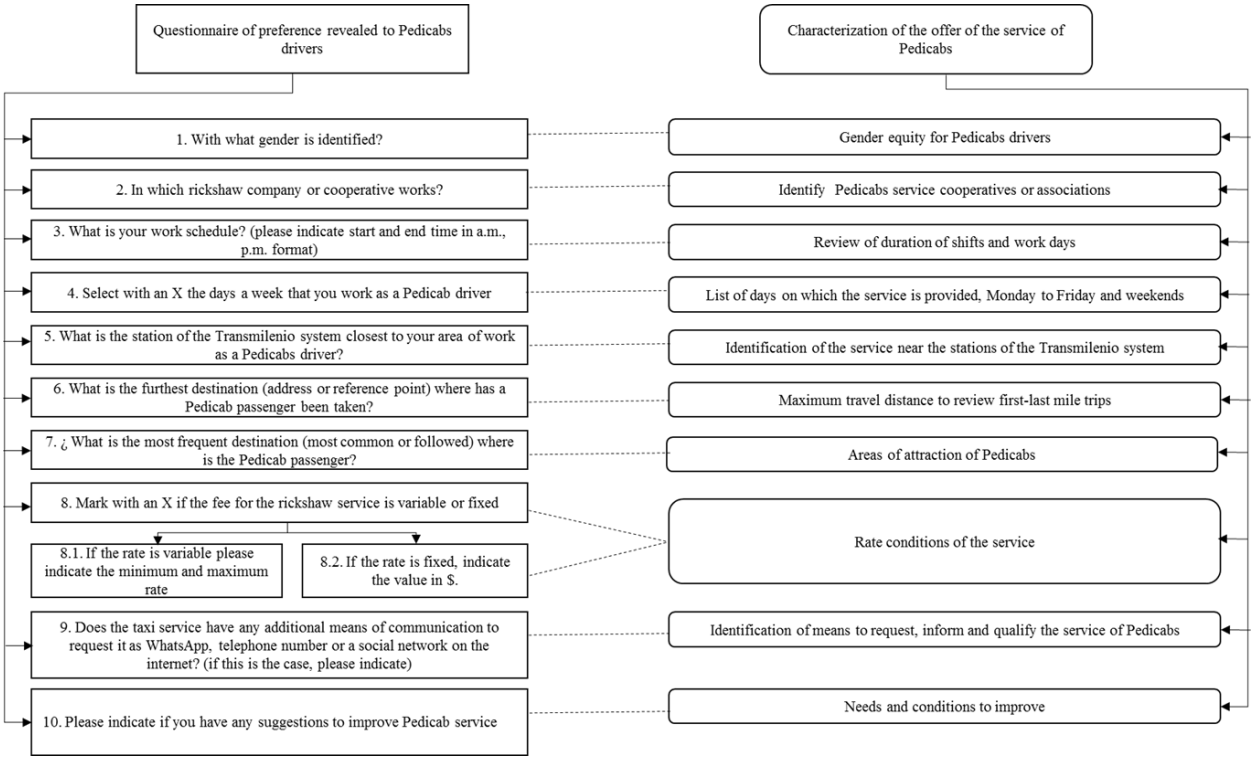
Fig 2. Map of the Transmilenio system and pedicabs areas




Source: Own elaboration from QGIS software

A face-to-face survey of revealed preference was conducted with ten (10) questions to have a characterization of the offer of the Bicitaxi service in Bogotá. In Figure 3, a scheme of the objective that each question was presented in the questionnaire made to rickshaw drivers is presented.

Fig 3. Revealed preference survey and characterization of the offer of the pedicabs




It was found that in terms of gender, 100% of the people who dedicate themselves to this work are men, also 2 types of associations of Bicitaxistas were identified, the first in which these are owners of their vehicles and the second in which a only one person has many vehicles and rents them, the hours of attention vary between 6:00 and 22:00, the Pedicab service operates from Monday to Sunday, however on Sundays the number of drivers who work decreases. On average it was found that the maximum distance of the trips is 1.5 to 2 km around the main point of operation, as far as the rate was found it is variable and depends on the distance traveled. The way to take the service of Pedicab is done in the street in a simple way without making use of any particular mechanism or technology.

### *3.2. Phase 2* ***Demand:*** *characterization of users of Bicitaxi and the Transmilenio system*

The average for a typical April business day, 2,459,437 users entered the system in the three phases of the trunk component plus the dual component of the seventh race; The 25.11% of the entrances are concentrated in the nine (9) portals and the 16.45% in ten (10) stations considered of the highest demand, achieving altogether 42% of the validations (Transmilenio S.A., 2018). That is to say, of the 139 stations and 9 total portals of the Transmilenio system, the 9 portals and 10 stations concentrate more than 40% of the demand of the system, therefore, they were points of study in this investigation to identify if they have or not of informal rickshaw service as evidenced in Table 1.

Table 1. Transmilenio service points with the highest demand

| Terminal or Station | Entries registered on a typical business day | Pedicabs Point |
|---|---|---|
| Américas Terminal | 95615 | Yes |
| North Terminal | 93279 | Yes |
| Street 80 Terminal | 81751 | Yes |
| Suba Terminal | 74704 | Yes |
| South Terminal | 67485 | Yes |
| El Dorado Terminal | 60476 | Yes |
| Usme Terminal | 53285 | No |
| Tunal Terminal | 50458 | Yes |
| 20th July Terminal | 38667 | No |
| San Mateo Station | 56378 | It is part of the municipality of Soacha |
| Banderas Station | 47366 | Yes |
| Street 100 Station | 45605 | No |
| Jimenez Avenue Station | 39849 | No |
| 72 Street Station | 39695 | No |
| Marly Station | 38595 | No |
| 63 Street Station | 38210 | No |
| 45 Street Station | 34354 | No |
| Alcalá Station | 31688 | Yes |
| Toberín Station | 31673 | Yes |

### *3.3. Phase 3* ***Diagnosis****: Pedicabs service conditions*

The pedicab service at this time is an informal public transport service, however, it has been a subject of study in recent years for the city of Bogotá as evidenced in Table 2.

Table 2. Comparison of research about pedicab service in Bogotá

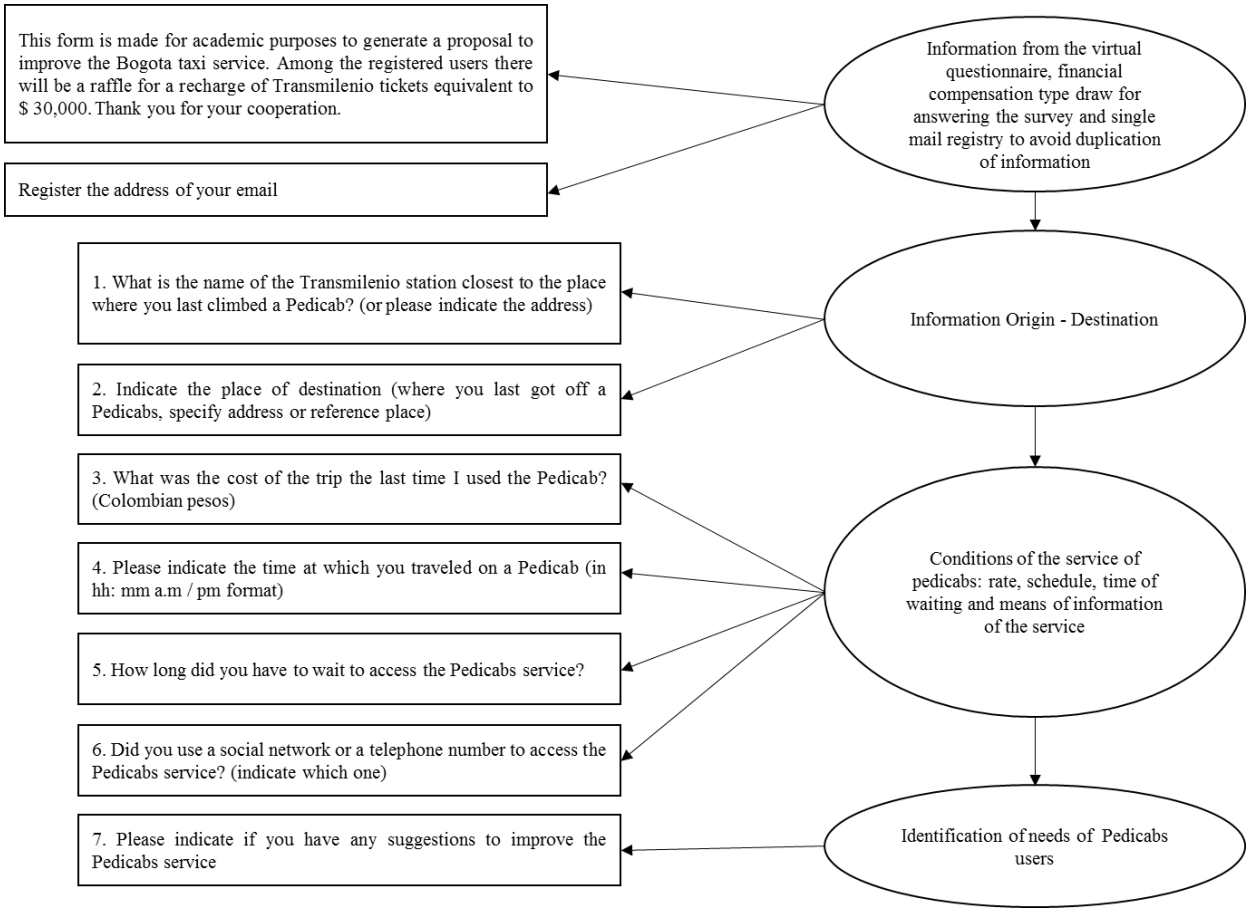
| Research year | 2013 | 2014 | 2016 |
|---|---|---|---|
| Zone | Bogotá | Kennedy districts of Bogotá. | Kennedy, Usaquén and Suba districts of Bogotá |
| Information collected | Census of the drivers of Bicitaxi and inventory of vehicles that operate (pedicabs) in the city of Bogotá D.C. | Surveys to users and drivers of pedicabs | Surveys to users and drivers of pedicabs |

| | | | |
|---|---|---|---|
| Results | • In the city of Bogotá D.C., 3054 people are employed as rickshaw drivers.<br>• There are 3477 tricimobiles that are used to provide the informal rickshaw service. | • Users use the rickshaw (59.11%) for time saving and 25.26% due to crime in the area.<br>• 94% of users surveyed use the service from Monday to Friday and 6% on weekends.<br>• Trips on an average of 2.1 km.<br>• 61% of trips are 1 km and cost between 500-1000 Colombian pesos, 31% between 1 km and 2 km cost between 1000-2000 Colombian pesos and 8 % more than 2 km for 2000. | • Average passengers transported ranges between 15 and 200, which indicates that income ranges from 20,000 to 100,000 Colombian pesos per day.<br>• 94% of the drivers of pedicabs do not own the vehicle, therefore they must cancel a value for the rent from 15,000 to 52,000 Colombian pesos daily. |

Source: Own elaboration from (Secretaria Distrital de Movilidad, 2013) (Morales et al, 2014) (Suárez Garzón, 2016)

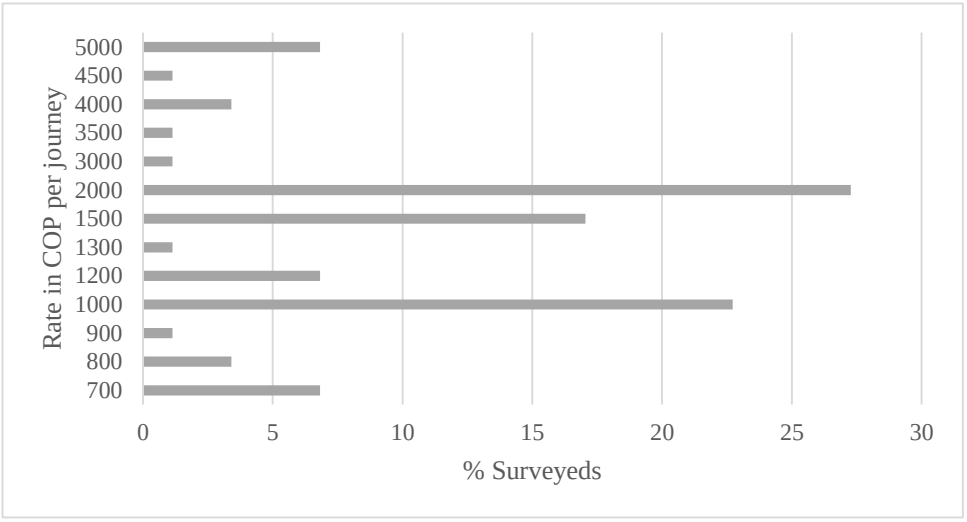
The informal pedicab service currently in Bogotá has operating conditions that were identified according to the response of users in the virtual revealed preference survey. In addition, this information was analyzed according to a field review of service points. Then, in figure 4, on the left side, each question of the questionnaire made in virtual form and the information of the draw for a recharge of Transmilenio passages to those who answered the survey, in parallel, on the right side of the figure specified the objectives of the survey design.

Fig. 4 Characterization and demand of the pedicab service



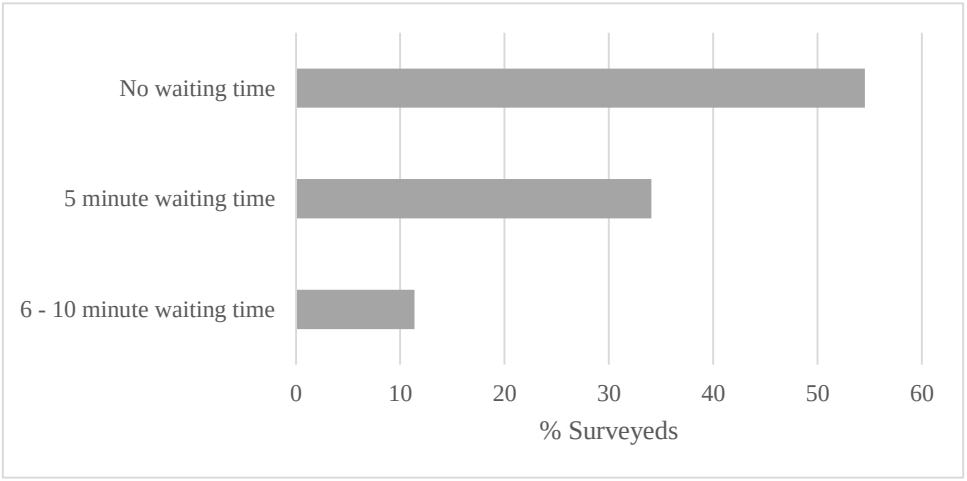

The tariff analysis is fundamental to know the characteristics of a possible fare integration between the pedicab service and the Transmilenio system. Therefore, as shown in figure 5, more than 70% of respondents paid between 1,000 and 2,000 Colombian pesos for a pedicab service. It is important to know that currently the Transmilenio ticket has a cost of 2300 Colombian pesos, equivalent to 0.69 euros or 0.80 american dollar.

Fig. 5 Pedicab tariff according to user survey




The wait time to access the pedicab service was analyzed to understand the options that users of modes of transport have, for example, if waiting for a pedicab exceeds ten minutes, it is preferable to travel first-last mile on foot. In Figure 6, 80% of the respondents did not have to wait to access the service or wait less than 5 minutes.

Fig. 6 Wait time according to user survey




*3.4. Phase 4* ***Analysis:*** *coverage of the Transmilenio system in travel first-last mile*

The informal origin of the neighborhoods of Bogotá, the lack of planning in the accommodation of the population as a result of the motivation of permanent mobility to the peripheral sector of the city as a consequence of the construction of housing projects of social interest (with its effects on the insufficiency of formal public transport to cover the demand), the characteristics of the equipment and the urban structure in the peripheral zones were the determining factors for the phenomenon of Pedicabs to emerge and for it to settle on the territory.

The mobility planning policies of the city of Bogotá have focused on long-distance travel, while short-distance trips or First-last mile have not had the importance they deserve, so a transport system that can provide a solution has not been designed. These issues are especially acute in the Bogotá where land-use patterns have moved more jobs and

people to lower-density suburbs that are often not within walking distance to existing public transportation options. Therefore, transit use in these areas is often less practical. (Ramírez J., 2010)

Traditional solutions to the first mile problem in public transit have included the use of feeder buses, bicycling infrastructure, and urban planning reform. Other methods of alleviating the last mile problem such as bicycle sharing systems, car sharing programs, pod cars (personal rapid transit ), and motorized shoes have been proposed with varying degrees of adoption. In Bogota the Pedicab appeared spontaneously to cover the demand for trips in areas far from stations and terminals, where there are also problems because the demand exceeds the available supply of feeder routes and available SITP buses. Also, currently there is the possibility of doing a free transfer within a 90-minute window from Transmilenio to feeder buses and SITP buses, however, due to the congestion and dynamics of Bogotá, many times the users, especially from the periphery, do not manage to make the transfer, so a change to a vehicle to complete in its last mile trip represents a high additional cost, hence the importance of raising Pedicabs with fare integration with Transmilenio.

### *3.5. Phase 5* ***Proposal:*** *articulation characteristics of the Bicitaxi with the Transmilenio system*

The Table 2 shows that the number of cities in which the pedicab is used exclusively as a mode of transport is lower, on the contrary, it is mostly for tourist use and design, fare, use and legality conditions that are compared then.

Table 2 Situation of Pedicabs in some cities of the world

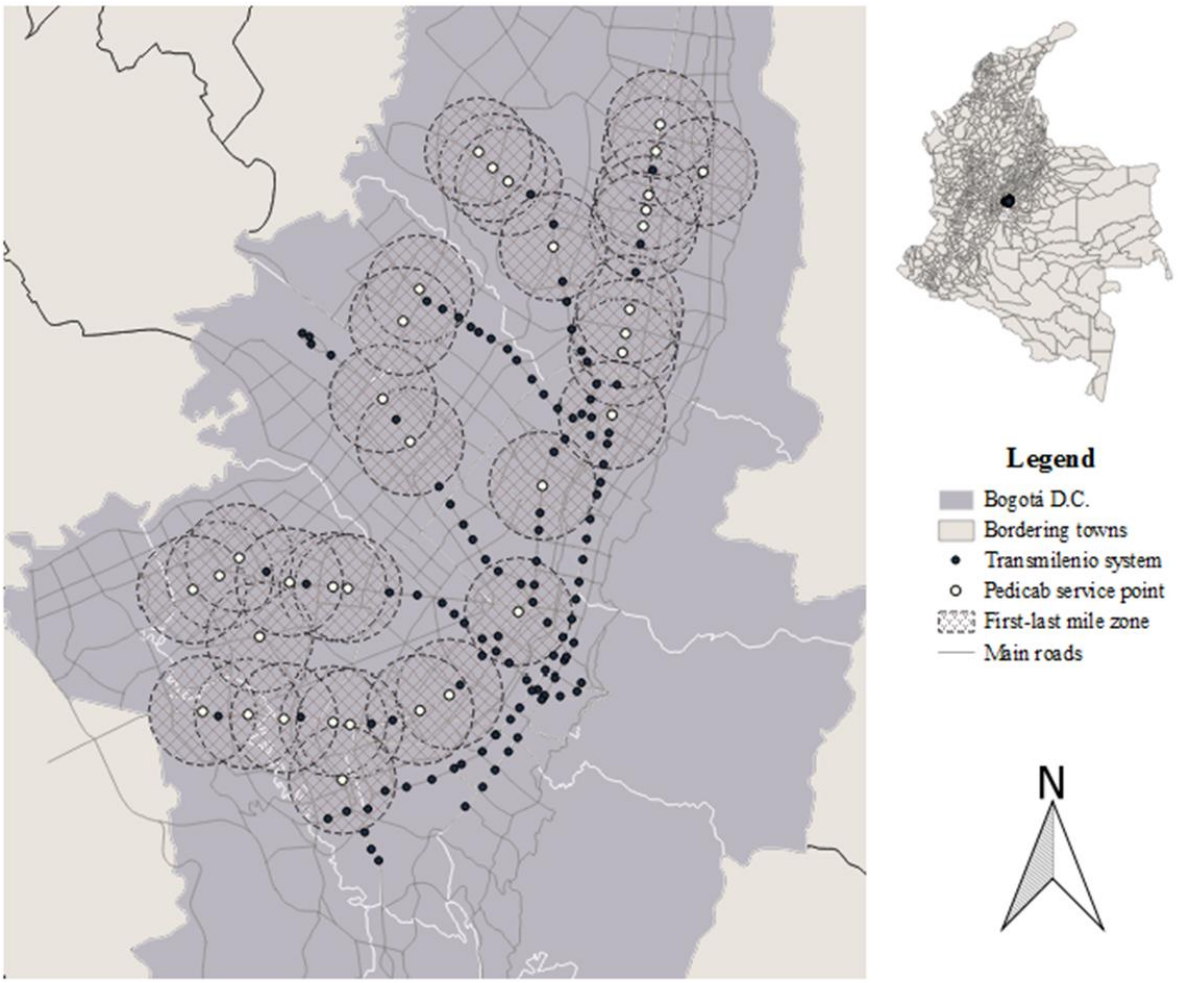
| City | Country | Name | Characteristics | Main Use | intermodal Conexion | Desing |
|---|---|---|---|---|---|---|
| Toronto | Cánada | Ecocab | Rechargeable electric battery | Tourism | Disconnected |  |
| New York | EE.UU. | Pedicab | Fee regulation bill. Operation hours are 9:00 am to 9:00 pm everyday of the year. | Tourism and public transport, | Disconnected |  |
| Bogotá D.C. | Colombia | Bicitaxi | Bill for regulation. They exist with and without motor. | Public transport | Disconnected |  |
| Beijing | China | Rickshaw | Rate for tourists | Tourism | Disconnected |  |
| Londres | England | “Bicitaxi” or pedicab | Driver must have a level three certification issued by the CTC (The National Cycling Charity) | For promotion of advertising campaigns and tourism | Disconnected |  |

| | | | | | | |
|---|---|---|---|---|---|---|
| Dehli | India | Cycle rickshaws | No legalized and drivers without a license | Public transport | Disconnected |  |
| Barcelona | Spain | Trixi | It has a digital communication platform between clients and collaborators | Tourism | Disconnected |  |
| Berlin | Germany | Velotaxi-fahren | With the velotaxi system as an advertising and events business strategy | Publicidad y eventos | Disconnected |  |

Source: Own elaboration from (Mercado, 2012) (Tavera, Manrique, & Martín, 2014) (Benavides & Delgado, 2016) (Trixi Barcelona, 2018) (Velotaxi Deutschland, 2018) (EcoCab Toronto, 2018) (New York Pedicab services, 2018)

The territorial approach of the intermodal system Pedicabs - Transmilenio is taken out considering the firs mile last, a distance of 1.5 Km around of Transmilenio point (station or terminal). In the Figure 7, it is evident.

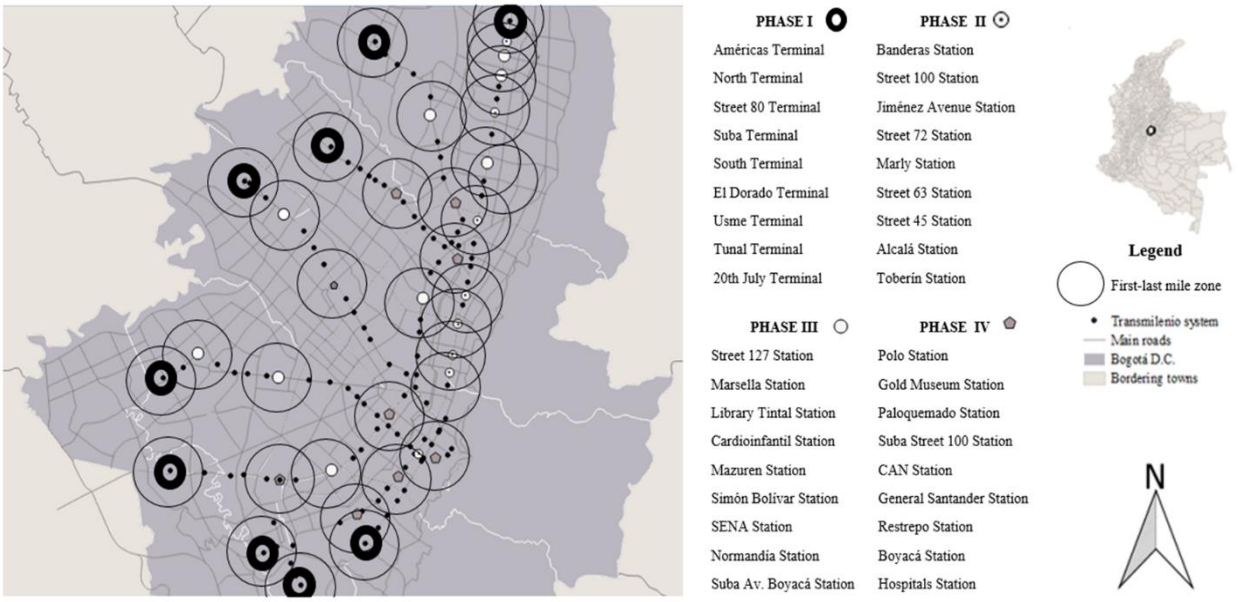
Fig 7. Map of the Transmilenio system and pedicabs first las mile areas




Source: Own elaboration from QGIS software

Finally, a sistems of pedicabs is proposed in 4 phases of implementation as is showeb by the Figure 8. Phase I is to implement the Pedicab as a feeder mode in the 9 portals of the system, phase II refers to the 9 stations with the highest demand or entries registered by the Transmilenio system, the next phase is recommended in 9 stations where the Pedicab currently operates informally and according to respondents are the points that are in greatest demand. Finally, a phase IV is recommended with 9 stations identified as areas of travel attraction for shopping, tourism and intermediate connectivity with the stations of phases I. II and III. The figure 6 shows the locations of the proposal and the distribution of the respective firs-last mile journeys.

Fig 8. Map of the Transmilenio system and pedicabs




Source: Own elaboration from QGIS software

## 4. Guidelines or recommendations

It is recommended for Bogota a vehicle model such as the ones implemented in Toronto, Berlin and Barcelona and the non-motorized sea for the trips of the first and last mile and without terrain slopes. Also, because Bogotá has peripheral areas with slopes; it is the opportunity to generate research in designs of electric vehicles such as solar energy systems. (Srdjan, Mulhall, & Emadi, 2008).

Multimodal integration of the Transmilenio system with the pedicab service is necessary due to the 39 informal service points identified in this investigation. It is suggested in the intermediate points indicated in figure 8 to avoid oversupply and coverage with equitable distribution in the system. The above, because the discussion so far has demonstrated that private NMVs (like bicycles) and NMPT (Non-motorized Public Transport like cycle-rickshaws and rickshaw vans) are not a substitute for motorized public transport. Instead, they are complementary and partially overlapping modes of transport. Each has unique strengths and weaknesses. In combination, they offer strong potential competition to private motorized transport for variable trip dimensions in developing cities of the world. Therefore, instead of enforcing policies to eliminate non-motorized modes, more attention should be paid to the integration of motorized and non-motorized modes, such as encouraging bicycle and cycle-rickshaw as access modes to express transit services for longer distance trips (Rahman, D´este, & Bunker, 2008)

## 5. Conclusion

The Pedicabs demonstrates how a non-motorized mode of transport can meet an unmet demand for short trips or first-last mile, for which mobility has evidently never been planned. Since the mobility planning policies of the city of Bogotá have concentrated on long-distance travel, while those of short distance have not had the importance they deserve, so a transportation system that manages to give solution to this is very necessary.

As a result of the analyzes carried out in the present case study, it was found that the informal origin of the neighborhoods, the lack of planning in the accommodation of the population as a result of the motivation of permanent mobility to the sector as a consequence of the construction of projects of housing of social interest (with its consequences in the insufficiency of formal public transport to cover the demand), the characteristics of the equipment and the urban structure in the study area were the determining factors for the phenomenon of bicitaxism to arise and

to settle about the territory.

In this sense, if the pedicabs as an informal mode of transportation, have now been able to spontaneously resolve the first-last mile trips, the system proposed in this article represents a possibility of improving mobility in Bogotá. he implementation to supply the conditions of greater supply-demand of the service of pedicabs and Transmilenio is advisable to do it in phases with the stations suggested in this investigation around the system, with conditions that meet the needs of road safety in vehicles, the articulation with the regulations which is projected by the Ministry of Transportation of Colombia, tariff integration, citizen identity and communication with the user.

## 6. Acknowedgements

To the Pedicab drivers of Bogota and to the users of the Pedicab and Transmilenio, who through their answers to the surveys made possible the characterization of the supply and demand of the Pedicabs.

## 7. References

Benavides, J. A., & Delgado, P. L. (2016). *Evaluación de los comnportamientos ambientales en la prestación del servicio de bicitaxis para la ruta Balmoral-Galicia en la loclaidad de CIudad Bolivar.* Bogotá D.C.: Universidad Distrital Francisco José de Caldas.

Bogotá, S. G. (10 de Diciembre de 2012). PROYECTO DE ACUERDO 260 DE 2012. Bogotá.

Carvajal, N. G. (19 de Diciembre de 2014). Bicitaxismo: Cerca de la legalización. *El Tiempo*.

EcoCab Toronto. (23 de Marzo de 2018). *EcoCab Tours Toronto* . Obtenido de http://www.ecocabtours.com/

Mercado Velandia, C. J. (2012). Viabilidad Técnica y financiera de la utilización de bicitaxi como medio de transporte público en el marco del Sistema Integrado de Transporte Público en Bogotá D.C:. Bogotá: Universidad Nacional de Colombia.

Mercado, C. (2012). *Viabilidad Técnica y Financiera de la Utilización del Bicitaxi como medio de transporte público en el marco del Sistema Integrado de Transporte Público en Bogotá D.C.* Bogotá: Universidad Nacional de Colombia.

Mineta Transportation Institute. (2009). *Using Bicycles for the First and Last Mile of a Commute.* San José: College of Business, San José State University.

Morales , R., Mellado, W., Garavito, S., Mancipe, J., Mariño , M., Martinez, M., & Orozco, A. (2014). Socio-technical analysis of bicitaxismo in Kennedy (Bogotá D.C.) Cases estudies: Patio Bonito and Margaritas. *memorias congreso internacional d ei ngenieria civil de la Universidad Santo Thomas Tunja*, 1-16.

New York Pedicab services. (23 de Marzo de 2018). *newyorkpedicabservices*. Obtenido de http://newyorkpedicabservices.com/

Ojeda, C. (2013). Metodología para la implementación de un SIG de bicitaxis en Bogotá. *Universidad San Francisco de Quito*, http://goo.gl/fX8R4y.

Rahman, M. M., D´este, G., & Bunker, J. (2008). Problems and prospects of non-motorized public transport integration in developing cities. *30th Conference of the Australian Institutes of Transport Research*, 2-19.

Rahman, M. S.-U. (2013). *Integrating BRT with Rickshaws in Developing Cities: A Case Study on Dhaka City, Bangladesh.* Dhaka: The University of Leeds, Institute for Transport Studies (ITS).

Ramírez J. (2010). Análisis Jurídico y Social Del "Bici-Taxi" Como Servicio de Transporte Público en el Distrito de Bogotá Durante El 2009 – 2010. *Universidad Militar Nueva Granada*, http://repository.unimilitar.edu.co/bitstream/10654/3538/2/RamirezMoraJuanPablo2010.pdf.

Reyes, J. M. (18 de Abril de 2016). El pulso por los bicitaxis en Bogotá. *Publímetro*.

Secretaria Distrital de Movilidad. (2013). *Cemso de la población que trabaja prestando el servicio informal de transporte a la comunidad "bicitaxista" y el inventario de cada uno de los vehiculos de operan (bicitaxi) en la ciudad de Bogota D.C.* Bogotá D.C,: Alcaldía Mayor de Bogotá.

Srdjan, L., Mulhall, P., & Emadi, A. (2008). Energy Autonomous Solar/ battery auto Ricksaw. *Journal of Asian Electric Vehicules. Volume 8. Number 2.*, 1135-1143.

Sreehari, M. (2012). *Multi Modal Transport Integration for Sustainable Development – Experience from Indian City*

*with Vietnam City*. Vietnam: Proceedings of International Conference on Advances in Architecture and Civil Engineering.

Suárez Garzón, M. (2016). Bicitaxismo, Nueva alternativa de trabajo de ayuda al medio ambiente y la movilidad en Bogotá. 1-210. Bogotá: Universidad Santo Tomás.

Tavera, J., Manrique, O., & Martín, H. (Septiembre de 2014). REFERENTES DEL BICITAXISMO EN EL ORDEN INTERNACIONAL: ¿un modelo de transporte altamente demandado, un medio de subsistencia, una forma de vida o un foco de desorden y congestión vehicular? *Investigaciones y productos CID*(23). Obtenido de http://www.fcenew.unal.edu.co/publicaciones/images/inv-productos-cid-23.pdf

Transmilenio S.A. (21 de Agosto de 2013). Obtenido de http://www.transmilenio.gov.co/Publicaciones/la_entidad/nuestra_entidad/Historia

Transmilenio S.A. (2018). *TRansmilenio en cifras, estadísticas de oferta y demanda del Sistema Integrado de Transporte Público.* Bogotá D.C.: Alcaldía Mayor de Bogotá.

Trixi Barcelona. (20 de Marzo de 2018). *Movilidad ECO CITY*. Obtenido de www.movilidadecocity.com

Velandia, C. (2012). *Viabilidad Técnica y Financiera de la Utilización del Bicitaxi como medio de transporte público en el marco del Sistema Integrado de Transporte Público en Bogotá D.C.* Bogotà: Universidad Nacional de Colombia.

Velotaxi Deutschland. (22 de marzo de 2018). *www.velotaxi.de*. Obtenido de http://www.velotaxi.de/

*Viabilidad Técnica y Financiera de la Utilización del Bicitaxi como medio de transporte público en el marco del Sistema Integrado de Transporte Público en Bogotá D.C.* . (2012). Bogotà: Universidad Nacional de Colombia.