
Master Thesis Abstract

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Topic: **Development of a Handbook for the Design and Assessment of BRT Stations**

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One definition of Bus Rapid Transit systems (BRT) says: it is a flexible, rubber-tired rapid-transit mode that combines stations, vehicles, services, running ways and intelligent transportation system elements into an integrated system with a strong positive identity that evokes a unique image.¹ This definition underlines the importance of a system-wise concept emphasizing the high significance of BRT stations. Although there are very successful examples of efficient station designs worldwide, reaching a functional, operational and attractive design of stations is frequently underestimated. The consequences are manifold, ranging from capacity problems² to non-acceptance of the transport system by the users.³

With this background, the objective of this thesis is to represent the development of a globally applicable manual for the design and assessment of BRT stations in which a wide range of design alternatives are considered. This is an ambitious assignment since the *station design process* represents a complex interaction between various given *conditions* and stakeholders' *requirements* to be fulfilled by the different *station elements*.

Firstly, the **BRT station elements** are identified and classified into eight functional categories from platforms and loading areas to maintenance considerations. The elements' main characteristics, essential functions and key concepts for their design are outlined. The analysis is supported by literature about the design of transit stations in general (bus, rail), planning guides and technical reports about BRT systems worldwide.

Secondly, the specific **conditions** constraining the design and assessment of BRT stations are identified and grouped into three categories: site specific conditions (e.g. climate, adjacent traffic lanes, other transport modes), the economic and legal framework (available funds, regulatory laws) and conditions arising from a BRT system perspective (as stations represent only one element of a complete BRT system, they must be designed to interact with other components such as running ways, buses and operation issues).

Thirdly, the stakeholders' **requirements** are divided in a simplified manner into two principal groups: planners/operators' requirements (service providers) and passengers' requirements (service users).

The planners' requirements include costs and revenues, functional/operational aspects, and also institutional and coordination issues.

According to adaptations made to the TCQSM and DIN EN 13816, the passengers' requirements (or also called service requirements) for the service at stations are:

- Availability, which focuses on the question if a station is an option for a given trip regarding *capacity, accessibility, and information*.
- Comfort and convenience, related to how attractive it is to make a trip at a specific BRT station compared to make the same trip at other available station or with another public transport mode (e.g. private car). The service requirements to be considered under this item are *safety and security, time saving, comfort, and customer service*.

As the above described conditions and requirements are not always compatible on to another –as a *fourth step*– a **Level of Service (LOS)** based methodology for the design and assessment of BRT stations is applied and further developed. The LOS are value ranges (from “A” to “F”) that reflect the quality of service offered from the passenger's point of view, but depends to a great extent on the operating decisions made by the planners/operators within the constraints of its budget and other specific given conditions. Quality of service also measures how successful a planner/operator is in providing service to the passengers with ridership implications.

The numerous stations' elements are analyzed systematically and interlinked according to their functions to each of the service requirements. The resulting matrix provides an overview and serves as the fundamental guideline reference for the identification of the station elements and the requirements to be fulfilled.

¹ TCRP90 (2003a), Bus Rapid Transit

² The Institute for Transportation and Development Policy reports that in general, the bottleneck point for most BRT systems will be vehicle congestion at the stations

³ Considering that stations are the first point of contact between the passenger and the BRT service

In the respective literature, LOS value criteria are mostly given for the service requirement regarding *capacity* such as the LOS for waiting areas, walking ways and ramps, stairways and for fare collection and verification. LOS for the average pedestrian and bus delay times for the service regarding *accessibility* were also in the literature. Nevertheless, considering that the LOS represent the passengers point of view -and the passenger requirements are much broader than just capacity- the consideration of LOS for the rest of the service requirements such as accessibility, information, safety and security, time saving, comfort and customer service must also be integrated. For the missing service requirements, the LOS values are developed and consistently defined within this study:

- LOS for saturation of loading areas
- LOS for integration with other transport modes, accessibility for persons with reduced mobility, manual docking (interface platform-bus)
- LOS for information at stations, safety measures, security measures
- LOS for average buses delay time at a signalized intersection
- LOS for weather protection, features , customer service

Lessons learned from current BRT systems in operation with emphasis on problems at stations, and also passengers' complains about stations as result of surveys, etc. were especially considered for the definition of the LOS values.

As a last step, an optimization and validation of the existing and newly defined LOS values was achieved by the application of the developed process and methodology at the BRT system "Metrobüs" in Istanbul. The current conditions at four stations were measured on site and later a comprehensive assessment in compliance with the LOS based methodology was realized. Within this process, significant improvement potentials against the originally prevailing LOS values were identify. The relations between the stations' elements and the service requirements were also prioritized and validated. Suggested and assumed default values were corroborated with the field measurements.

By the application of the present manual at the design and assessment of BRT stations a systematic, transparent and fact-based approach forming the basis for subsequent working phases is given. Although, the detailed effects and results by applying this manual cannot be predicted in a quantitative manner, it can be assumed that by the application of this manual in the design and assessment of BRT stations, more passengers might be attracted to BRT because of the quality of service orientation (*user-focus*) and in turn more people might shift from private vehicles to public transportation.

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