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Towards multi-modal integrated mobility systems: Views from Panama City and Barranquilla

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ABSTRACT

This paper undertakes the assessment of the bus transport systems of two port cities in the Caribbean, the BRT system *Transmetro* in Barranquilla, and *Metrobus*, a 'light' BRT system, in Panama City. Although the systems have different contexts, design and operational characteristics, they have in common that over the last years their service quality has deteriorated, leading to negative users' perception and consequently decrease in patronage levels. Understanding these problematic factors is key for the mobility of these cities as they are both planning to expand their systems and consolidate multi-modal integrated transport systems in the upcoming years. Through a series of interviews with several stakeholders from institutions related to the mobility sector in each city our analysis identifies aspects of conceptual design, planning and implementation of institutional, operational, financial and management frameworks that might have been preventing the systems from achieving a better performance. Moreover, our analysis highlights two factors embedded at the core of the systems' difficulties: First, BRT technology transfer with limited understanding of context and little adaptation to local user's expectations and preferences; and second, design criteria that address financial requirements at the expense of quality of service for people's needs.

1. Introduction

Like many other Latin American cities Barranquilla (Colombia) and Panama City (Panama) have implemented new bus systems designed to transform existing inefficient bus systems into modern systems with new institutional, operational and physical characteristics (Hidalgo & Carrigan, 2010). The new systems being considered here are a Bus Rapid Transit system for Barranquilla and a 'light' BRT for the case of Panama. These aimed to provide sustainable urban transport by addressing the problems created by the existing traditional public transport services – private buses with low quality of service, high externalities, including high traffic accident rates and pollution caused by poor maintenance and old vehicles, resulting from the incentive structures associated with competition in the market and the 'penny war' (Estache & Gómez-lobo, 2005).

In both cities the systems started operation in 2010 and, although under very different contexts, by the end of 2014 both bus systems were facing great operational challenges that resulted in decreasing ridership and negative perception of the service from the users and general population. Both cities have plans to address the observed difficulties including, among other measures, the development of integrated multimodal citywide transport systems that promote the complementarity of existing transport modes. This paper presents the operational difficulties that the systems in both cities have been experiencing. In the following section the paper describes briefly a framework for conceptualizing BRT or Integrated transport systems which presents the criteria that is considered for assessing the Barranquilla and Panama City systems. Section 3 and 4 present the transport conditions previous to the implementation of the BRT system in each city and the current situation and challenges. The challenges described here emerged on a series of interviews conducted with the main stakeholder institutions from the mobility sector in each of the cities in mid-2014. The selection of the interviewed organizations aimed to be comprehensive and considered all organizations involved in the mobility from different sectors and government levels. However, user's groups or representatives from civil society might be under represented. Appendix 1 presents the summary of the stakeholders involved in these

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interviews. The paper ends with the cities' strategies to move forward, a discussion of main lessons learnt and critical factors to consider for the development of the multimodal integrated transport systems.

2. General framework for conceptualizing integrated transport systems

Existing literature provides highly detailed guidelines for the physical design of BRT systems; comprehensive planning guides and manual such as "BRT Planning Guide (3rd edit.)" (Wright & Hook, 2007) and "The BRT Standard" (ITDP, 2014) provide description on how to design physical elements, more specific documents have covered safety or universal accessibility considerations for planning and design (Rickert, 2011), or evaluated conditions to improve capacity (Barker et al., 2003; Hidalgo, Lleras, & Hernandez, 2013), among others. The conceptual framework presented on this paper builds on the available literature and defines general conceptual guidelines for key areas that need to be considered when planning, implementing and operating a bus rapid transit or an integrated transport system. As presented in Fig. 1 the framework for the conceptual design has two large components: i) physical elements and ii) 'soft' elements. The case studies will present a brief description of the physical characteristics of the systems and will primarily focus on the 'soft elements' criteria defined in Fig. 2 because of their relevance for Barranquilla and Panama City.

3. Description of Barranquilla BRT system

3.1. Barranquilla general characteristics and urban configuration

Historically, Barranquilla is a city that was not founded, but that emerged as a result of commercial activity. Barranquilla's Metropolitan Area (AMB) comprises 5 municipalities (Soledad, Malambo, Puerto Colon, Barranquilla y Galapa). The total population of the metropolitan area is 1.8 million inhabitants, with the two largest populations located in Barranquilla (1.2 million) and Soledad (around 650.000) which is contiguous with Barranquilla (DANE, 2005). Soledad is the 7th municipality in terms of population in the country and its population is mainly of low income.

From the perspective of the economic activity in the city, the role of the AMB is very relevant as 40% of the distribution and logistics centres are or will be based on the other 4 municipalities outside Barranquilla. The overriding vision of those municipalities is to have heavy industries. Hence it is important to guarantee good connectivity between municipalities and between residential and industrial areas. However coordinating this public transport provision is complex because each municipality of the Metropolitan Area has its own mayor and land-use plan. Moreover, the transport routes operating between municipalities are the responsibility of the Ministry of Transport. Perhaps, due to that complexity, until now the connectivity needs of outskirt industries workers have been addressed by their own company through private transport routes. Nonetheless, the city wants to position itself as a port city in which the industrial and trading activity is dominant, but also as a sustainable and attractive city to live in (Findeter, 2014). As part of this transformative aspiration the city is currently turning its face back towards the river, after decades of neglect of this resource. In this context, the pier will be transformed into a touristic area and the passenger transport service in the city should be able to serve this purpose. This city vision imposes a great challenge for the transport system in the city because the industrial activity requires considerations regarding freight and logistics, whereas the commuting needs of workers and travel needs of tourists demand adequate levels of urban passenger mobility and urban design that promotes quality of life. Hence, the need to formulate a multimodal integrated transport system.

3.2. Barranquilla's public transport characteristics

Barranquilla is a dense city (around 8000 inhabitants per km^2) with a diversity of land uses. The public transport modal share, including traditional buses, Transmetro (BRT) and informal services

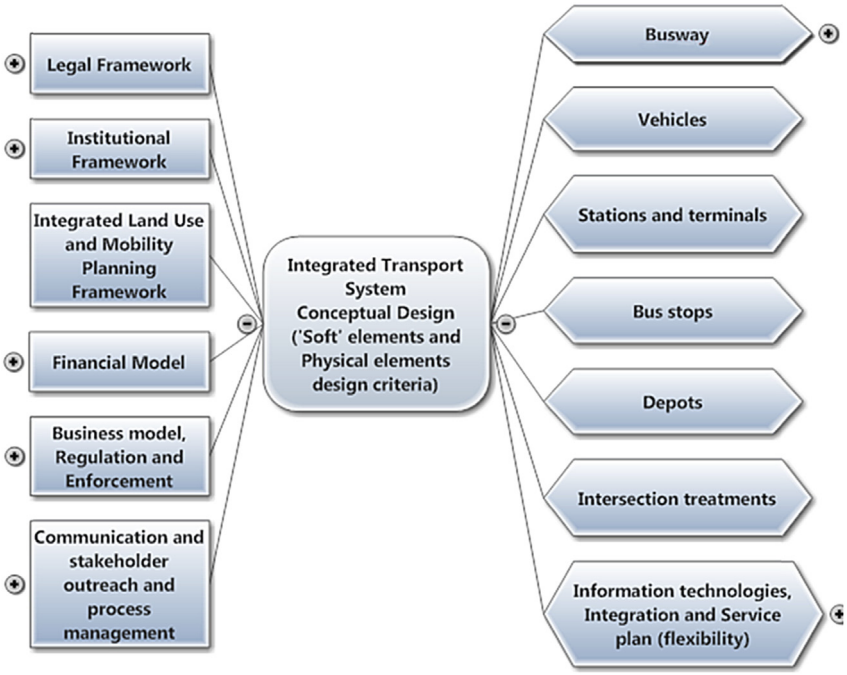

Fig. 1. General framework for the conceptual design of BRT and Integrated Transport Systems.

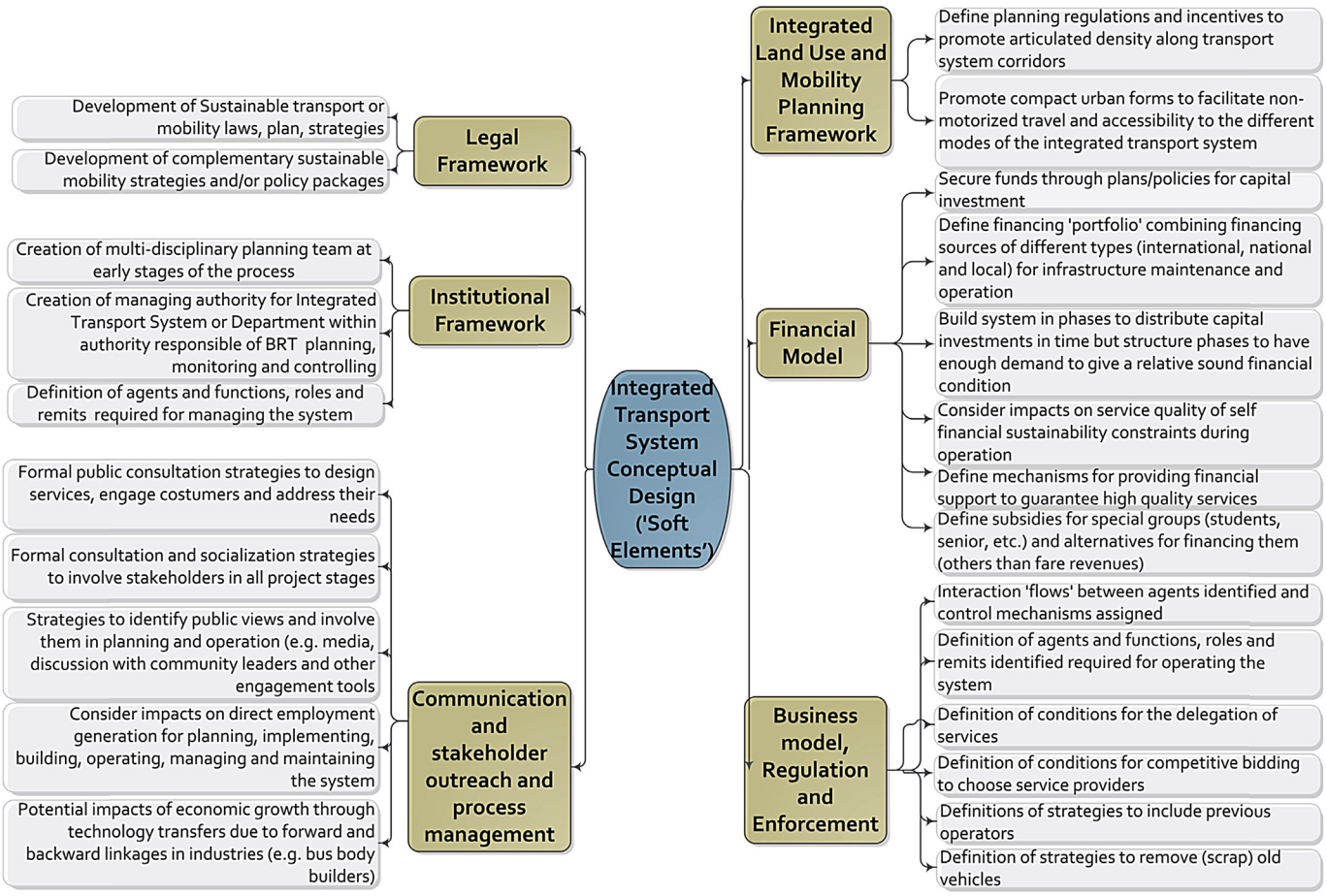

Fig. 2. Soft Elements for the conceptual design of BRT or Integrated Transport Systems. Source: Authors based on Hidalgo et al. (2013), ITDP (2014), Wright and Hook (2007), Warren and Ortegon-Sanchez (2016) and Wrigth et al. (2011).

is around 50.2% of the total 2.2 million daily trips, with the BRT accounting in 2013 for 50 thousand or 2.25% of the daily trips. Non-motorized trips account for 31.2% of the demand (96% of which are walking) and the remaining 18% corresponds to car (5.84%), taxi (5.11%), motorcycle (3.48%) and other modes (TPD-EPYPSA, 2012). Walking accessibility in the city is considered in the legislation and to some extent is viable due to the characteristics of the road network (dense grid) but there is a gap between regulation, practice and policy implementation and although walking share is very high the quality of the pedestrian environments is poor in the majority of the metropolitan area. An example of this is the use of sidewalks as parking areas, which, combined with the high ambient temperatures, makes walking conditions in the city very rough and almost completely inaccessible for people with special needs (Fig. 4). Although there is knowledge and consensus on the importance of providing pavements for pedestrian mobility not many measures have been applied due to weak enforcement and high political costs. Because all trips begin and end with a walk segment, all of these factors result in a detriment of the overall perception of the transport system in terms of 'door-to-door' trips. Public spaces and green areas, which are key parts of the walking environments in the city are also an issue, with less than 1 m^2 of such space per inhabitant on average, which is scarce specially compared to the World Health Organization suggested optimal value of 10–15 m^2 per inhabitant (Brebbia, Hernandez, & Tiezzi, 2010). More importantly a marked inequality of green space access between higher income and lower income population (ranging from 2.98 m^2 per inhabitant to 0.47 m^2 per inhabitant respectively) has been observed (Findeter, 2014).

3.2.1. *Barranquilla's BRT system*

Barranquilla's BRT system, Transmetro, was implemented in April 2010. The service was provided for free during the first 4 months after which the regular fare of COP 1700 (approx 0.78 USD) was charged. As presented in Fig. 3, the system started operation with 2 segregated trunk corridors, Olaya with a length of 4.5 km and Murillo with 9.5 km (SIBRT, 2015), 1 terminal station and 15 regular stations with high platforms for level boarding and off-board payment before entering the station, which is a closed paid-zone. With 18 trunk-feeder services the system was mobilizing daily 30,000 passengers in the last months of 2010 and continued to increase its ridership levels to 90,000 in 2011 reaching a maximum of 120,000 in 2012. However, due to operational difficulties and lack of resources for maintenance the operational fleet was reduced and the patronage decreased to around 77,000 passengers daily in mid-2013 but returned to a daily average of 115,000 passengers at the end of the year after some measures were taken (DNP, 2013).

3.2.2. *Institutional framework*

The management of the different transport modes and services in the metropolitan area is dispersed between several institutions from different government levels (local, municipal, metropolitan and national). The roles and remits of the different sectorial agencies are defined in legislation documents but in practice the distinction is not clear. Area Metropolitana de Barranquilla (AMB) is an administrative entity created to be the only agency in charge of public transport regulation, legislation, route layout, supervision

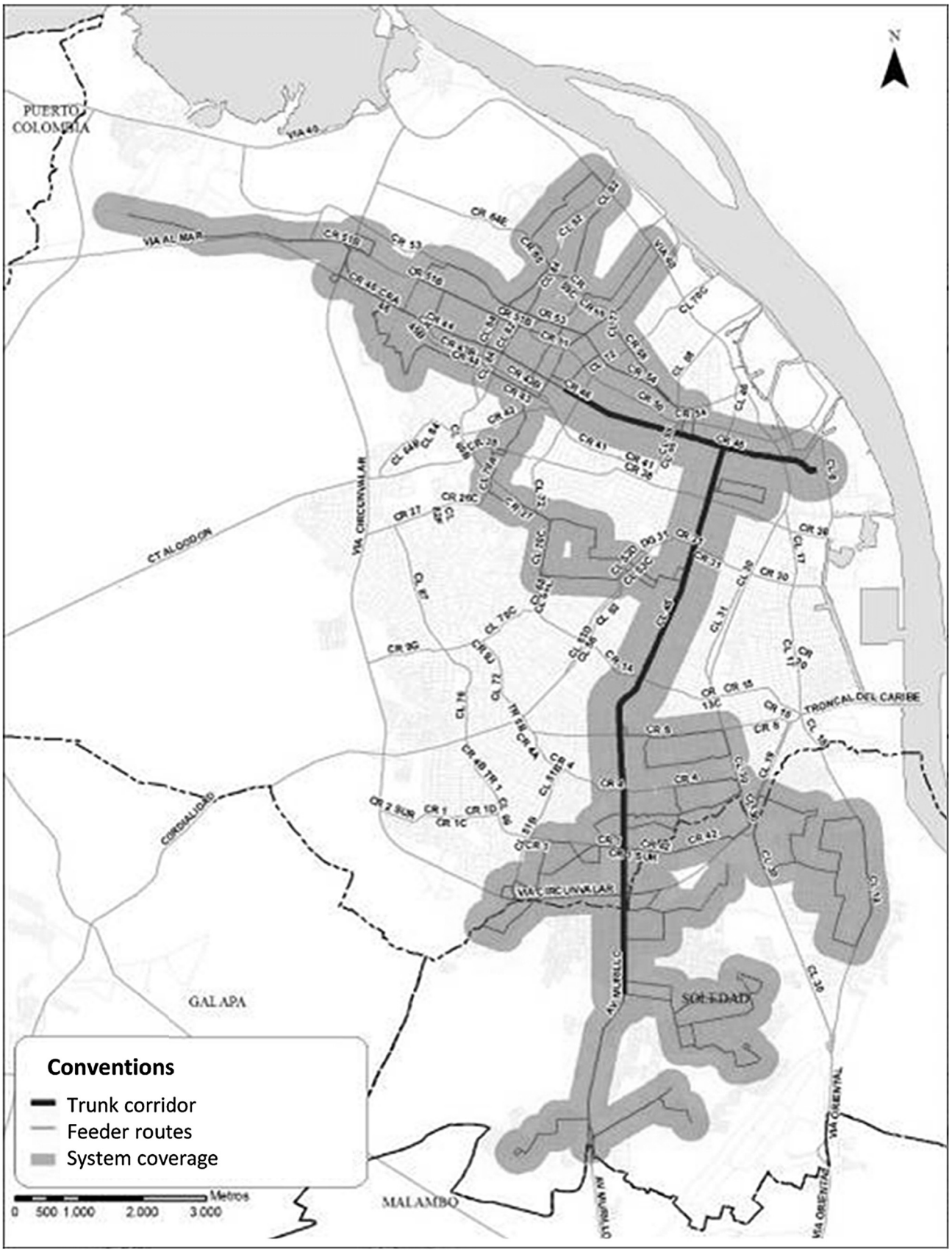

Fig. 3. Transmetro Barranquilla. Trunk corridors and feeder routes coverage (UT GSD-Moviconsul, 2013).

Fig. 4. Transmetro Barranquilla bus stop. Source: Authors.

and control; however its technical capacity (and the size of the team) is limited. Hence, the Mobility Secretariat (SdM) gives support on technical aspects, together with the Municipal Institute of Traffic and Transport is in charge of individual public transport. Transmetro S.A. is the managing body of the BRT system (Integrated Massive Public Transport System or SITM for its name in Spanish). The BRT system is operated through contracts by 2 private concessionaires (UT Sistur Transurbanos S.A. (Sistur) and Grupo Empresarial Metrocaribe S.A. (Metrocaribe) which provide 60% and 40% of the fleet, respectively). In addition, the company Recaudo SIT Barranquilla S.A, was selected to be the technology operator and fare collector. Another 2 concessionaires where hired to develop complementary infrastructure such as garages and terminal stations. The BRT system currently only provides service to 2 of the 5 municipalities (Barranquilla and Soledad). The national Ministry of Transport authorizes and controls the routes between municipalities which are supposed to operate from terminal to terminal, but, given the difficulty for the Ministry for controlling operations from Bogota, these services operate similarly to the traditional transport. Finally, ANALTRA is the association in charge of protecting the interests of transport operators. This association acts as a very strong stakeholder as 18 operators are affiliated to ANALTRA and 24 of the 26 traditional transport operators have shares in the firms operating the BRT. Fig. 5 gives a schematic representation of the agents.

The institutional framework design that allowed the implementation of Transmetro changed years of inertia and poor executive capacity due to high levels of corruption and inefficiency. Around the same time other institutions like the SdM, were also restructured at the managerial and operational level as part of the development plan of the Mayor Alejandro Chard. Consequently, the institutional and technical capacity of the entities was improved and continues to be improved, partly, due to the link between the universities and the public sector institutions. The Universities (Universidad del Norte and Universidad de la Costa) have facilitated the strengthening of institutional and technical capacity through the provision of taught and research programmes related to transport planning, resilience of mobility systems, freight and logistics, among others which have trained professionals that after finishing their degrees go to work in the mobility sector agencies. Universities also participate as technical advisers for the definition of planning documents such as the Land-use plan.

As a result of the new institutional framework changes were also observed at the 'bottom-up' scale as better institutions and completed projects showed citizens that it was possible to realize plans. This resulted in an increasing interest within the community to engage and demand public actions from politicians to solve their problems. As mentioned in Section 3.1, the municipality of Barranquilla comprises five "Boroughs" (Localidades), each one with its own local mayor. This structure might require decentralization for planning of activities and budget allocation. However, decentralization at the Borough level still raises concerns about corruption.

3.2.3. *Land-use and mobility planning instruments*

High level guidelines from the National Government and specifications for projects and budget allocation come from the Transport Ministry, the National Planning Department and the Finance Ministry through laws or other planning documents. At the metropolitan level Barranquilla has developed the Master Mobility Plan and at a more local scale the Plan for the Renovation of the Historic centre of the municipality of Barranquilla.[2] The Master Mobility Plan defines a planning horizon for the city and sets priorities such as: i) modal integration, ii) changes in operators' structure (e.g. service delegation by zones), iii) fleet renewal, iv) changes to road network (e.g "circunvalar de la prosperidad", radial rings and express ways) and v) green corridors to increase the city's walkability. More recently a bidding process for the design of the Integrated Public Transport System (SITP) was held. The consultancy's work will be reviewed and controlled by Transmetro S.A., AMB and SdM.

Regarding Land-Use, each of the 5 municipalities of the metropolitan area has its own plan, making integrated land-use and mobility planning very difficult. Recently the municipality of Barranquilla defined its **Land-Use Plan**, which establishes concepts for the city vision for 2032. The city is still very new in the management of public consultation strategies and studies could be better socialized and agreed with the community. Nevertheless, the plan was presented for public consultation and agents like Universidad del Norte were part of the team involved in its production.

3.2.4. *Current challenges for Barranquilla's BRT system*

3.2.4.1. Institutional framework. Despite the improvements, institutionally the BRT system has many capacity issues as its managerial body, Transmetro S.A, is perceived as a private, not a public, institution, neither by the citizens nor by other public sector institutions (including the police force) which limits collaborative work. Transmetro S.A has many responsibilities such as to plan the system's operation and manage infrastructure investments, but not enough technical or financial capacity to address them. The BRT system is supposed to keep expanding whilst traditional transport routes are restructured and reduced, however operation of conventional transport is still in a favoured position, compared to the BRT, because they assume less operation costs (no payment for use of infrastructure, lack of vehicle maintenance, informal working conditions for drivers and long working hours, among others). Tension between the BRT system and the traditional buses keeps increasing (despite the fact that they are the same companies) as operators suggest that they are losing money in both businesses. Although, in theory the AMB is responsible for public transport in the city, its technical capacity and regulation mechanisms are limited so SdM is in charge of the restructuring. Although, many of the traditional buses still operate on a deregulated market under

[2] The Master Mobility Plan for the Municipality of Barranquilla was financed by the Administration (Distrito Especial, Industrial y Portuario de Barranquilla) and developed by an spanish – colombian consultancy (EPYPSA – TPD). The plan's extension, to cover the Metropolitan area, was hired by the Area Metropolitana de Barranquilla – AMB, and financed by CAF, Development Bank of Latin America (the same consultancy made that work).

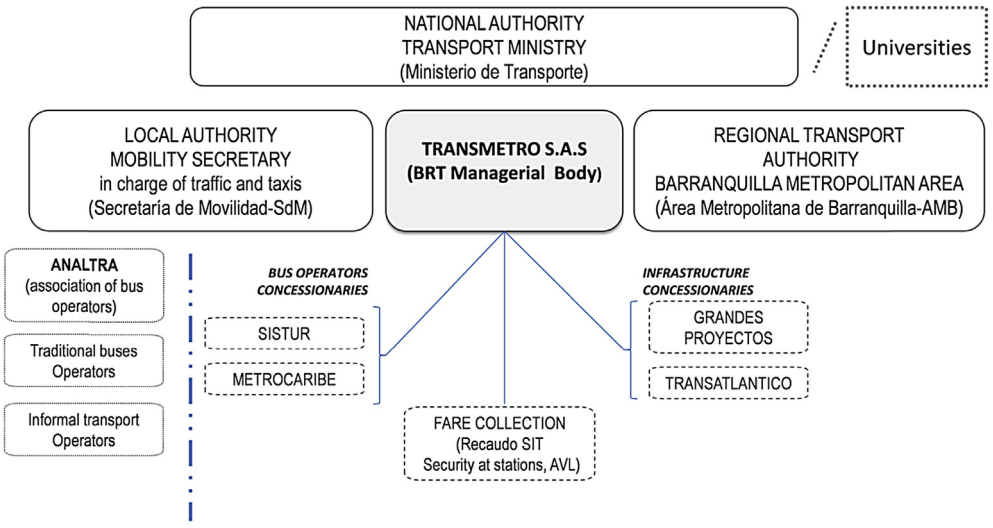

Fig. 5. Mobility sector agents. Source: Author based on Gomez (2015).

the 'penny war', the structure of the conventional system has evolved and multiple conventional bus operators have organized themselves into a semi-unified agent.

The quality of the BRT system services has deteriorated not only because of operational issues but also because in many cases the informal transport operators vandalise the system (e.g. throwing stones at the feeder buses) which decreases further the quality of the service and the safety perception. Transmetro's many difficulties have been publicised constantly by the media. In consequence, the long term sustainable transport vision for the city loses credibility day by day. As an alternative communication strategy, Transmetro S.A is using technology and other channels such as social networks and twitter feeds for allowing users to express their complaints.

3.2.4.2. Financial model. The initial financial commitments were not enough to complete the required infrastructure. Only 1 of the 2 main stations was built. One of the garages-workshop needed for operation (Plataforma Soledad) is 98% completed and the other (Barranquilla) is only 33% completed. Moreover, 2.2 kms of trunk corridor are still to be completed. To compensate the lack of resources for initial capital investment the financial model relied heavily on fare box revenue, and hence on demand, as presented in Fig. 6, 9% of the fare revenue was destined to capital investment in infrastructure and another 9% to old bus scrapping and only the remaining percentage to covering operation costs. However, demand levels were far lower than expected as the breakeven point was defined based on performance data from larger cities in the country for 330,000 passengers but the system's maximum has been 120,000 with only 80,000 passengers travelling as of mid-2014. The system has been operating in deficit from the start. Moreover, from the bus operators' perspective, the operational planning done by Transmetro S.A inhibits them from reducing operating costs because they have to supply the buses required to follow a timetable. The operators argue that the system is operating inefficiently because it offers low supply, low frequencies, excessive waiting times (15 min) and it has excessive dead miles (many buses returning empty) and routes which are too long. Consequently, people in the city have no interest in using the BRT system. Evasion is increasing and it needs to be controlled, especially because operators are currently receiving only near 60% of the value per passenger that was estimated in the bid. The fare structure stipulated that the payment was dependent on distance but because of the system's crises the payment has instead been linked to the number of passengers. The operators state that for them it would be preferable that the compensation was estimated as a function of cost-km.

Transmetro S.A regards the system as falling into an "operation trap" – analogous to a poverty trap – in which the financial model, the fare structure and the low patronage levels limit the available financial resources to pay for the service to bus operators and to the fare collection agent. This results in lack of incentives and means to maintain buses, which leads to vehicle and service deterioration with less frequent services, overcrowding in the remaining buses, and decreases in ridership which further lower the system's revenue, creating a vicious cycle as presented in Fig. 6. From the fare collector agent perspective, less resources result in less provision of points for buying or charging the electronic tickets and security staff being removed from the stations.

Demand reductions are increasingly critical because as the quality of Transmetro decreases, informality has found an opportunity for capturing a demand that is unsatisfied with the service – moto-taxis in the peripheral neighbourhoods and colectivo taxis in the inner city – compete directly with trunk services for a slightly higher fare than Transmetro, trying to capture passengers in the vicinity of stations, offering a service without waiting, door to door, more comfortable and with air conditioning. This informal service might be perceived by users as of better quality but it has negative externalities for the city in terms of increased congestion and emissions per passenger. Especially considering that there is an oversupply of taxis in the city with 1 taxi for every 200 inhabitants and, including the supply that comes from other municipalities, the city has more than 20,000 taxis operating. These are all looking for a market and this is provided, albeit unintentionally, by Transmetro S.A. as a result of the rundown of its bus services.

4. Description of Panama BRT system

4.1. Panama City general characteristics and urban configuration

The city's geographic shape is elongated with contrasting densities in different areas and disconnected neighbourhoods. The Panama City Metropolitan Area (PCMA) comprises four districts: Panama, San Miguelito, Arraijan and Chorrera. The existing urban form is, to some extent, a consequence of the design of roads for cars, and, as a result given that the road network follows a leaf-like structure, the city has permanent congestion on the main corridors.

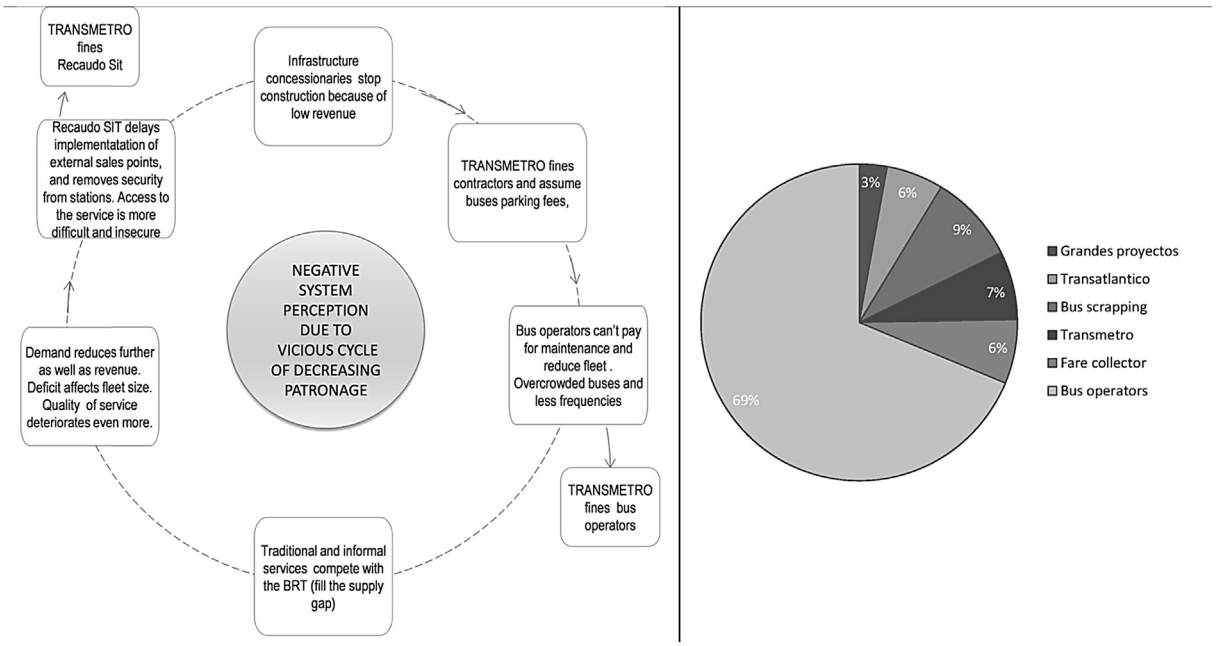

Fig. 6. Operational vicious cycle and fare structure. Source: Author based on Gomez (2015).

Nonetheless, the city mobility experts acknowledge that flyovers for thousands of vehicles are not the solution.

The city is growing at 2% per annum, which is a lower rate than has been observed during the urban expansion of the last 40 years. The growth is concentrated in the city's outskirts where growth rates are between 4% and 7% or on the city centre where the city is going through a sort of gentrification process. The new developments of the city are two very contrasting types of developments. The informal settlements are individual two-floor houses whereas in other areas very high rise development is taking place. However, more than half of the city's employment is still in the city centre, which creates travel patterns that concentrate all trips in few areas of the city. Employment centres like Tocumen, which is a logistics area and other development areas such as Panamá pacífico are also rising as important trips attractor or generators but without land-use and transport integrated planning. To promote construction in the city urban regulations were changed and tax exemptions for all developments in the city were approved for 20 years. Through that strategy the financial centre was developed and this pulled the development of other office and residential buildings. Therefore the city does not have a floor-area ratio policy and the regulation allows 1000 housing units (5000 people) per Hectare.

4.1.1. Panama City public transport characteristics

Through Metrobus, better quality buses have replaced part of the more than 1800 old iconic, highly polluting, individually-owned and completely deregulated “Diablos Rojos”. Some of the bus services have been restructured (although most of the route layouts were preserved). However, the new Metrobus system is not specifically a BRT in the sense that it does not fully operate as a high capacity system. Metrobus buses do not operate on segregated lanes and there are no paid-zones for all the stations (ticket validation is done mainly on-board). The restructuring of the system was mostly in relation to soft elements such as the characteristics of the bus operators and the business model for service delegation. Hence, a professionalized bus operator, Mibus, was selected to run the bus services through operation contracts. Metrobus services are operated by bus drivers hired by Mibus through formal contracts with strict conditions regarding working hours and social benefits and with incentives to improve their performance through productivity bonuses. These changes improved the public bus transport system; however, road infrastructure improvements or segregated lanes, needed to ensure reasonable bus operation speeds, were not provided. Specific conditions of Panama City road network, such as toll highways add another level of complexity to Metrobus operating conditions. Metrobus buses are allowed to use the toll corridors but they still need to pay the toll which make the fare higher, and although users experience higher speeds and time savings in the highway these are lost at the tolls, which act as bottlenecks. Metrobus system operates with a fleet of 1236 buses, more than 300 routes and 10,000 services mobilizing around 710,000 passengers a day (MiBus, 2014). Fig. 7 presents the complete coverage of the routes in the system and Fig. 8 Line 1 of the metro system. The system operates with six garages.

In addition existing road capacity is limited by an increasing number of private vehicles. The amount of car traffic is growing drastically in Panama. The exact motorization rate and modal share is unknown but it is believed that in 2012 there were 522,792 vehicles in the city. It is estimated that the fleet size has increased by more than 90,000 vehicles, with 2013 and 2014 showing the highest car sales in the last decade, which suggests an approximate figure of 350 vehicles per 1000 inhabitants. Moreover, users' perception of congestion levels, especially of car users is not too negative and once the works for Metro Line 1 were finished, the traffic conditions improved in comparison to the previous situation. ANAM, the relevant environmental authority, thinks that there is an issue with car use culture because the population is growing and young professionals aspire to own a car because it is perceived as a symbol of progress. The need for a more efficient use of cars has not been identified (no car-pooling, or car sharing initiatives). In relation to the use of non-motorized transport modes and increasing the use of public transport, ANAM considers that cycle-ways are available in the old town but not in other areas – where perhaps there is a greater need. Because of the hot weather, re-engineering of roads, pavements and cycle-ways to include functional “green infrastructure” for cooling effects is needed to promote the use of these modes.

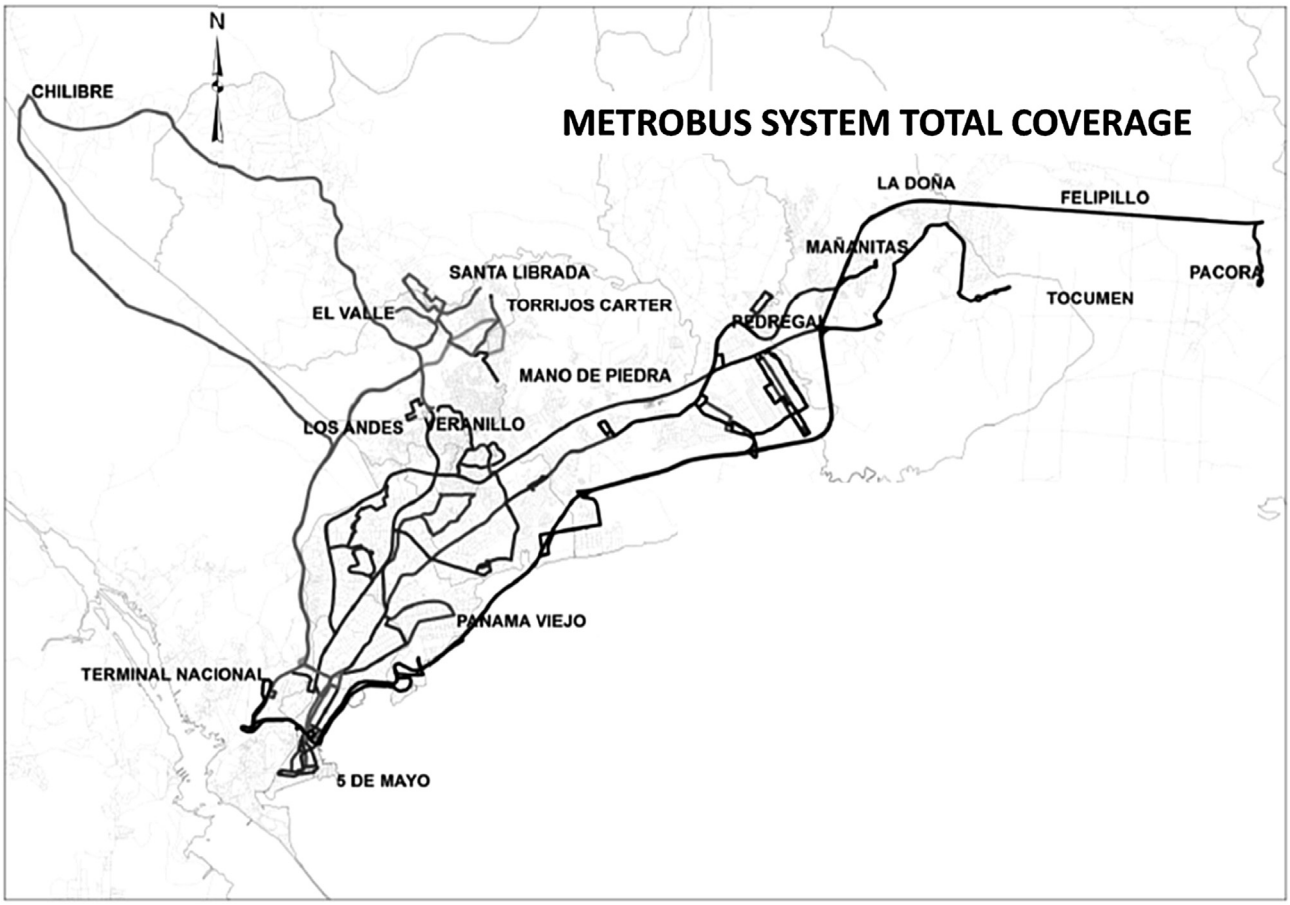

Fig. 7. Metrobus system total coverage (Montañez & Roa, 2014).

There are still traditional bus services or "Pirate bus services" operated by companies that only affiliate buses and their services still operate under "penny war" schemes, competing in the market, on the street, for passengers and getting their revenue depending on the number of passengers they transport. Pirate services are considered illegal because although they have licence plates, they do not have operation permits.

To compensate for the negative environmental effect of high traffic levels there has been plenty of promotion of the use of renewable energies and biofuels. In 2007 the legislation for biofuels was defined and fuel quality was improved by adding ethanol (currently 5%). Metrobus buses have had positive environmental impacts because of their Euro III technology. However, because of the low quality of fuels (high sulphur content in gasoline) there are still negative consequences both for health and vehicle performance. Nonetheless, noise pollution and "black clouds" from smog from old buses have been reduced.

4.1.2. Institutional framework

Unlike other BRT systems in Latin America, Metrobus does not have an independent managerial authority. The management of the bus system is one of the functions of the Surface Traffic and Transport Authority (Autoridad de Tránsito y Transporte Terrestre – ATTT). The ATTT has technical oversight of the entire road network but the Corredores (toll roads) are operated by the National Company of Highways.[3] The transport authority ATTT was created under Goals Secretariat (Secretaría de Metas) from the National Government. The architecture of the authority was defined as an initiative from the Metro Secretariat (Secretaría del Metro) and the President. The development of the authority has been related to the decentralization process. The ATTT has two big directorates: Traffic and road safety and Urban Mobility. The Ministry of Government chairs the ATTT board but ATTT is an autonomous authority – and the managerial body of Metrobus. For the time being the Ministry is giving support on specific issues related with the bus system operator (Mibus) in the city. Metrobus services are provided by three concessions: i) EUPAN, responsible for paid-zone modules and typical bus stop shelters, ii) SONDA, in charge of the system's financial administration and managing of electronic ticketing including access control to buses and paid-zones and iii) Mibus, responsible for the design, planning, implementation and control of the bus operations. For the integration of existing services communication with other national and local agents takes place. Fig. 9 shows the agents involved.

4.1.3. Land-use and mobility planning instruments

In terms of planning instruments the Mayor has defined a Development Plan and has consolidated the Secretaría de Planeación (Planning Secretariat) which is in charge of having a global vision for the city that integrates different levels and that consolidates capabilities for the future. The Secretaría de Planeación is also in charge of coordinating the different Land Use Plans (of different geopolitical levels) of the city. There is a Metropolitan Plan that is being revised and updated and MIVIOT (Ministry of Housing and Land-Use Planning) generated Land Use

[3] A concessionary working for the National Government and with operation contract with the Ministry of Public Works.

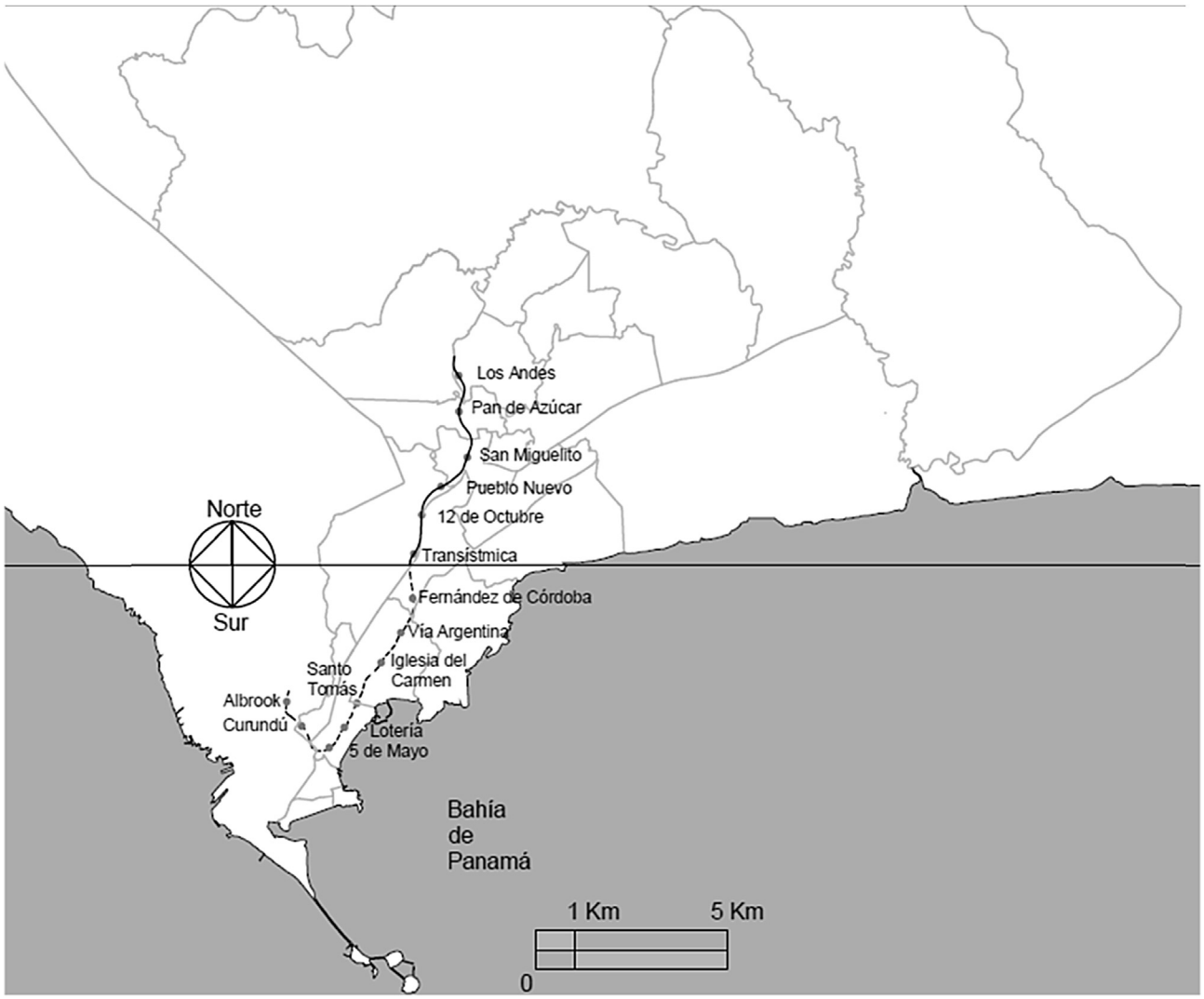

Fig. 8. First metro line and stations.

Plans for the municipality of Panama (indicators level) and partial "village" plans (investments level) which at the moment are not articulated with the urban dynamic of the metropolitan area. An integrated plan of sustainable urban mobility (Plan Integrado de Movilidad Urbana Sostenible – PIMUS) was under development at the time of the interviews (July 2014).

4.1.4. Current challenges for Panama City's BRT system

4.1.4.1. Institutional framework. On the initial design it was estimated that the system required 7 garages to operate, but not all of them were in operation. Only a few of the system's stations are enabled to have closed 'paid-zones', but they have reached capacity and are saturated. Many of the stakeholders interviewed for this research believed that the observed flaws were consequences of the bidding process which was done in a rush causing that many design criteria were not adapted to local context, 'because of inertia more than anything else'.

Regarding, road infrastructure, buses operate in mixed traffic, without priority, and because route layouts were kept unaltered from the previous system, routes are long and travel times are high which has an impact on the importance of finding a place to sit as people do not want to travel for hours standing in the bus (on average, the travel time in rush hour is more than 70 min) (MiBus, 2014). A consultancy evaluated the possible implementation of "contra-flow" lanes for public transport. In theory this should be viable and should not have great implications in terms of safety because people are already familiar with that sort of measure. However, giving a lane for public transport during certain hours of the day represents a conflict of interest for the National Highways Company in charge of operating the toll highway concession because their business depends on the number of vehicles using the road. A lane dedicated to public transport means less vehicles on the road and, therefore, less revenue. In general, it is difficult to consider providing an exclusive lane for the bus system without actually providing one extra lane (therefore not reducing capacity for the private vehicles). Moreover, because the bus system does not have an explicit "managerial body" it is difficult to create the spaces for high level discussions to advocate explicitly for Metrobus interests.

The ATTT is Metrobus managerial authority but does not have enough technical capacity to manage the system so it is supported by the Metro Secretariat. However, the incentives on the service delegation contracts are not aligned to make the system perform well. For example for the revenue collector the number of passengers is not relevant, as the fare is subsidised, nonetheless it is the agent responsible for evasion control. Metrobus operates in the metropolitan region, but the future of Mibus as the operator of the bus system is not clear as both ATTT and the city government are very disappointed with the outcomes of the system so far. ATTT

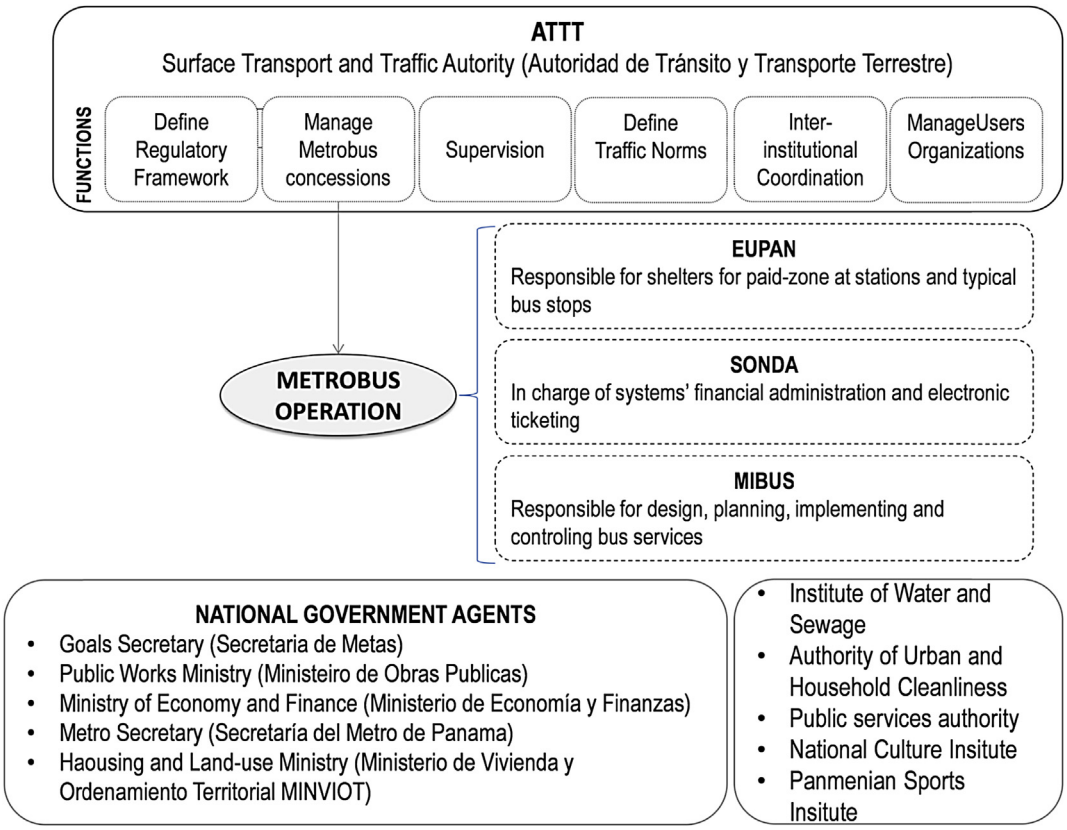

Fig. 9. Mobility sector agents in Panama. Source: Author based on Montañez and Roa (2014).

authorized conventional parallel services to prevent people waiting for 2 h for a Metrobus bus. However, the service provided by those buses has several difficulties including high accident rates due to the penny war. This weak institutional coordination can create further difficulties and unintended consequences in the context of fast development of transport infrastructure projects which could lead to bad planning and poor implementation (e.g. increase of informal unauthorized services).

4.1.4.2. Business model, regulation and enforcement. For the bidding process bus occupancy and fleet size for operation was designed to make the system financially self-sustainable. Under that constraint the fare had to be USD 0.62 per passenger. However, the government does not want to change the fares so the service has been subsidised. Consequently, fares have been kept at USD 0.25 (A taxi service can cost up to USD 1.5 per person) and fleet size has not been adjusted to provide service levels that address users' preferences.

Mibus believes that the service parameters, specifically occupancy rates were not defined consistently with the preferences of the Panamanian users. 5 passengers per square metre for a total of 85 passengers (30 seated, 55 standing). However, it has been observed that users perceive a bus with occupancy of about 60 passengers as full, so they do not board it. Timetables are set to provide services with an average waiting time of 15 min; however people wait for up to 5 buses so that they can find a seat, showing that users are willing to trade more than 30 min of waiting time for a seat.[4] Furthermore, the operational arrangement of Metrobus created a **"Cultural shock"** going from a system (Diablos rojos) in which by law standing passengers were not allowed to one that requires the majority of passengers per bus to be standing. Although Mibus expressed the need to restructure the contracts, ATTT's approach for addressing Metrobus' difficulties was to authorize parallel services. This measure resulted in a decrease in Metrobus patronage of approximately 100,000 passengers that shifted to the alternative service. The contract for the bidding process estimated a demand of 710,000 passengers per day but in practice, by mid-2014, the system was moving 600,000.

5. Addressing difficulties

5.1. Barranquilla: towards an integrated multimodal transport system

5.1.1. Financial model

An action plan for improving Transmetro has been outlined and is being developed. The short term strategy includes relieving the financial pressure from the fare by agreeing with the local government the financing of bus scrapping and part of the infrastructure investment. The national government will also co-finance investment in infrastructure. A total of COP 187.711 million (41% from national government and 59% from local government) will be invested to complete the infrastructure and rolling stock for Transmetro (El Heraldo, 2013). This will release 18% of fare revenue to be reinvested in the operation of the system to improve the quality of the system in aspects like fleet entailment. Improving the performance of Transmetro and its image is key for the future integrated public transport system because the BRT will be the mass transport component of the system.

[4] This suggests that the value that users give to seated travel is higher than the perceived cost of waiting time which challenges the transport planning theory that assigns higher cost to walking and waiting times.

5.1.2. Institutional framework

In Barranquilla, the Integrated Public Transport System (detailed design planned to be commissioned in 2014), will be called RITMO and it will be operated at the Metropolitan scale by the AMB with the support of SdM and Transmetro S.A. This will require further restructuring of existing transport routes. Although in theory AMB would be the authority in charge of the RITMO, it is possible that further arrangements to coordinate functions and capabilities between Transmetro S.A and SdM might be needed. Some institutional coordination exists at the moment as Transmetro S.A board of directors includes SdM but further improvement of the communication between the agencies would be useful, which perhaps could be facilitated by sharing the same building for their offices.

5.1.3. Business model, regulation and enforcement

The conventional buses operators have already adopted a "unified fare box approach" but without electronic payment. Revenue from each trip is collected at the end of the route and at the end of the day is added up and divided proportionally to the number of trips. For the future Integrated Transport the delegation scheme will be by operation zones and operators have stated that they are willing to provide the service to achieve quality standards as long as they can plan the services. The operators think that in order to attract passengers the integrated transport system needs to (1) be more similar to the traditional transport system in terms of frequencies, (2) be better promoted, (3) have a strong marketing component, and (4) facilitate access by having more top-up points for recharging the electronic tickets (currently there is an agreement with only one of the supermarkets in the city). However, operators do not think that the studies commissioned by the SdM for the restructuring of services are reliable, which still shows lack of articulation between the initiatives of the Mobility sector authorities and these operators.

5.1.4. Communications and users' outreach

More importantly, for thinking about the future the city is aware of the need to re-understand the argument that gave birth to the BRT systems in the country: for example in issues such as the long-term socio economic impact or sustainable mobility objectives. Moreover, the negative changes in people's behaviour and perception of sustainable mobility due to the system's deteriorated image need to be transformed. Together with investments in hard infrastructure and engineering, investment in education, civic culture and enforcement is needed. Improving compliance with the pedestrian crossings, shared space, traffic signals is a matter of culture as much of engineering and good built environment design. It is also important to find mechanisms to get the private sector (as individuals and institutions) to contribute to the overall process (i.e. respecting the fact that footways are for pedestrian movement and providing support to other modes (e.g. bicycles) by providing facilities such as cycle parking and showers in the work place).

5.2. Panama City: Metrobus-metro integration and a citywide transport system

5.2.1. Institutional framework

Fare integration and physical integration between Metrobus and the metro at certain stations could start improving the quality of the services and overall travel times. The integration of Metrobus and the metro has not been coordinated on a regular basis but there has been interchange of information between Mibus and Metro Secretariat and the objectives of both companies are aligned around providing good transport service and increasing patronage. Moreover, a consultancy project was commissioned to define a restructuring of the routes to facilitate integration. Mibus, ATTT and Metro Secretariat have regular meetings to discuss the topic. Currently, there are some services that are allowing the transfer between Metrobus buses and metro and for that service users are doing the interchange because the time savings are considerable (for example, travel time reduced from 1 h 30 min to 20 min).

Further institutional arrangements such as the establishment of a metropolitan transport authority need to be considered. This authority will be responsible for operation of the Metropolitan Integrated Transport System which will regulate or incorporate traditional and informal services and will structure the feeder system for the mass transit modes. With respect to interurban routes, the integrated authority might need to be responsible for them because the land-use plans already include other Municipalities such as San Miguelito and Chorrera.

5.2.2. Business model, regulation and enforcement

Measures to provide better quality of service for Metrobus are needed, such as prioritized or exclusive lanes for buses in main avenues. Strengthening of institutional capacity to facilitate enforcement is also important given that there are vehicles without licence plates but with public transport operation permits. Dialogues with the government are being held with the aim of changing the contract specifications on issues such as average occupancy. The idea is to move towards an integrated transport system with a unified electronic payment mechanism. Mibus perceives the user as the biggest loser of the restructuring of the bus services, because they have longer waiting times, longer walks, and longer travel times on more crowded buses. Although this coincided with a time in which traffic was considerably worse due to metro works, for Mibus it is very important to understand what went wrong and restructure the contracts to reconfigure service operation. From the ATTT perspective, the bus transport system requires two fundamental changes. i) The operational structure needs to be more public than private and ii) Performance parameters for the service need to be included in the contracts to reflect punctuality, frequency, number of buses at specific times of day, reliability and service provision because so far the system has focused solely in the number of passengers and this has created perverse incentives. Moreover, modern monitoring systems are required.

5.2.3. Integrated land-use and mobility planning

The integrated transport system aims to integrate several transport modes, but also to have an integrated planning approach with other public services to ensure the systems overall functionality. It was stated by some stakeholders that Panama City will benefit greatly from learning from other growing cities to ensure good project management for the big city-scale projects. Works for new transport infrastructure need to be coordinated with works required for replacing pipes or installation of underground utility grids. This will prevent future damages to new road infrastructure in order to provide other services. Moreover, as part of the partial plan for the metro Line 1, considerations regarding permeability of surface are included. The integrated transport system is also considering integration of land use and transport planning. Recently for the metro station catchment areas (taken to be 100–200 m around the station entrance) a partial plan was developed to allow the Metro Secretariat to assess any new development in the area (MINVIOT Ministerio de Vivienda y Ordenamiento Territoritorial, 2013).

6. Results and discussion

Based on Barranquilla and Panama City systems' strengths and challenges and looking at the strategies defined by the cities to move forward some key lesson can be extracted for thinking about multi-modal integrated transport systems which are presented bellow:

Institutional framework: Several stakeholders mentioned the need of a metropolitan transport authority in Panama City and the need for better inter-institutional coordination in Barranquilla. This could lead to land-use planning and mobility integrated planning at the metropolitan level in a coordinated manner. Moreover, further integration and coordination of infrastructure provision of city's services, for example coordinating transport infrastructure development with installation of underground utility grids, could lead to more sustainable solutions in the long term.

Business model, regulation and enforcement: Repeatedly in the meetings the idea of needing to restructure bus service provision contracts appeared. Service standards defined on existing contracts are not consistent with users' expectations. This is especially interesting because in the case of Panama the system is already subsidized so financing issues are not direct constraints to service quality, which is not the same for the case of Barranquilla. The message is that financial restrictions are not necessarily at the heart of the problems but is essential to have (1) the capacity to monitor and measure what is important from the users' perspective and (2) the ability to deliver the changes needed to address them.

Communications, civic culture, education and behaviour change: citizens must be informed and formed within the desirable social values for sustainability. In the short term behavioural change towards the use of sustainable public transport and communications are vital to give viability to the new system and continuity over time.

Integrated land-use and mobility planning: During the last decades the two cities have given many incentives, such as tax exemptions for property developers, to attract foreign investment. In consequence considerations regarding the integration of transport planning and land-use planning have been overlooked. However, the lesson from the development of the first Metro Line in Panama City and the BRT corridors is that future transport infrastructure developments need to be coordinated with land use planning. Moreover, strong regulations and mechanisms are needed to guarantee the quality of public space, especially when this is responsibility of the private developer of the site.

Built environment design for physical integration: In these two tropical cities, for the minority of car users the hot weather was regarded as a factor that made walking or cycling impossible, even for short distances and it was argued that this forces people to use the car, and to find parking places as close as possible to their desired destinations. However, at least in the case of Barranquilla the evidence shows that many people are walking under these conditions. Several stakeholders stated that if better conditions – such as walkable surfaces on the footways, trees for shading and cooling effects, at level pedestrian crossings with less waiting times were provided, a walking and cycling culture could start to emerge. Beyond the use of non-motorized modes the perception of convenience is a key determinant in the decision whether or not to use public transport, as everyone is a pedestrian for the access/egress trip to the system. This is even more important for the design of integrated systems in which transfer might need to occur at the street level. Finally, considerations regarding service design to optimize coverage, good quality infrastructure and fare structures for social inclusion need to be included. Parking management and Demand management need to be evaluated as part of the multimodal integration system. For that, the identification of best locations to promote multimodal nodes (e.g Park and Ride) to promote the use of the public transport system and to prevent congestion on main roads should be identified as well as business models suitable for this purpose.

7. Conclusions

Both cities have strengths related to their capacity of attracting investment and the advances they have made regarding planning tools and institutional capacity for the transport system. For the implementation of multimodal integrated transport systems there are opportunities related to a general consensus among stakeholders and citizens of the importance of implementing sustainable mobility solutions. A drawback to this are the aspirations related to car culture but because congestion is incipient and mega large highway networks have not been developed, these aspirations can be challenged by the provision of good quality, convenient and comfortable integrated public transport systems and the implementation of policies to change car users behaviours, especially when they create negative consequences for the people and other transport modes (e.g. stop allowing the use of footways as parking spaces). The main challenges come from the layers of complexity associated with the diversity of stakeholders involved and the various interests around the system and the need to integrate land-use and mobility planning. Hence a strong institutional framework for the mobility system is needed to develop tools to manage this complexity effectively and continuously over time. Strengthening of institutional and technical capacity will also facilitate taking concepts into practice as this has not been an easy task in the cities, even in the absence of financial sustainability constraints. As is has already started in Barranquilla, this strengthening can be fostered through a close work of the public sector with Universities/Research institutions/Civil society, Government and Industries (Private sector). This will provide the system with continuous feedback on performance, improvements in technical capacity and alternative sources of funding which, when combined, will give the city and its transport system the capacity to evolve and adapt.

The main general message is that the system's ‘soft elements’ need to be considered as system components which are context specific and need to be designed and implemented with the same level of rigorousness as the physical elements. Careful design of ‘soft elements’ is what ensures the transferability of solutions from one city to another and prevents systems' operational failure. Although less was discussed about physical elements, the examples show that the quality of the service depends on infrastructure completeness and quality and adequate investment in infrastructure for non-motorized modes and pedestrian accessibility to the system.

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Appendix 1

List of stakeholders interviewed for the development of this research.

City	Organization	Participants
Panama	MiBus	Raul Roa Natalie Montañez
	Alcaldía de Panama	Deputy Mayor Raisa Banfield and advisers at Alcaldía de Panama
	ATTT	Carlos Ayuso and technical advisers
	ANAM	Rosilena Lindo, Director of Climatic Change Unit, and Yahaira Cárdenas, Climate Change Analyst (ANAM)
	Government Ministry	Minister Milton Henríquez
	Metro Secretariat	Alvaro Uribe Planning Adviser of Metro Secretariat
	ECOTV Panama	Interview in night time news
	CIAM	Rodrigo Noriega, Board Member; Sonia Montenegro, Executive Director; Soledad Porcell and Tania Arosmena, Technic and Legal Coordinators
	Red Ciudadana Urbana	Juan Pablo Purcell, Denia Arauz, Adolfo Trutte, María Chavez and other members
Barranquilla	Universidad del Norte	Victor Cantillo
	Area Metropolitana de Barranquilla	Susana Cadavid Oswaldo Bermudez William Llanos Javier Visbal
	Transmetro	Manuel Fernandez Federico Diaz Ruby Rubio
	Camara de Comercio de Barranquilla	Jorge Bermudez
	Universidad de la Costa	Luis Ramirez Santiago Nieto
	Findeter	Maria Lourdes Lacouture David Montero
	Secretaria de Movilidad Barranquilla	Walid David
	Analtra	Maria Fernanda Barros Ricardo Altamar
	Pro-Barranquilla	Sindy Padilla Laura Murcia

Appendix 2. SWOT analysis

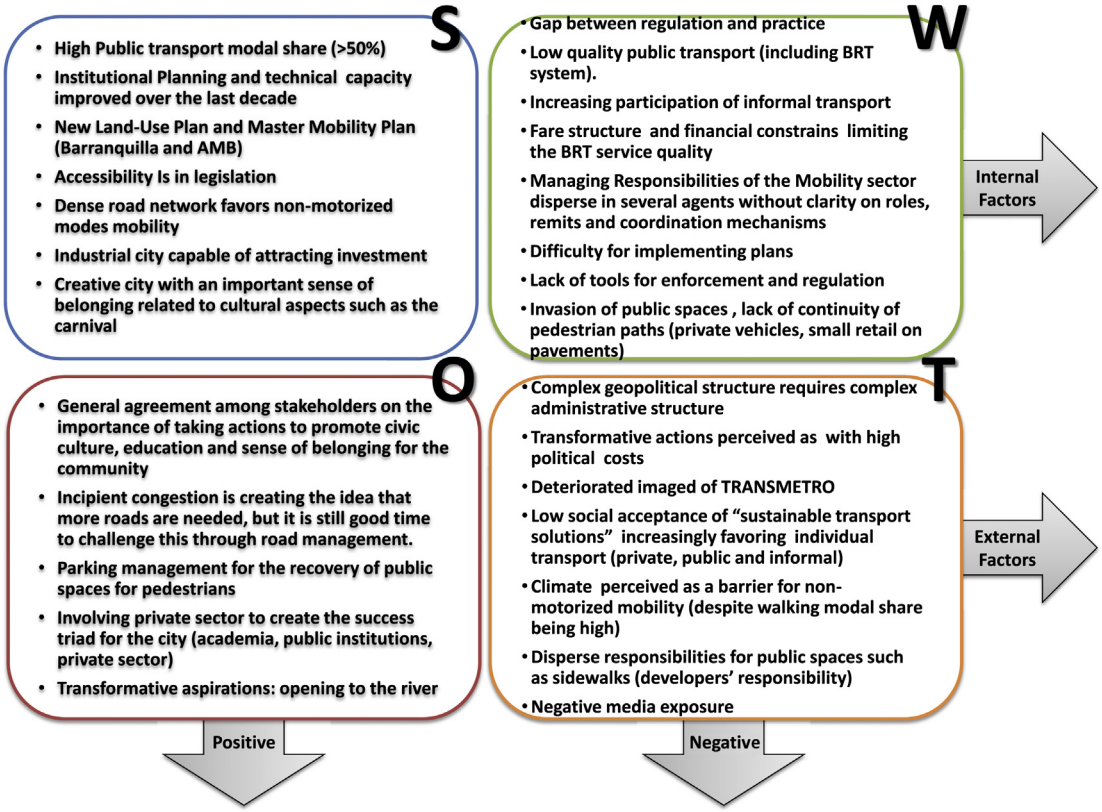

Fig. 10. SWOT Analysis for Barranquilla transmetro system. Source: Authors.

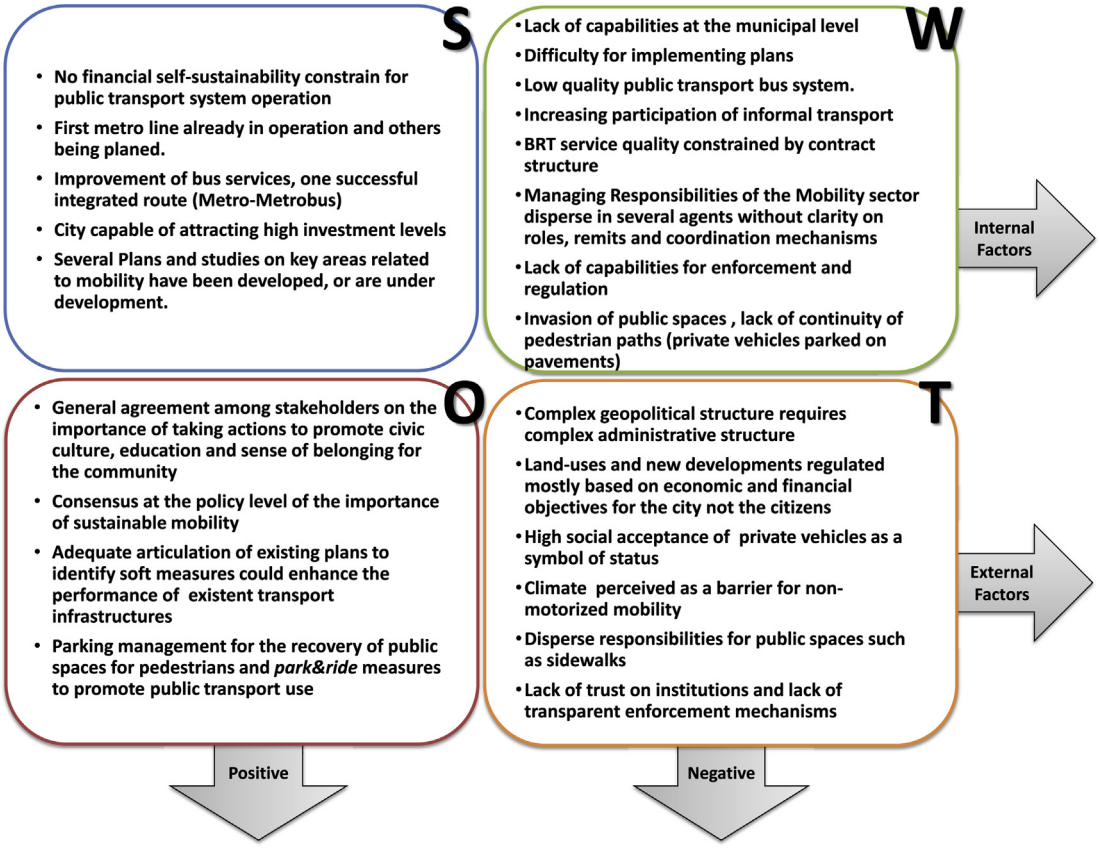

Fig. 11. SWOT Analysis for Panama Metrobus system. Source: Authors.

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