

Transit quality of service

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Discussion

- ▶ Why do you use transit?
 - Will you still use it if you have a car?
- ▶ Why don't you use transit?
- ▶ How would you measure transit quality of service?

Quality of service

Definition (Quality of service or QoS [TCQSM]). It is the overall measured or perceived performance of transit service from the passenger's point of view.

It focuses on two areas:

- ▶ Is transit service an option for a given trip?
- ▶ If it is an option, how attractive it is to the potential passengers?

QoS depends on the decisions made by a transit agency within the constraints of its budget, particularly where to provide service, how often and how long it is provided, and how it is provided. Better QoS attracts higher ridership.

Capacity

Definition (Capacity [TCQSM]). It refers to the maximum number of transit vehicles, passengers, or both, that can travel past a particular location in a given period of time under specified conditions.

Types

- ▶ Maximum (theoretical) capacity reflects the greatest number of persons or transit vehicles that can be served under any circumstance.
 - Maximum capacity is unstable-and thus unreliable - form of operations.
 - It should not be used for planning and operations.
- ▶ Design (achievable, practical) capacity reflects the number of persons or transit vehicles that can be served at a specified QoS (e.g., design loading level or design reliability level).
- ▶ Vehicle (bus, train, vessel) capacity is measured in vehicles per hour and expresses how many transit vehicles can pass a point in an hour.
- ▶ Passenger capacity is measured in persons per vehicle and expresses how many persons a transit vehicle can carry at a design passenger loading level.
- ▶ Person capacity is measured in persons per hour and expresses how many persons can pass a point in an hour. It is the product of vehicle/facility/line capacity (veh per hr) and passenger capacity (person per veh).

Why should we be concerned about capacity?

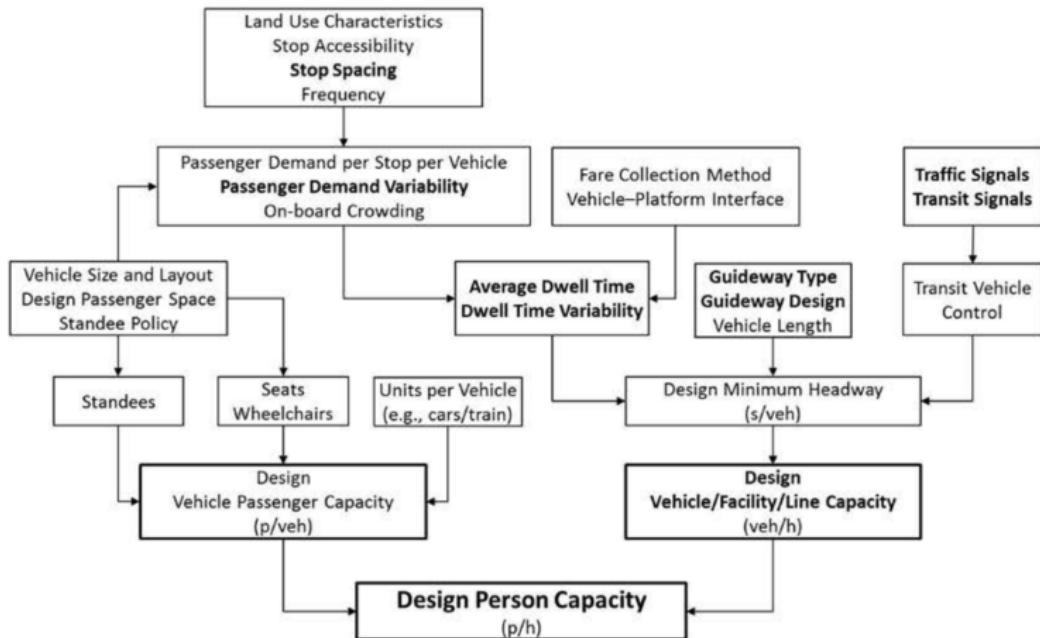
- ▶ **Speed and reliability:** Factors influencing capacity also influence speed and reliability
 - Reliable service is attractive to passengers and help reduce the recovery time¹.
 - Speed improvement will help cover the route length faster.
- ▶ **Managing passenger loads:** Capacity help determine the number of buses, trains, or railcars required to provide a desired quality of service wrt pax loading.
- ▶ **Forecasting the effects of change** of fare collection procedure, vehicle types, etc.
 - **Dwell time** (time required to load and unload passengers) affects speed and capacity.

¹time included in the schedule between trips to allow late arriving buses to start their next trip on time

Why should we be concerned about capacity?

- ▶ **Planning for the future:** To plan for a travel demand, we require capacity information for various options.
- ▶ **Analyzing the operation of major bus streets:** Capacity analysis can help understand the delays caused on major streets where multiple bus routes converge.
- ▶ **Special event:** To serve the demand for special events (fair, festivals, sports, etc.)
- ▶ **Transportation systems management:** Increasing transit capacity can increase the person capacity as compared to automobile.

Factors influencing person capacity



Note: Inputs to design person capacity shown in bold also influence transit speed, reliability, or both.

Figure: Exhibit 3-1 TCQSM

Speed

- ▶ impacts the time required by passengers to make a trip.
 - which further influences the attractiveness of transit compared to other modes.
- ▶ impacts the cost of operating a route
 - number of vehicles required to provide a given frequency depends on the cycle time².

²time required to make a round-trip on a route, plus driver layover time and recovery time.

Factors influencing speed

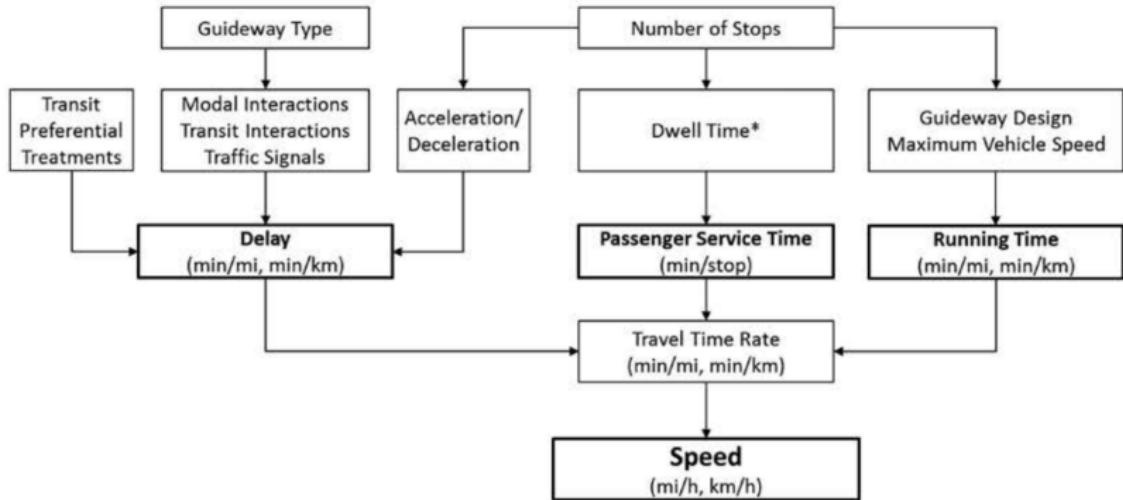


Figure: Exhibit 3-3 TCQSM

Reliability

- ▶ important for passengers
 - to arrive on time at their destination
 - having not to wait too long at a stop/station
- ▶ impacts the schedule recovery time
 - which further influences the operating cost when recovery time requires extra vehicle
- ▶ Unreliable operations can cause **bus bunching**.

Factors influencing reliability

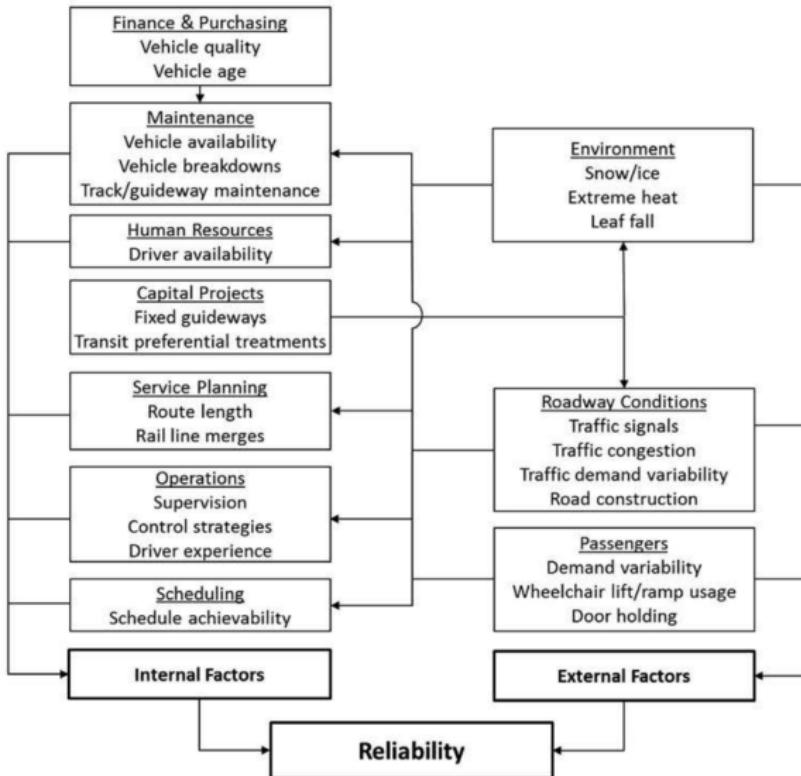


Figure: Exhibit 3-5 TCQSM

Dwell time

Definition (Dwell time). Time spent at a stop/station serving passengers movements, including the time required to open and close doors³.

Dwell time components

- ▶ Passenger boarding and alighting counts
- ▶ Fare payment procedure
- ▶ Vehicle type and size
 - Low-floor buses require less dwell time
 - Multiple doors in metro require less dwell time
- ▶ In-vehicle circulation
 - Boarding and alighting occurs slowly when standees are present
 - Passengers using front door to alight

Remark. More dwell time decreases the capacity and average speed.

³time spent at stop for other reasons (waiting for traffic signal, etc.) is not counted part of dwell time.

Operating environment

- ▶ **Mixed traffic:** shared lane operation with general traffic
- ▶ **Semi-exclusive:** a lane partially reserved for transit use, but others can use it at certain times/locations
- ▶ **Exclusive:** a lane, portion of roadway, or ROW reserved for transit use at all times, but still affected by some traffic interference
- ▶ **Grade-separated:** a facility dedicated to exclusive use of transit vehicles

More exclusive the ROW, less is the interaction of transit vehicles with other modes resulting in more speed and lesser headway variability. The interaction can be in form of traffic control, traffic delays, or speed restriction.

Stop and station characteristics

- ▶ Vehicle-platform interface affects transit speed and capacity
 - height differential between vehicle and platform
 - platform position relative to guideway
 - no. of transit vehicles that can stop simultaneously
- ▶ Vehicle characteristics affects dwell time and maneuvering
 - # of doors available for use
 - seating arrangement inside the vehicle
- ▶ Fare collection affects dwell time
 - on-board (whether separate conductor present)
 - fare collection procedure
- ▶ Stop spacing
 - more frequently vehicle stops, more time lost in accelerating and decelerating
 - interference due to signal control

Transit performance points of view

Stakeholder Interest Areas	Performance Measure Examples	
Stakeholders	TRAVEL TIME	<ul style="list-style-type: none">▪ Transit-auto travel time▪ Transfer time
	AVAILABILITY	<ul style="list-style-type: none">▪ Service coverage▪ Service denials▪ Frequency▪ Hours of Service
	SERVICE DELIVERY	<ul style="list-style-type: none">▪ Reliability▪ Comfort▪ Passenger environment▪ Customer satisfaction
	SAFETY AND SECURITY	<ul style="list-style-type: none">▪ Vehicle accident rate▪ Passenger accident rate▪ Transit crime rate▪ Safety device inventory
	MAINTENANCE/CONSTRUCTION	<ul style="list-style-type: none">▪ Road calls▪ Fleet cleaning▪ Spare ratio▪ Construction impact
	ECONOMIC	<ul style="list-style-type: none">▪ Ridership▪ Average fleet age▪ Cost efficiency▪ Cost effectiveness
	TRANSIT IMPACT	<ul style="list-style-type: none">▪ Economic impact▪ Employment impact▪ Environmental impact▪ Mobility
	CAPACITY	<ul style="list-style-type: none">▪ Vehicle capacity▪ Person capacity▪ Roadway capacity▪ Volume-to-capacity ratio
	TRAVEL TIME	<ul style="list-style-type: none">▪ Delay▪ Average system speed

Figure: Exhibit 4-1 TCQSM

QoS factors: survey results

Comfort, nuisances, scheduling, fares, cleanliness, in-person information, passive information, safety, transfers, hours of service, frequency of service, convenience of routes, on-time performance, travel time, transferring, cost, information availability, vehicle cleanliness, ride comfort, employee courtesy, perception of safety, bus stop locations, and overall satisfaction.

Transit trip decision making process: Availability

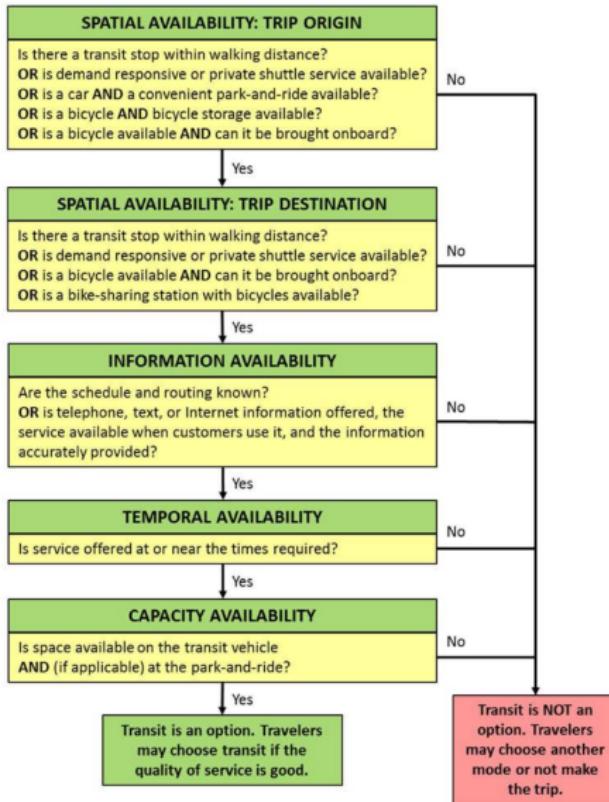


Figure: Exhibit 4-9 TCQSM

Transit trip decision making process: Comfort and convenience

- ▶ Passenger loading
 - less attractive if passengers have to stand for long periods of time due to crowding
- ▶ Reliability
 - affects wait time at stop for a transit vehicle to arrive and time of arrival at destination
 - encompasses both on-time performance and regularity of headways between successive transit vehicles
 - causes: traffic conditions, road constructions and track maintenance, vehicle and staff availability, line merges, route length, etc.
- ▶ Travel time
 - access, waiting, in-vehicle, transfer, egress time
- ▶ Safety and security
- ▶ Cost
- ▶ Appearance and comfort (climate control, seat comfort, ride comfort, and amenities)
- ▶ Customer relations

Fixed route QoS (quantifiable)

Availability

- ▶ Frequency
- ▶ Service span
- ▶ Access

Comfort and convenience

- ▶ Passenger load
- ▶ Reliability
- ▶ Travel time

Suggested reading

All material is taken from the following report:

- ▶ Transit capacity and quality of service manual, 3rd Edition [Link]
(Chapters 1-5)

Thank you!