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TRB Webinar: Planning and Assessing Ferry System Capacity

April 11, 2023

2:00 – 3:00 PM



AICP Credit Information

1.0 American Institute of Certified Planners Certification Maintenance Credits

You must attend the entire webinar

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Purpose Statement

This webinar will provide an overview of the pre-published TCRP Report 238: Quantitative Procedures for Designing and Operating Ferry Services. The report presents guidance for scheduled and fixed-route transit services and facilities that serve passengers and vehicles. Presenters will define the capacity of a ferry system and its challenges and provide quantitative procedures for designing and operating ferry services.

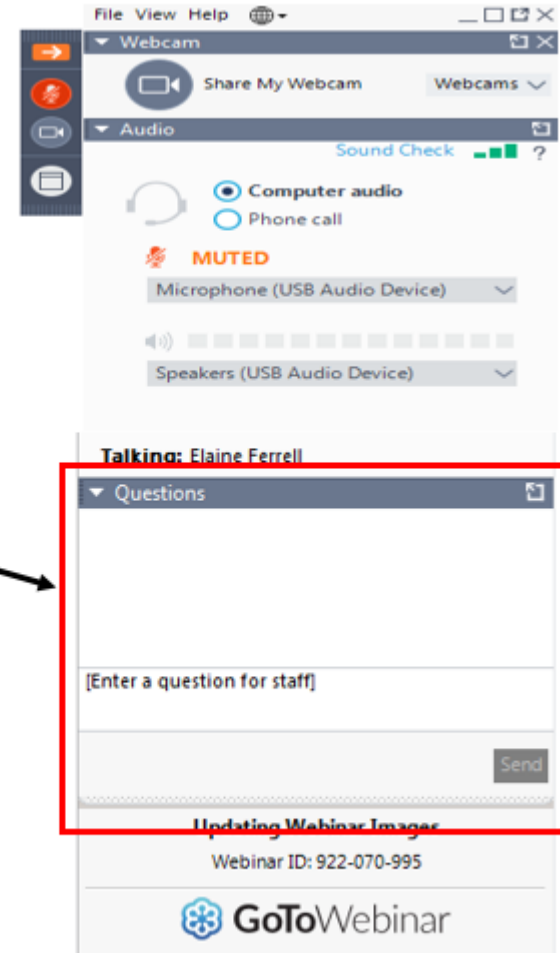
Learning Objectives

At the end of this webinar, you will be able to:

- Identify how ferry system elements, including operating conditions and assets, are related and affect overall system capacity
- Quantify and assess passenger and vehicle movement
- Address capacity challenges through design of infrastructure investments, operations, and service planning

Questions and Answers

- Please type your questions into your webinar control panel
- We will read your questions out loud, and answer as many as time allows



Today's Presenters



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TCRP Research Report 238: Quantitative Procedures for Designing and Operating Ferry Systems

- Research Team and Contributors
- Overview and Research Approach
- Passenger Throughput Observation
- Application: Passenger-Only Ferry Service
- Application: Vehicle-Passenger Ferry Service

Next Steps and Further Research Needs

Research Team

KPFF

Authors:

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Contributors:

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Passenger Throughput Data Collection and Analysis:

Anthony Bruzzone, Sr. Transportation Planner

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Contributors

TCRP Staff

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Panel

Justin Resnick (Panel Chair), *Washington State Ferries*
Martha Bewick, *The Harbor Consultancy International*
Richard Bickel, *Econsult Solutions, Inc.*
Charles Carr, *Office of Intermodal Planning, Mississippi DOT*
Alan Danahar, *WSP*
Mike Gougherty, *San Francisco Bay Ferry*
Peter Martin, *CDM Smith*
Peggy Tadej, *Northern Virginia Regional Commission (NVRC)*
James Wong, *NYC Ferry, New York City Economic Development Corporation*

FTA Liaison

Steve Truong
Vanessa Williams

TCRP Research Report 238 – Approach

Objective: Develop quantitative procedures for designing and operating scheduled and fixed route ferry services and facilities.

- Focus on passenger and vehicle service
- Build upon existing capacity procedures and ferry system background in previous reports
- Focus on key capacity concepts and elements

Audience: Existing ferry operators and transit decision-makers looking to address capacity challenges.

Need for Research: Ferry services are complex and dynamic systems

- Vessels and terminals are long-term, costly investments

Information Sources

Literature Review

- TCRP reports
- Ferry system planning documents, including feasibility studies and terminal design standards
- Transportation system planning guidance for other transit modes

Ferry Operator Questionnaire

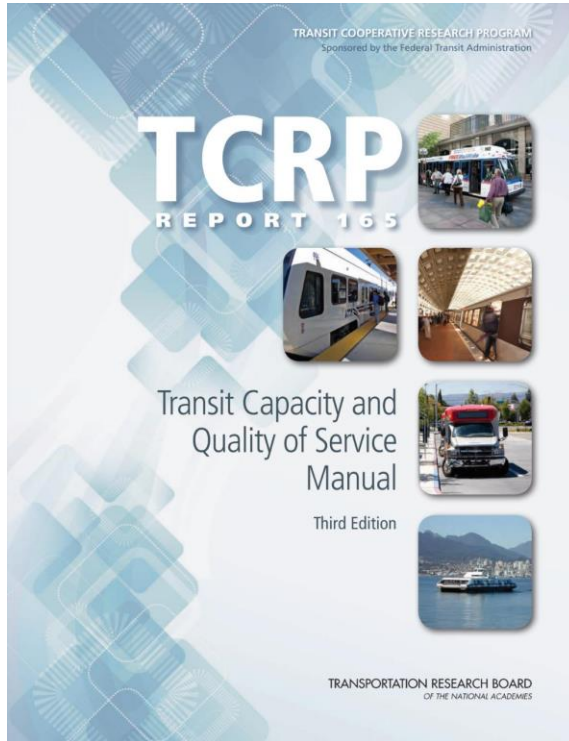
- Responses were received 5 passenger-only and 5 passenger and vehicle ferry operators

Terminal Passenger Throughput Observation

- On-site observations & security camera footage review



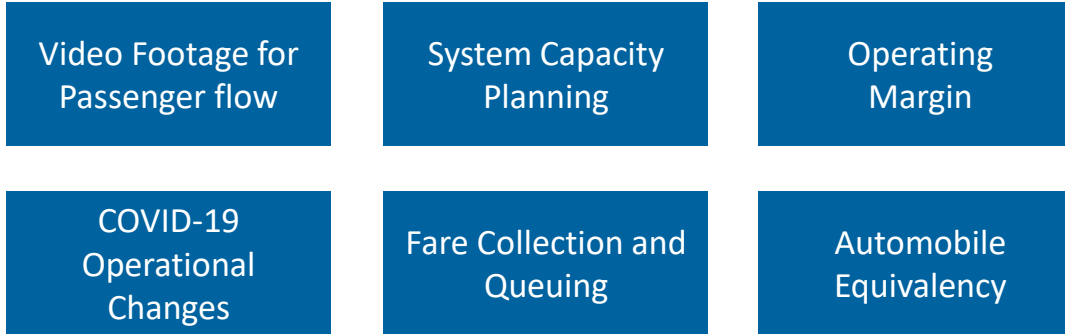
Previous Studies Ferry Studies



- 1980, Functional Designs of Ferry Systems (*prepared for Maritime Administration, U.S. DOT*)
- 2012, TCRP Report 152: Guidelines for Ferry Transportation Planning
- 2013, TCRP Report 165: Transit Capacity and Quality of Service Manual, Third Edition
- 2013, TCRP Synthesis 102: Integrating Ferry Services with Mass Transit

Operator Survey

Operator Survey - focus areas of questions:



Vehicle Ferry System / Respondent	Passenger-Only Ferry System / Respondent
BC Ferries (B.C. Canada)	HADAG (Hamburg, Germany)
BKV (Budapest, Hungary)	King County Water Taxi / King County Metro, Marine Division (WA)
Cape May-Lewes Ferry / Delaware River and Bay Authority (NJ/DE)	Kitsap Fast Ferry / Kitsap Transit (WA)
Steamship Authority (MA)	NYC Ferry / New York Economic Development Corporation (NYCEDC) (NY)
Washington State Ferries (WA)	San Francisco Bay Ferries / Water Emergency Transportation Authority (WETA) (CA)

Operator Survey Findings

- **Analysis of passenger flow rates:** operators provided video footage for data collection.
- **COVID-19:** most operators do not anticipate lasting impact to operations aside from a continued shift toward contactless payment.
- **System capacity planning:** best practices included detailed collection and review of ridership and vessel utilization data, and standardization of fleet and terminal assets to allow for flexibility and interoperability.
- **Fare collection and queuing:** methods and location, queuing layout, lane and ramp widths, and some queuing management best practices.
- **Operating margin:** most operators indicated extra time is built into the schedule on certain routes/sailings in different ways to maintain on-time sailings.
- **Automobile Equivalency:** provided guidance on standard auto equivalent unit sizes used for capacity planning.

Passenger Throughput Observation

Research Hypothesis

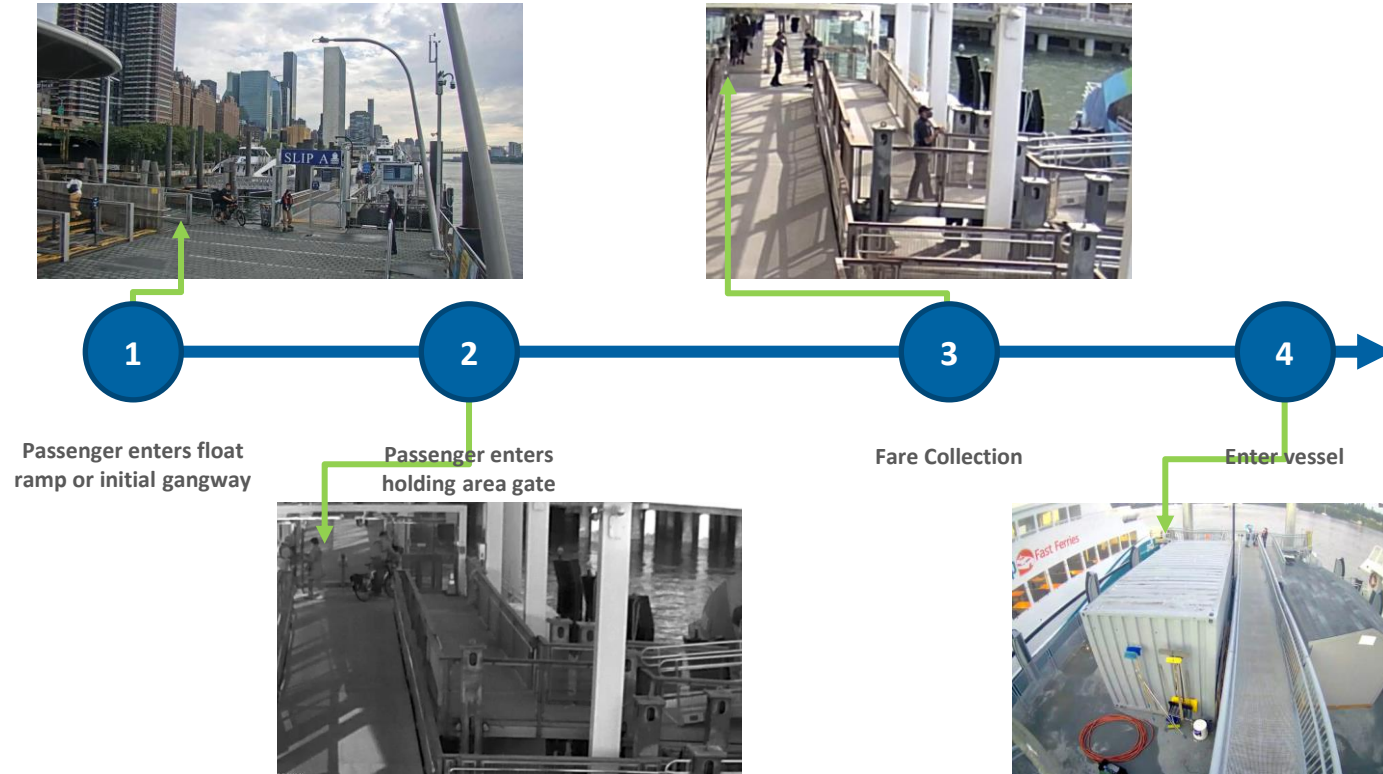
Ramp width and slope will be primary capacity constraints for passenger throughput

Methodology

1. Conduct in-person observations for passenger ferry terminals in Seattle, New York City, and San Francisco/Oakland and measure ramp slope and width at observation locations
2. Collect and review security camera footage at piers for the 3 busiest hours in the AM and PM peak periods
3. Sample individual passengers and measure walk speed between 2 travel points
4. Collect data on high/low tide, gangway high/low tide gangway slope, ramp width, observation length, walk speed, passenger throughput, and docking duration



Passenger Throughput – Capacity Constrain Points



Empirical Research Limitations

Benefits

- Represents real-life observations (rather than modeled results)
- Generally, less biased (data collection can be replicated and validated)
- Flexible

Limitations

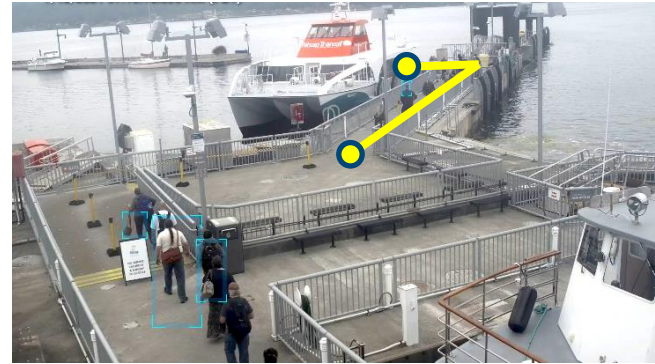
- Small sample size can limit broad findings or generalizations
- Small sample size can also skew results (ideally would have more days/seasonal data to average results)
- Time consuming



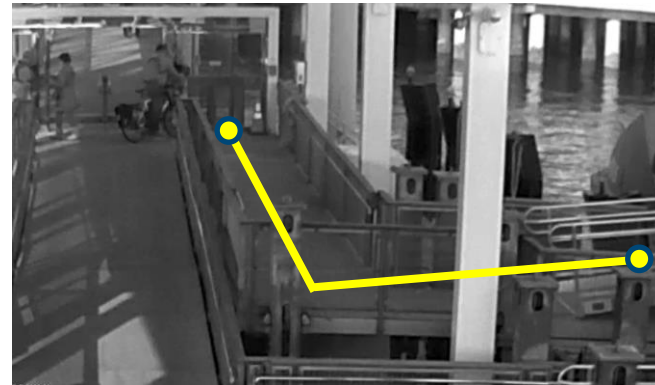
Passenger Throughput Observation

Terminal Locations and Travel Time Points

- Seattle, WA:
 - Bremerton Ferry Terminal
 - Seattle Pier 50
 - Kingston Ferry Terminal
- New York City, NY
 - Wall Street/Pier 11 A
 - Wall Street/Pier 11 B
 - Brooklyn Bridge Park/Pier 6
 - East 34th Street A
 - East 34th Street B
- San Francisco Bay Area, CA
 - Alameda Ferry Terminal
 - Oakland/Jack London Square
 - San Francisco Ferry Building Gate E
 - San Francisco Ferry Building Gate F
 - San Francisco Ferry Building Gate G



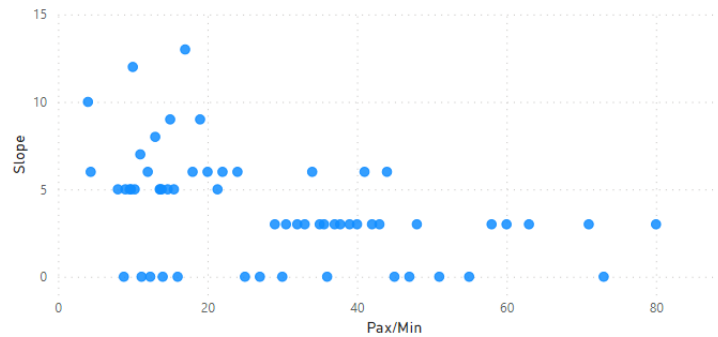
Bremerton Ferry Terminal



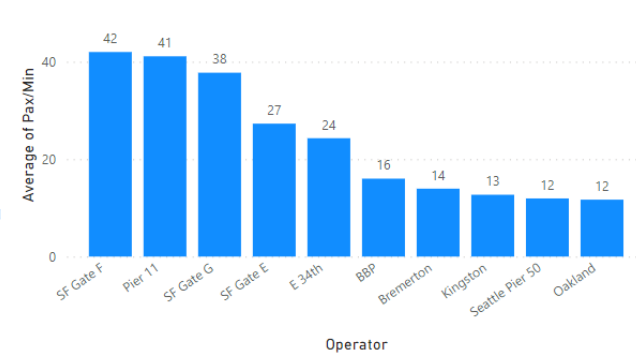
San Francisco Ferry Building Gate F

Data Observations

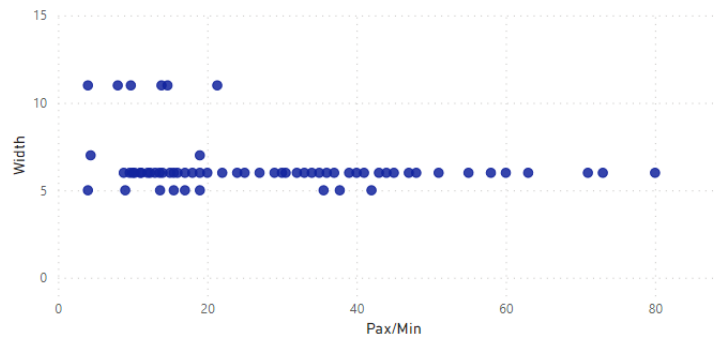
Slope by Pax/Min



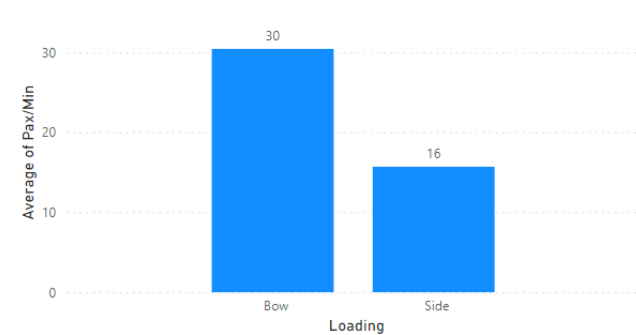
Average of Pax/Min by Operator



Pax/Min and Width



Average of Pax/Min by Loading



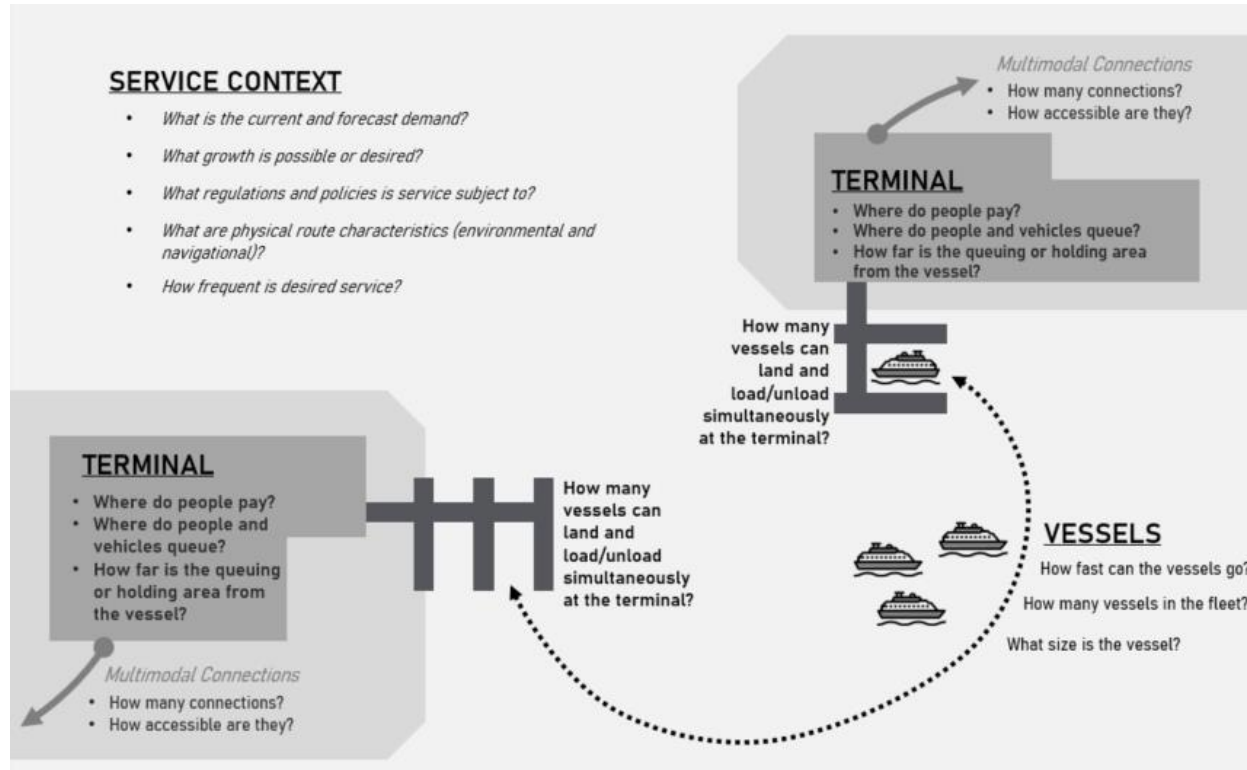
Findings

1. Changes to ramp slope and width **results in insignificant changes to passenger throughput**
2. **Door width is primary constraint for passenger throughput.**
Minor increases in door width are negligible but operators can roughly double passenger throughput by doubling door width
3. **Ramp length between holding gate and vessel doors impacts average passenger throughput** as passengers can board faster
4. Estimates from **previously developed spreadsheet-based model for Transit Capacity and Quality of Service Manual are consistent** with site observations and review of security footage

TCRP Research Report 238 Report Overview

- **Chapter 1: Introduction**
- **Chapter 2: Fundamentals of Ferry Capacity**
 - Vessel and Fleet Planning
 - Terminal Capacity and Design
 - Sailing Frequency
 - Governance and Policy Factors
- **Chapter 3: Capacity Concepts and Analysis: Passenger-only Ferries**
 - Optimizing the Service Schedule
 - Passenger Facility Capacity Planning and Minimizing Dwell Time
- **Chapter 4: Capacity Concepts and Analysis: Vehicle Ferries**
 - Optimizing the Service Schedule
 - Understanding Vessel Capacity and Vehicle Demand
 - Vehicle Facility Capacity Planning and Minimizing Dwell Time
- **Chapter 5: Application: Example Capacity Procedures Use**
 - Example 1 – Passenger-Only Ferry
 - Example 2 – Vehicle Ferry
- **Chapter 6: Procedures Application and Strategies for Implementation**

Ferry System Elements and Interconnections



Capacity of the system depends on many related factors

Passenger-only Ferries: Key Concepts

Best practices for:

- Scheduling
- Fare collection location
- Bicycle loading & unloading
- Queuing Space Design



Capacity Concept	Description
Passenger-only Ferries	
Equation 1: Calculating Operating Margin	Estimate the time needed to account for typical delays and longer than average dwell times
Equation 2: Passenger Boarding Station Throughput	Estimate the passenger throughput of a given vessel boarding station

Vehicle Ferries: Key Concepts

Best practices for:

- Fare collection
- Bicycle loading & unloading
- Holding area capacity
- Passenger counting



Capacity Concept	Description
Vehicle Ferries	
Equation 3: Using AEU to calculate Vehicle Capacity of the Vessel	Apply automobile equivalent units (AEU) to calculate the number of standard-sized vehicles that can be carried on a vessel
Equation 4: Estimating Vehicles Left Behind	Estimate the number of vehicles in a linear queue by the distance from the terminal
Equation 5: Sizing Vehicle Fare Collection Facilities	Estimate the number of toll booths needed to process vehicles at a targeted rate

Application: Urban Passenger-Only Ferry

A passenger-only ferry operator with multiple vessels on multiple routes in an urban area needs to service growing demand. The operator needs to know if a busy hub can support additional service during the peak morning and evening commute periods, and plan operational and capital improvements to increase capacity.



Application: Urban Passenger-Only Ferry

Process:

1. Evaluate current berthing capacity of existing terminal
 - Calculate the maximum number of vessel landings per hour: Equations 9-1 and 9-5 of the TCQSM (2013)
2. Evaluate current passenger throughput and dwell time
 - Calculate embarking and disembarking times for each vessel landing using Equation 9-3 of the TCQSM (2013)
3. Assess the feasibility of service schedule adjustments
 - Calculate the operating margin used on each route using Equation 1

$$O_m = T_T - (T_r + M_t + D_t)$$

Operatin
g margin

Schedule
d trip
time

Trans
it
time

Maneuv-
ering time

Dwell
time

Application: Vehicle Ferry



An agency that serves passengers and vehicles with one vessel on a lifeline route is planning to replace their aging vessel. This is a major investment that is expected to serve the route for at least 30 years. The agency is seeking guidance on how to size the replacement vessel to serve current and forecast demand.

Application: Vehicle Ferry

Process:

1. Establish desired level of service (how many vehicles are planned to be carried over a given period)
2. Establish the automobile equivalent unit (AEU) to calculate vessel capacity requirements

$$V_S = L / (AEU + S) + C$$

- Calculate vessel capacity using Equation 3

Number of vehicles Linear feet of straight lanes Space between vehicles Number of vehicles in curved lanes

3. Assess vessel size and service frequency tradeoffs
4. Assess the impact on dwell time of using a larger vessel
 - Calculate the time required to load and unload vehicles using Equation 9-4 of the TCQSM (2013)

5. Explore options for monitoring level of service

- Estimate the vehicles left behind using Equation 4

$$V_{LB} = L / (AEU + S)$$

Vehicles left behind Linear feet of queuing lanes Space between vehicles

Additional Research Recommendations

Research Report 238 identifies gaps in data related to ferry capacity planning that could not be included within the scope of this project but are recommended for future research. Some of the identified gaps include:

- **Alternative vessel propulsion** – potential impacts to terminal and schedule capacity
- **Climate change** – impacts to terminal and vessel design
- **Freight** – practices for incorporating freight with passenger and vehicle ferry service
- **Passenger flow rate modeling** – Calibrate and validate baseline passenger throughput model and make adjustments to slope, ramp width, door width, range in walk speeds, to test interventions that maximize passenger throughput

Today's Presenters



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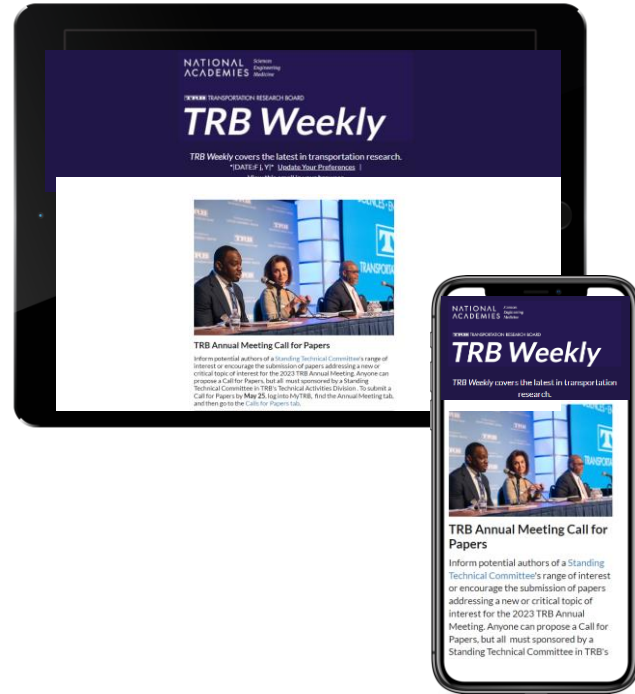


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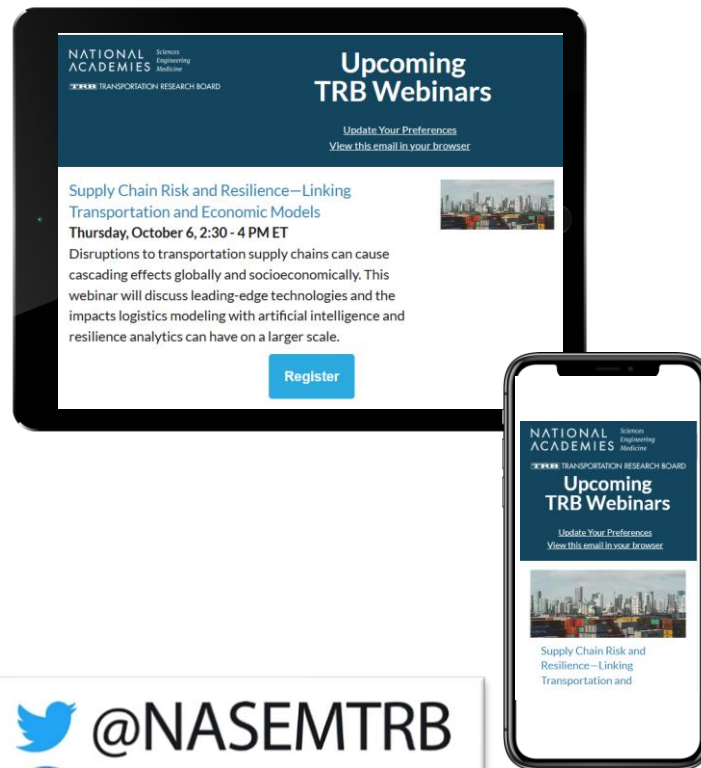
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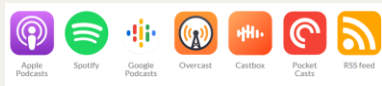
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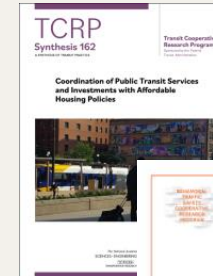
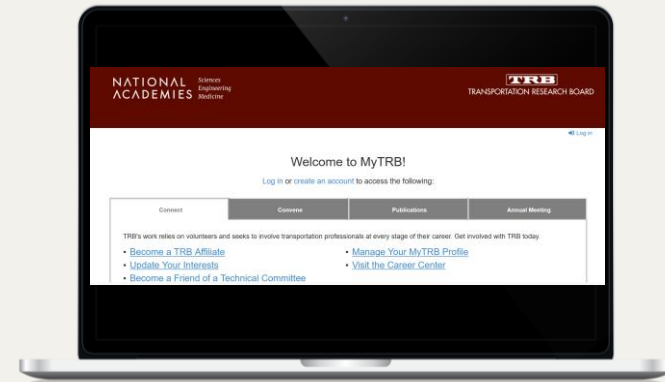
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