September 24, 2019

QUICK RESPONSE FREIGHT METHODS (QRFM III) UPDATE

Learn more about the latest QRFM update and leveraging its methods in development of State Freight Plans.

U.S. Department of Transportation
Federal Highway Administration

AGENDA

1. **QRFM III Overview and Webinar Purpose**

    Birat Pandey, FHWA

2. **Leveraging Freight Analysis for State Freight Plans**

    Tiffany Julien, FHWA

3. **QRFM III Contents and Organization**

    Dan Beagan and Dan Tempesta, Cambridge Systematics

4. **Q&A / Discussion**
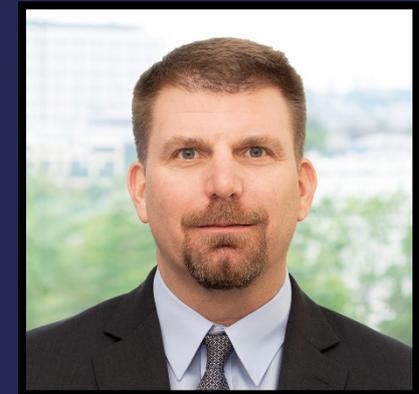
PRESENTER INTRODUCTIONS

Birat Pandey, P.E.
Freight Analysis and Data Manager, FHWA

Tiffany Julien
Transportation Specialist, FHWA

Daniel Beagan, P.E.
Principal, Cambridge Systematics

Daniel Tempesta
Northeast Regional Forecasting Manager, Cambridge Systematics

OVERVIEW

Webinar series on the latest freight analysis resources and research.

1. **Quick Response Freight Methods (QRFM III) Update**

2. Update to Freight Analysis Framework (FAF) Tool for Estimating Truck Flows

3. Exploratory Research and New Tools in Freight Data and Analysis

LEARNING OBJECTIVES

This webinar aims to:

Increase your understanding of QRFM III content coverage

Enhance knowledge on available resources to help make decisions on uses of freight data and methods for more effective freight transportation planning and analysis.

EVOLUTION OF QRFM III

- QRFM I – 1996:
    - Make freight information background available
    - Locate freight related data
    - Provide simple techniques and transferable parameters for four-step models and site planning

- QRFM II – 2007:
    - Update 1996 Manual
    - Provide freight methods appropriate for different geographic and temporal scales
    - Provide alternative analysis methods, data sources, and data collection methods to improve the accuracy of freight forecasts

EVOLUTION OF QRFM III

- QRFM III – 2019:
  - Quick Response Freight Manual is now Quick Response Freight Methods.

  - Informational and descriptive resource, not prescriptive.

  - Background information on the freight transportation system and factors.

  - Provides options that use various data sources and analysis methods to prepare freight demand and forecasts.

  - Simple techniques and elements used to develop freight forecasts.

STATE FREIGHT PLAN

49 U.S.C. 70202 lists ten required elements that all State Freight Plans must address for each of the transportation modes.

STATE FREIGHT PLAN

Fast Act Requirements

- **Requirement # 1:** Identification of significant freight system trends, needs, and issues. Key issues confronting the freight system (present and future).

- **Requirement # 2**: Description of freight policies, strategies, and performance measures guiding transportation investment decisions.

- **Requirement # 3**: When applicable, a listing of…
  - Multimodal critical rural freight facilities and corridors designated within the State under Section 70103 of Title 49; and
  - Critical rural and urban freight corridors designated within the State under Section 167 of Title 23.

STATE FREIGHT PLAN

Fast Act Requirements

- **Requirement # 4:** How the plan will improve the ability of the State to meet the goals of the National Multimodal Freight Policy and the National Highway Freight Program?

- **Requirement # 5**: Innovative technologies and operational strategies that improve the safety and efficiency of freight movement.

- **Requirement # 6**: Description of improvements that may be required to reduce or impede the deterioration due to heavy vehicles.

- **Requirement # 7:** An inventory of facilities with freight mobility issues, such as bottlenecks, and mitigation strategies.

STATE FREIGHT PLAN

Fast Act Requirements

- **Requirement # 8**: Consideration of any significant congestion or delay caused by freight movements and mitigation strategies.

- **Requirement # 9**: A freight investment plan that includes a list of priority projects and describes how funds would be invested and matched.

- **Requirement # 10:** Consultation with the State Freight Advisory Committee, if applicable.

IMAGE SOURCE

All image sources are FHWA, unless otherwise indicated.

QUICK RESPONSE FREIGHT METHODS

2019 Update of the QRFM III available online at:
https://ops.fhwa.dot.gov/freight/resources/bookshelf/index.cfm

QRFM III CONTENTS

- Part A – Introduction

- Part B – Data

- Part C – Methods

- Part D - Applications

Third Edition

Quick Response Freight Methods

July 2019

U.S. Department of Transportation
Federal Highway Administration
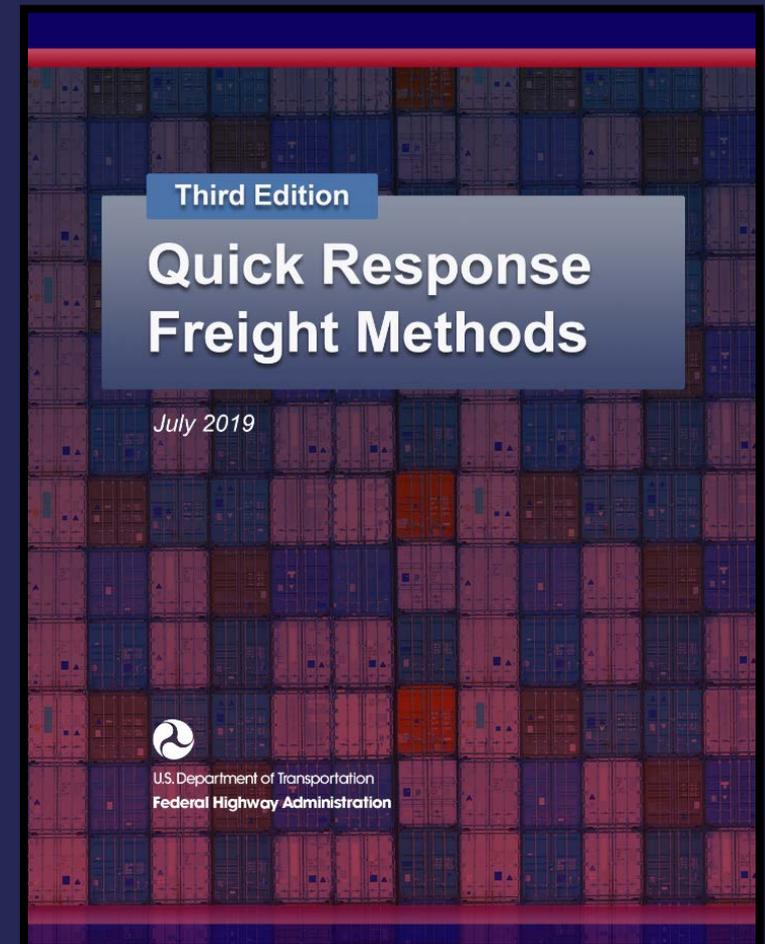
PROGRESSION OF TRUCK MODELING

U.S. Department of Transportation
Federal Highway Administration

Factor Auto Trips → Truck Generation Rates (QRFM I) → O-D Matrix Estimation (ODME) → Commodity Flows → Truck Touring Models → Supply Chain Models

- Factor Auto Trips – factor auto table to obtain truck tables

- Truck Generation Rates – QRFM I: light, medium, heavy rates

- ODME – Build a truck table from count data

- Commodity Flows – Convert goods flows to truck flows

- Truck Touring – Intra-city truck movements

- Supply-Chain – Freight logistics modeling

FACTORS THAT AFFECT FREIGHT

Economic Structure

- **Who moves freight?**

Supply Chains and Logistics

- **Where does freight move?**

Cost and Service by Mode

- **How does freight move?**

Freight Flows

- **What and how much freight is moved?**

Organization and Public Policy

- **Why does freight move the way it does?**

All Trucks

Urban Trucks

All Freight
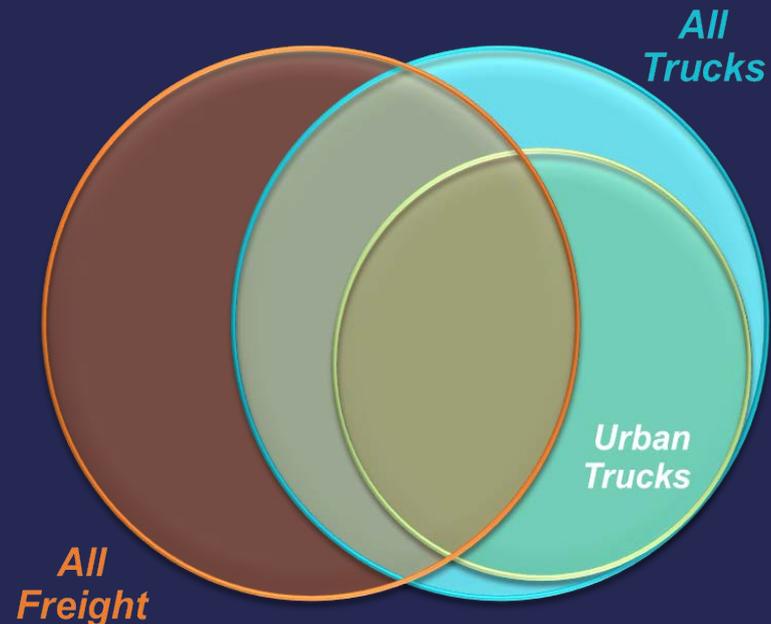
PART B: DATA

- Existing Data

- Data Collection

EXISTING DATA: ORIGIN-DESTINATION (O-D) FLOWS

Multimodal Commodity Origin-Destination Tables

- FAF

- Commodity Flow Survey

- IHS Markit's TRANSEARCH Data TRANSEARCH
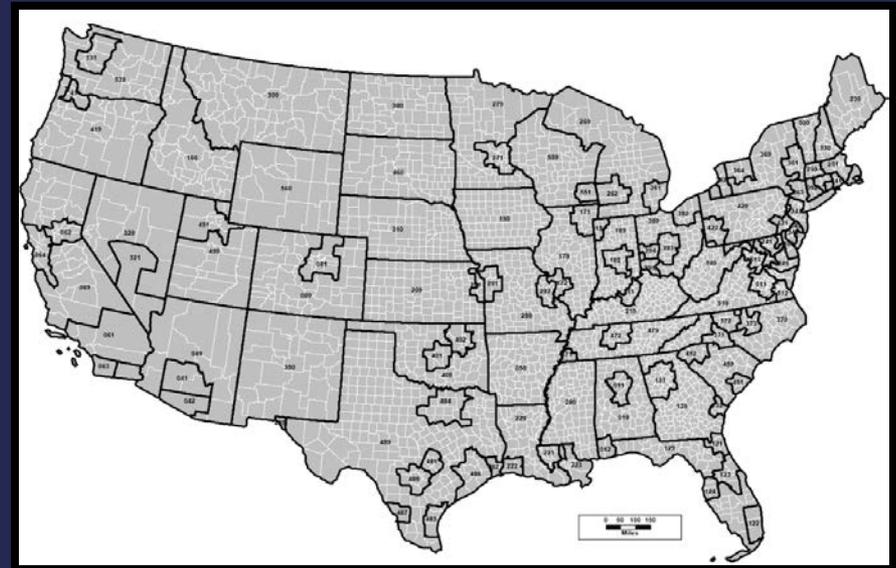
EXISTING DATA: SYSTEM USAGE

Mode-Specific Data

- Vehicle Inventory and Use Survey (VIUS)
- Carload Waybill Sample
- Waterborne Commerce Statistical Database
- Travel Monitoring Analysis System (formally VTRIS)

EXISTING DATA: NETWORK

Freight Network and Infrastructure

- Multimodal Freight Network
- National Transportation Atlas Database
- National Transportation Research Center
- Mode-specific sources:
    - Federal Highway Administration
    - Federal Railroad Administration
    - U.S. Army Corps of Eng. Marine Freight
    - Federal Aviation Administration

Average Daily Long-Haul Truck Traffic on the National Highway System: 2015

Flow Scale (FAF Truck/Day)

Note: Major flows include domestic and international freight moving by truck on highway segments with more than twenty five FAF trucks per day and between places typically more than fifty miles apart.
Source: U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework, version 4.3, 2017.

EXISTING DATA: EMPLOYMENT

Employment/Industry Data

- U.S. Bureau of Labor Statistics
- State Department of Labor
- Current Employment Statistics
- U.S. Bureau of Economic Analysis
- Local Area Unemployment Statistics
- Occupational Employment Statistics
- U.S. Census Bureau's County Business Patterns
- U.S. Economic Census Industry Data

https://www.bls.gov/

LOCAL DATA COLLECTION

Local Freight Data Collection Methods

- Establishment Surveys
- Travel Diary Surveys
- Roadside Intercept Surveys
- Vehicle Classification Counts

New Survey Methods

- Public/Private Data Sharing
- Integration of Different Approaches
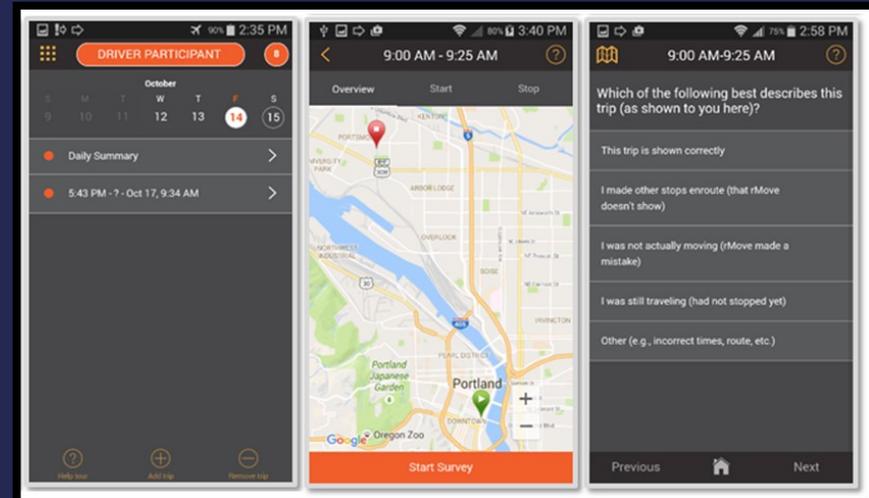
Example of a survey smartphone application.
(Source: Portland Metro.)

QRFM III PART C: METHODS

- Existing Forecasts: Use an existing forecasts

- Growth Factors: Edit an existing forecast

- Direct Acquisition of Commodity Flows: Use existing O-D flows

- Trip Based Forecasting: Combine commodity flow data with local data to develop rates

- Freight Supply Chain and Non-Freight Truck Touring: Advanced Activity/Tour-based approach

EXISTING FORECASTS

Existing Forecast: Use an existing study/report to support your project

Pros:
- Readily available
- Prepared/vetted by others
- Few special resources required

Cons:
- Forecast may not be consistent with local data/plans
- Demand stratification may not match areas of local interest
- Indirect impacts may not be considered

GROWTH FACTORS

Growth Factor Forecast: Factor an existing forecast O-D tables or assignments for your study

Pros:
- Can focus on specific facilities
- Limited resources required
- Uses readily available data

Cons:
- Cannot change usage and performance of background flows
- New facilities may not have been considered in forecast preparation

DIRECT ACQUISITION

U.S. Department of Transportation
Federal Highway Administration

Direct Acquisition Forecast: Acquire existing forecast O-D tables and assign them for your study

Pros:
- Local network usage and performance can be forecast
- Consistency with national forecasts
- Required resources can be modest

Cons:
- Uses trip tables, as is
- Indirect impacts not captured
- Data may be inconsistent with local data

TRIP-BASED

Trip-Based Forecasting: Development of O-D tables using estimated processes and assigning them for your study

Pros:

- Inclusion of local economic data and forecasts
- Predicts O-D table flow and routing changes
- Usage and performance for specific commodities and/or truck types

Cons:

- Substantial data resources required
- Special treatment of intermediate stops

TRIP-BASED FORECASTING: MAJOR COMPONENTS

Trip Generation

- Outliers
- Tons exceed employment
- Employment exceed tons

Trip Distribution

Mode Shares or Mode Choice

Payload Factors

Assignment

All Commodity Groups Freight Productions
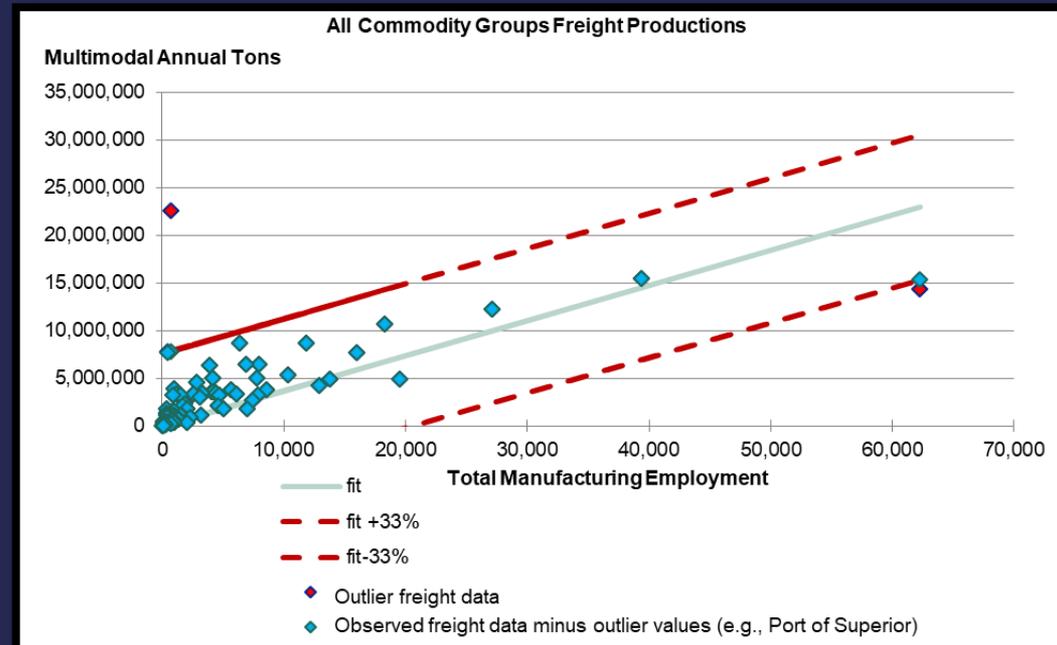
TRANSFERABILITY OF PARAMETERS

Trip Generation

- Region needs to have similar economy
- Must use same commodities or groups

Trip Distribution

- Region needs to have similar economy AND trading partners

Mode Shares

- Region needs to have similar economy AND trading partners AND mode availability

Payload Factors

- Region needs to have similar commodity groups

SUPPLY-CHAIN AND TOURING MODELS

Freight Supply-Chain Modeling

- Firm Synthesis
- Determined by the utility of each modal link or trip in the supply chain
- Considers level of service at the transfer points between trips along the supply chain (transport logistics nodes)
- Cargo is maintained throughout the entirety of the supply chain – Multimodal

Touring Models - Non-Freight

- Vehicle and tour pattern choice
- Number of tours and stops
- Stop sequence and duration
- Delivery time of day

NON-FREIGHT TRUCKS

- Traditional trip generation and distributions steps

- Light, Medium, and Heavy Trucks

- Generates origins and destinations (same rates for Origins and Destinations)

- Distributed using gravity models

- Combined with freight trucks to get total trucks
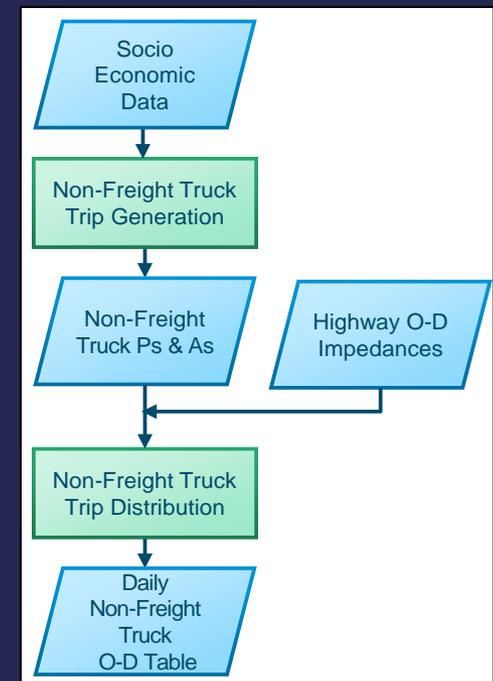
ASSIGNMENT

Assignment Type
- Preload
- Multiclass or simultaneous

Time of Day Factors
- Trip based – splitting of trip tables

Roadway Capacity and Congested Speeds
- Passenger Car Equivalents (PCEs)

Truck Values of Time
- Commodity sensitively to pricing and tolls

Truck Prohibitions

VALIDATION

Trip Generation
- Market sector
- Geography

Trip Distribution
- Average trip length
- Frequency plots

Mode Split
- Independent validation may not be possible

Assignment
- Vehicle classification counts
- A truck is a truck, regardless of what it carries
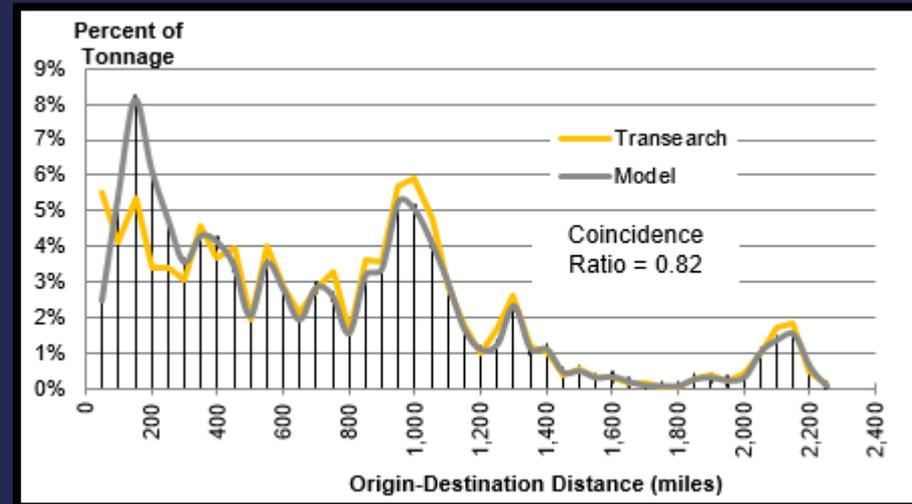
QRFM III PART D: APPLICATION ISSUES

- Controlling Factors: Shipment size/frequency, reliability, sensitivity to congestion and route resiliency

- Data Collection: Limited resources, transferability of parameters

- Growth Factoring: New facilities or changing markets

- Network And Zone Structure: Regions outside of the study area

- Developing and Assigning a Trip Table: Generation, Distribution, Mode Share/Choice, Flow Conversions, Assignment

- Integration with Passenger Models

- Visualization

CASE STUDIES

- California Statewide Freight Forecasting Model

- Florida Department of Transportation Model

- Iowa Statewide Traffic Analysis and Iowa Freight Optimization Models

- Maricopa Association of Governments Model

- Memphis Metropolitan Planning Organization Truck Model

- New York Metropolitan Transportation Council Best Practice Model

CASE STUDIES

General Information
- Usage
- Methodologies

Coverage
- Geography
- Modes
- Commodities

Forecast Details
- Freight Table
- Non-Freight Table
- Modal Network Assignment
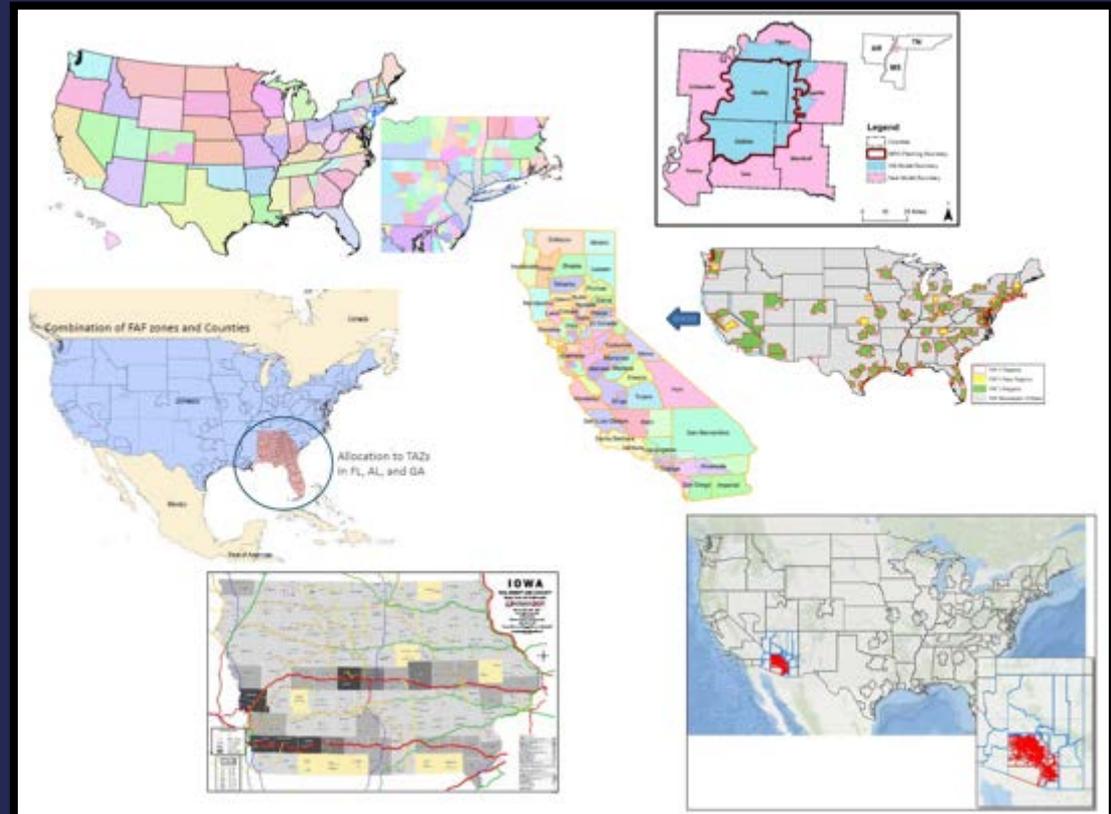
CASE STUDY METHODS

California Statewide Freight Forecasting Model

- FAF-based, four-step commodity-based model capable of capturing high-level interactions between various industries

Florida Department of Transportation Model

- Uses supply chain and economic methods to explicitly model various aspects of freight decision making behavior

Iowa Department of Transportation Iowa Statewide Traffic Analysis Model and Iowa Freight Optimization Model

- Integrated commodity flow, long distance, and passenger forecasting model

CASE STUDY METHODS

Maricopa Association of Governments Model

- Behavioral-based freight model covering the majority of the freight and truck movement in the State of Arizona

Memphis Metropolitan Planning Organization Truck Model

- Trip-based model, considering truck freight as an external model and non-freight truck model as the internal model

New York Metropolitan Transportation Council Best Practices Model

- Activity/tour-based model for regional demand forecasting

INTERACTIVE WEBSITE

WEBSITE CONTENT NAVIGATION

Table of Contents expands to show Part and Chapter contents for direct access

WEBSITE – FIGURE AND TABLES

U.S. Department of Transportation
Federal Highway Administration

Quick Response Freight Methods   **Third Edition**

Documentation

List of Figures
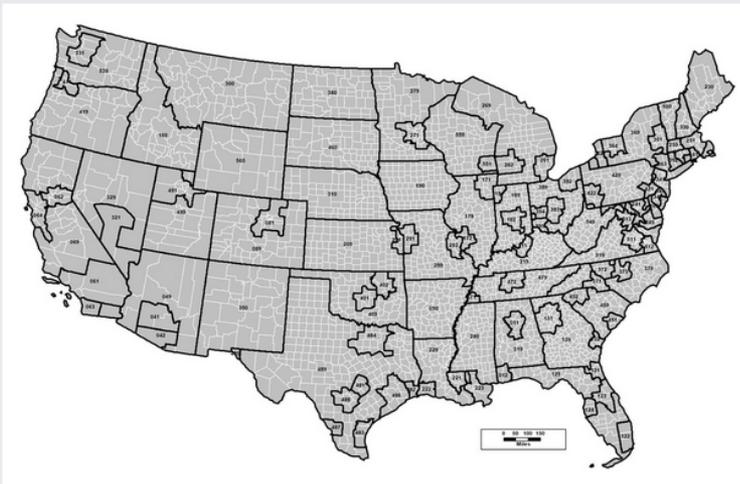
Table of Contents

Home
Documentation
Technical Report Documentation Page
SI Modern Metric Conversion Factors
List of Acronyms
List of Figures
List of Tables
Part A. Introduction
Part B. Data
Part C. Methods
Part D. Applications
Acknowledgements

Feedback

WEBSITE – FIGURE AND TABLES

WEBSITE – FIGURE AND TABLES

WEBSITE – SEARCH FUNCTION

Q&A

via Chat Pod and Phone

SUMMARY

- Informational and descriptive resource

- Broad audience of planners

- Data sources and analysis methods

- QRFM availability
  - Hard copy print version
  - Downloadable PDF
    https://ops.fhwa.dot.gov/freight/resources/bookshelf/index.cfm
  - Interactive website

CONTACT

Birat Pandey, P.E.

Federal Highway Administration
Office of Freight Management and Operations
U.S. Department of Transportation Headquarters Building E84-444
1200 New Jersey Avenue, SE
Washington D.C., 20590
202-366-2842

Birat.Pandey@dot.gov

QRFM@dot.gov