Public Transport as a Public Place: Urban Insertion Strategies of the Coquimbo – La Serena Light Rail Project

R Hidalgo

1Associate Professor School of Architecture, Faculty of Architecture, Design and Urban Studies, Pontificia Universidad Católica de Chile, Santiago, Chile.

E-mail: rocio.hidalgo@uc.cl

Abstract. The public transport systems, as much for its infrastructure magnitude as for the importance of its services, have been addressed from the urban design theory and practice as potential structure elements of the contemporary urban experience. They are presented as privileged meeting points, and as possible protagonists of the form, culture and identity of a city. The Coquimbo-La Serena light rail project arises as an alternative to improve the connectivity through public transportation of this conurbation, a new metropolitan area of almost half million inhabitants, which has undergone far-reaching changes in its mobility habits in the last decades. The use of private cars has doubled in detriment of the use of public transport and walking, which consequently produces congestion and pollution problems. This project proposes a new longitudinal connection, a clean, efficient and interconnected backbone of public transport, which links isolated residential sectors with the city town areas and the main public infrastructure of both cities. It is presented as a “complete street” project that unites important elements of history, geography and city life, being a new urban landmark that conveys the will of diverse actors accomplished as a public-private project through the MOP (Acronym for Ministry of Public Works) concession system. This article, which is the first academic work about the project, highlights the role of the public transport infrastructure as a central element of the sustainable construction and development of the city, and it discusses the light rail suitability in this sense, particularly compared to the BRT option. Through the presentation of the urban insertion strategies of the Coquimbo – La Serena light rail project, it is stated that a public transportation infrastructure constitutes “place” when it is integrated to the structure, landscape and urban public spaces in a sustainable way.

1. Transportation, community and identity

Since the mid-nineteenth century, the infrastructures or urban technical networks have accompanied the development of the cities, contributing to define its form, character and growth patterns. The energy, transportation, roadway system, sanitation, drinking water and telecommunication networks have determined since then the extension, cohesion and the habitability of the urban environment [1, 2]. In this context, the public transportation infrastructures go even further, since they constitute habitable spaces in themselves. Depending on how they have been conceived, they may become or not part of the public spaces and urban monuments system [3], thus configuring a “place”, understood as a physical space of collective identity and reproduction of the social relationships in the city [4].

From this perspective, the role of the public transport infrastructure stands out as a place of collective experience. Beyond its connective function, it is offered to the citizens as a privileged space of encounter.
and daily interaction. Through them, the act of moving becomes a mode to understand the city that surrounds us in a preferential way, also to establish legibility moments of society and the place each one has in it [3].

An infrastructure element becomes a monument inasmuch as it integrates and informs the coexistence space in the city. This potential condition is not related to its size, but to its ability to adapt to diversity [5], to embrace and to represent certain daily routines of community life [6]. Consequently, an urban infrastructure must be presented as a legible and finite artifact, being able to establish an effective dialog with the grain, the scale, the rhythm and the city memory [5].

In relation to the public transport, the metro facilities -its accesses, stations, tunnels, viaducts and others-, have made their way into the public imaginary of multiple cities, as prominent places of the collective experience [6]. In this case, the infrastructure is identified as a common good integrated to the public places system of a city, contributing to the construction of its image and daily experience.

Therefore, it is an infrastructure that moves away from the monofunctional conception, adopting the guidelines of a sustainable development, in the sense that increases the effects of the technological advances and economic growth in order to have more equity and an improvement in the living conditions of the city. It is foreseen as a new generation infrastructure that should be, based on Samuels: multifunctional, public, visible, socially productive; locally specific, flexible and adaptable; responsive to the eco-economy; symbiotic; technologically intelligent; and finally, it should be developed from a multidisciplinary team work of different areas. [7]

In the last decades, the public transport has experienced significant technological advances which ensure a cleaner and more efficient operation. The current challenge, within the sustainable development frame, is found in the integration of its infrastructure and services as an active part of the built environment construction and the living habits in the city, being also sensitive to the more complex social and environmental systems, longer lasting, adaptable and open [8].

These considerations should be present when deciding to incorporate a certain mean of public transportation in the city. This decision is determined first by the scope and demand of the new mode to implement. For long distances and greater capacities, subways or trains are preferred, since they operate at greater speed and exceed five times the capacity of other means of public transports [9]. On a second level, there is already a great debate about the convenience between LRT (Light Rail Transit) and BRT (Bus Rapid Transit) for main lines of midsize cities or as shuttles to access larger metropolitan systems.

2. Public transport and sustainable development ¿LRT or BRT?

Each time more cities through the globe prefer LRT or BRT systems to deal with its challenges regarding mobility and sustainable development. Its growth is seen at the level of investment amounts and as well as the number of new projects [10] and this is explained, to a large extent, because both have been able to increase the standards of the public transport service and to represent a competitive alternative against the use of private cars [11].

On the one hand, the LRT is an improved version of the former trams that maintains the electrically propelled rail vehicles, but that operates preferentially along dedicated rights of way, using single or multiple car trains, each time more spacious, faster and comfortable [10]. The BRT, on the other hand, is a high standard bus system, defined by the use of dedicated rights of way, scheduled routes, assigned bus stops, higher comfort and quality vehicles, and the use of ITS technologies (Intelligent Transportation System) for bus monitoring, information for passengers and fare recollection [11].

At first sight, it is often argued in favor of BRT due to its lower costs and implementation time for the same service levels and capacity as LRT (a quarter of the cost and a third of the construction time); but in other cases it is argued for LRT, in spite of its higher costs, emphasizing its appeal to more passengers, their permanence and its positive impacts in the city, particularly on the public space quality and the land value of its surroundings (two or three times higher return of investments compared to the BRT) [10, 11].

LRT and BRT are functionally similar systems, being semi-fast transports, separated from street traffic, both delivering a higher service level, and both having a more positive impact than a basic bus
Moreover, both require significantly higher investments than regular buses, but lower than the metro [11]. Nevertheless, LRT and BRT are drastically different regarding its technology, operation, quality service, and their short- and long-term impacts on the urban environment. LRT demonstrates to be superior in most of the efficiency and service level measurements: speed, comfort, image and passengers appeal [11, 12], as well as energy consumption and pollutant emissions (considering the use of diesel fueled buses) [13].

In middle sized cities and in specific corridors, BRT can perfectly achieve the capacity and service level required for lower costs than LRT. But, in medium to large cities, LRT offers superior service levels for routes with a demand above 20,000 passengers per day [12]. They can operate in a more efficient way on pedestrian areas, with platforms integrated into the public space or circulating through underground tunnels in central districts, having more positive impacts because of the presence and permanence of its infrastructure in the land use planning, urban form, quality of life and sustainability of a city [11].

3. Coquimbo–La Serena light rail project, context and urban insertion strategies

Recent case studies about LRT in different cities around the world, confirm that they contribute to the sustainable urban environment construction in five dimensions: effective mobility, in terms of its operating competence, urban efficiency, referring to its contribution to urban development; economy, as a contribution to the welfare in and for the city; environment, contributing to the construction of a sustainable environment and to the reduction of the carbon footprint; and equity, in favor to the social inclusion and cohesion, facilitating job access, trade and public infrastructures for all citizens [12].

The Coquimbo-La Serena light rail project is presented based on those principles, as a new urban entity which more than providing a solution to the growing connectivity and conurbation transport problems, proposes the creation of a new structural city axis, a backbone that connects and links diverse urban surroundings and means of transportation as an intense seed of urban life and integral improvement of its citizens’ quality of life.

Coquimbo and La Serena are nearby cities that share the geographic scenario of the Coquimbo bay in the IV region of Chile. Coquimbo is a city port of a fishing origin located in the Coquimbo peninsula since pre-Columbian times, and that gained strength with the mining boom and the arrival of the train on the second half of the 19th century. La Serena, on the other hand, is a colonial city founded by the Elqui river mouth, above the second geographic terrace of the bay, which consolidates itself as a touristic and administrative center since the 19th century. The growth of both cities increased in the last decades of the 20th century due to mining, port and service activities, currently becoming one great metropolitan area of 450,000 inhabitants (census 2017), with its corresponding complexities, demands and challenges.

From their central areas, both cities have spread into diverse residential sectors, identifiable and separated through geographical elements of the bay. In this sense, the metropolitan area is built through a group of urban fragments, separated by rivers, estuaries, hillsides and terraces, scarcely connected to each other by streets and avenues interrupted by waterways, slopes and multiple infrastructures. The conurbation growth has come accompanied, at the same time, by a change on the population mobility patterns. According to the Origin-Destination survey, the total mobility number into the conurbation increased 75%, from 530,000 to 930,000 trips per day (approximate values) between 1999 and 2010, diversifying their reasons and schedules. Although the trips amount by nonmotorized means of transport (walking and cycling) has slightly increased, trips by private cars has doubled, representing from 15% to 30% of the total trip amounts within the area. This is in detriment of the public transport use, such as taxis, buses and collective taxis, which decreased from 49% to 31%. This fact has triggered critical traffic congestion problems and an increasing deterioration of the transport services and the public street space, especially in the downtown city area and main avenues of both cities.
Figure 1. Vehicular congestion in late afternoon peak hours in Cienfuegos Street, in the east sector of the historic center of La Serena. Like the other streets of the central grid, it is a road with two traffic lanes for one-way vehicles and narrow paths against the walls of continuous facade, from where pedestrians are sometimes forced down the road by lack of space to circulate. The streets are usually between eight and nine meters wide between facades, sometimes leaving sidewalks less than a meter wide for pedestrians. Collective taxis and private vehicles interfere with each other, congesting the air and space of the place. Source: Authors’ photography, 2017.

The light rail project emerges in this context as an initiative to improve connectivity between Coquimbo and La Serena, and at the same time, to raise the standard of the public transport conurbation services, as a real alternative against the use of the private car, in terms of comfort, security and reliability, but also in favor of the environment protection and the promotion of a sustainable urban development.

The project is proposed from the alliance of private and public sectors and it is developed through the MOP concessions system, which declared it as a public interest project in November 2015, giving way to the study phase. The project was developed by SICE S.A., which is a specialized company in control and intelligent monitoring of transport systems, that convene other required specialties (engineering, transport administration, legal and environmental studies and urban and territorial insertion, among others), always in dialogue with public and technical authorities from the region.

Functionally, the project is defined based on a demand of 55,700 passengers per day on 2020. It proposes the use of 30 meters long trains, fed by catenary lines, with a maximum capacity of 220 passenger, which would circulate with an average speed of 24 km/h (20 km/h in central areas and 50 km/h in suburban areas) and a frequency of every five minutes on rush hour each way. The design considers, as a general rule, the construction of a double way platform with a total width of 6,5 meters and a distance of 3,5 meters between each axis, allowing a minimum turning radius of 25 meters and a maximum slope of 6,5%.

From an urban perspective, the light rail is projected as an opportunity to improve not just the connectivity between different urban fragments of the conurbation, but also to articulate the mobility and to extend the intensity of urban life beyond the central areas of both districts. Such objectives are developed from the urban insertion strategies of the project, from defining the general route layout and its type profiles, the location of the stops and the typological design of the stations.
Figure 2. Illustration of the Coquimbo - La Serena light rail route alternatives on maps of population density per block, public transportation coverage, socio-economic status, and land uses of the conurbation. Route alternatives are plotted with a black, yellow, black and red solid line respectively and the definitive route with a black segmented line. Population density and socioeconomic strata plans reflect the concentration of poverty in the sectors of Las Compañías, Coquimbo Peninsula and Tierras Blancas, in the north, south and center-east of the conurbation, the first two neighbors to the historic centers of both cities, but separated by strong geographical accidents, the river and the slope, which restrict their public transport coverage. Source: Plans corresponding to the diagnostic stage of the Urban and Territorial Insertion Study of the Project, prepared by the City and Mobility Laboratory of the Faculty of Architecture, Design and Urban Studies (FADEU) of the Pontificia Universidad Católica de Chile, 2016.

In relation to the route layout, the project strategy looks for providing a new connection, as straight as possible, between Las Compañías, on the north side of the Elqui river, and the Coquimbo downtown, connecting the central districts of both cities, and at the same time, attending isolated residential areas. After the analysis of different alternatives, an “interior route” is chosen, a central axis of approximately 18 km long (to be built in stages), which connects and combines a sequence of preexisting avenues, overcoming geographic features and infrastructure, and opening-up new routes to finally shape a new backbone of access and urban development inside the conurbation.
Figure 3. LRT Coquimbo-La Serena, definitive route layout of the first stage of the project and its stations (solid red line), between the Coquimbo Hospital and Francisco de Aguirre Av., in the historic center of La Serena. The tram runs along existing avenues in its northern and southern sections, while introducing new routes in the central area, in the Peñuelas sector, south of the administrative boundary between the two cities. The plan shows the longitudinal layout of the conurbation, which runs parallel to the great bay of Coquimbo but preferably on the second marine terrace, interrupted by the course of the Elqui and Culebrón rivers. With a darker tone, the poorest sectors of the conurbation stand out, Las Compañías, Tierras Blancas and Coquimbo Peninsula, which the project aims to reach in a next stage. Future extensions of the path are indicated in segmented red lines, currently under study. Source: Plan corresponding to the second phase of the Urban and Territorial Insertion Study of the project, prepared by the FADEU City and Mobility Laboratory, based on the plan carried out by Paula Buglio, 2018.

At the level of type profiles, the light rail crossing is presented as an opportunity to create or transform the entire street, proposing or renovating its pavements and arranging its facilities between facade and facade. Three type profiles are defined, according to the character and space available in each surrounding: central platform integrated to pedestrian paths in both cities historical centers; a central platform with a dedicated lane on the big avenues median strip; and a lateral platform with a dedicated lane integrated to the parks lateral strips of certain avenues.
Figure 4. Site plan and section of the stations “Hospital de Coquimbo” and “Estadio La Portada”, at the southern start of the tram and Balmaceda Av., just before entering the historic center of La Serena. The first represents the typology of stations with central platform, in this case incorporated to the September 11 Park, in front of the Coquimbo Hospital. While the second one represents the type of station with lateral platforms, occupying the median of Balmaceda Av. Source: Plans corresponding to the second phase of the Urban and Territorial Insertion Study of the project, prepared by the FADEU City and Mobility Laboratory, 2017.

The location of the stops is defined using the following criteria: 600 meters between each stop in consolidated areas and up to twice the distance in developing areas; proximity to public infrastructures
such as parks, schools, hospitals, stadiums, commercial areas and others; proximity to intersections and main crossings that may amplify the territorial range of the light rail, and facilitate the interchange with other public or private means of transport. Thus, a total of 19 stops are established on the first stage of the project, between the Coquimbo hospital and the Francisco de Aguirre avenue (13.5km), most of them associated to important services, or also proposed as future intermodal exchange stations.

The stations design is defined through two basic typologies: with a central platform and lateral platforms, built from prefabricated elements integrated visually and functionally to the public space surroundings and responding to the identity, security and orientation needs of the system. As for the pavement work, the continuity of the platform with the pedestrian sidewalk space is preferred, ensuring universal accessibility to every installation. Each station is proposed as a converging place and a citizen meeting point, identified at once with the system and the city.

![Figure 5](image.jpg)

**Figure 5.** View of Videla Avenue with the September 11 Park on the left and the Coquimbo Hospital in the background (above) and photomontage of the southern start station of the project, in the same place (below). A station with a central platform incorporated to the park is proposed, with the right platform of the tram integrated to the vehicular road of Videla Av. and the left platform forming part of the pedestrian pavement of the park. Source: Images corresponding to the second stage of the Urban and Territorial Insertion Study of the project, prepared by the FADEU City and Mobility Laboratory, 2017.
**Figure 6.** View from Balmaceda avenue median strip to the north in direction to the La Serena historical center (above) and photomontage of the Estadio La Portada station of the project in the same place (below). In this section, the project proposes the crossing of the tram along the central axis of the avenue, moving vehicle traffic sideways, with one track per direction. The stations of this type of profile correspond to the typology of lateral platforms, which replicate the public space of the sidewalk next to the tram. Source: Images corresponding to the second stage of the Urban and Territorial Insertion Study of the project, prepared by the FADEU City and Mobility Laboratory, 2017.
4. Project contribution to sustainable development

Under these design parameters the Coquimbo-La Serena LRT project might contribute to the achievement of a more sustainable urban environment for the conurbation, reflecting the five mentioned dimensions [12]:

- **Effective mobility.** The project is presented as a new metropolitan connection to link two cities in conurbation of similar size and density, with an estimated demand of over 25,000 passengers per day/way. This will be achieved by connecting the most densely populated sectors of the area, with the main centers and public services, which from this perspective, backs up the choosing of LRT.

- **Urban efficiency.** The project suggests the creation of a new structural axis of longitudinal connection for the conurbation, only possible in an unobstructed way, today along route 5 and Del Mar Avenue. Its insertion is proposed as a "complete street" intervention, creating public space and renewing the existing one, integrated to the main public infrastructures and monuments, and promoting the transit-oriented development in favor of the city densification.

- **Economy.** The better accessibility that the implementation of the LRT represents may favor the economic growth, as much as for the commercial activity of the central areas and the main avenues, as for future real estate development and public projects along its path. The new accessibility, joined with the new renovation of public street space, might produce an increase in the land value, as one of the most recognized effects of trams.

- **Environment.** The use of rail and electrical power technology guarantee a lower energy consumption and lower pollutant emissions, vibrations and noise. Additionally, the project would contribute, to a medium and long term, in the following aspects: reducing the number of vehicles, since it promotes the urban development by densification, and therefore, shorter travel lengths; public transport promotion to replace the use of private cars, by offering a higher standard of comfort and reliability; incorporation of fixed infrastructure, which contributes to establish a long term sustainable city structure; and the implementation of sustainable technologies, promoting the combination of the LRT with other non-contaminant means of transport, especially walking, bicycles and scooters.

- **Equity.** The project promotes social inclusion in the conurbation decisively, as it improves access to work, local commerce, public infrastructure and collective activities of sectors that are currently segregated socially and geographically. The proposed route layout, product of a constant dialogue between citizens, political representatives and local experts from different disciplines, connects in a preferential and direct way the lower to medium income level residential neighborhoods to the central districts of jobs, public services and infrastructures.

As presented, the decision to implement an LRT, instead of other public transport alternatives of similar characteristics (such as BRT), responds to social and territorial circumstances of a city. In Coquimbo-La Serena, this decision goes hand in hand with the will to build a new central urban axis that complements the scarce longitudinal connection from the residential neighborhoods to the areas of maximum activity. The proposed LRT integrates the different street profiles of the public space in a flexible way and aims, through the future experience of its route and stations, to be part of the system of public places of both cities, in dialogue with their natural spaces, main parks, squares and avenues, historic centers and residential enclaves, exalting the life and landscape of the conurbation.
Figure 7. Route layout of the Coquimbo-La Serena LRT project on the topographic map of the conurbation. The location of the project on the second terrace of the bay is observed, saving steep slopes estuaries and ravines. Source: Prepared by the author on the project's planimetry of SICE S.A..

Figure 8. Culebron estuary view, a geographical feature of 30 meters deep, in the place where the project considers the construction of a viaduct for the tram crossing, between the Peñuelas and San Juan sectors in Coquimbo. In the background, to the south, you can see the bay and the hills of the Coquimbo Peninsula. The LRT infrastructure is projected in this place as an opportunity to access and contemplate the landscape of the conurbation. Source: Author’s photography, 2017.
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