Freight Fluidity: Experiences from Maryland

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Defining Fluidity – "Themes"

- Multi-modal
- Spatially – covers freight network (and statewide)
- Temporally – covers times of interest
- Supply chains
- Origin-destination
- Performance – mobility (resiliency), reliability
- Quantity of goods moved
- Economic terms (costs, value)

Proposed Definition

"Freight Fluidity" is a broad term referring to the characteristics of a multi-modal freight network in a geographic area of interest, where any number of specific modal data elements and performance measures are used to describe the network performance (including costs resiliency) and quantity of freight moved (including commodity value) to inform decision-making.

Freight Fluidity Components

Components	Description	Selected Suggested Measures/Considerations[1]
Performance ("Ps")	How well are the links/nodes and network operating? Where are there bottlenecks in the system?	• Mobility (e.g., total delay, delay per mile, travel time index) • Reliability (e.g., planning time index) • Costs[2] (associated with delay, unreliability, wasted fuel)
	How well does the system (infrastructure, users, agencies) react to disruptions (i.e., how resilient is the system)?	Resiliency[3] has 4 aspects: • Robustness (ability to withstand disruption, measured in time) • Rapidity (time to respond and recover) • Redundancy (alternate route [capacity] availability/access within a certain travel time) • Resourcefulness (ability and time to mobilize needed resources)
Quantity ("Qs")	How much freight is moved (and where)?	• Volume (e.g., # of trucks, railcars, twenty-foot equivalent units [TEUs]) • Weight (e.g., pounds, tonnage) • *Commodity Value*[2]

[1-3]See TTI Document "Defining Freight Fluidity: A Framework for Implementation in Maryland and Beyond"

- Definition provides organizational framework for investment discussions and decisions
- Freight network quantified by *performance* and *quantity* components
- All measures ideally obtained by mode and commodity
- Resiliency considerations are within performance
- Costs in *performance* and value in *quantity* capture the economic impacts
- Scalable globally across modes

Fluidity Considerations: Data Sources

- Performance
  - Transit times (speeds)
    - Region-to-region
    - On a facility (to “edges” of a region)
  - Dwell times (transloads at “nodes”)
    - Or within a region
  - Supply chain resiliency
  - Associated costs (wasted time and fuel)
- Quantity
  - Volumes (# of trucks, railcars, TEUs)
  - Weight (pounds, tonnage)
  - Value
- By mode/commodity is vision
- Begin with trucks

Fluidity Considerations: Methodology

Option 1: Actual trip-based (ideal)

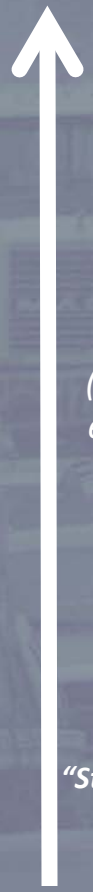
- Travel time sources
- Map to Traffic Analysis Zones (TAZs)
- Truck volumes matched to estimate vehicle-hours
- Develop mobility, reliability and quantity measures
  - Trip matrices of performance and quantity by origin-destination
- Ultimately link system performance to supply chains

Option 2: "Derived" Trip-based

- Facility-based data to develop travel time "trajectories" (traces)
- Rest as above
- We have data for this

Option 3: Facility-based (infrastructure vs. facility experience)

- Facility speeds
- Rest as above
- We have data for this



"State-of-the-art"

The lower the option #, the closer we get to what the user (mover of goods) experiences, and further away from what the infrastructure experiences.

"State-of-the-practice"

Fluidity Considerations: Methodology

Sample…

I-95 O-D	*BWI Airport*	*Port of Baltimore*	*Aberdeen, MD*	*MD/DE State Line*
BWI Airport				
Port of Baltimore	*Matrix contents are the "Ps and Qs"*			
Aberdeen, MD	*travel times (speeds), truck and all vehicle volumes, PTI, TTI, etc.*			
MD/DE State Line				

- Development of matrices (above)
  - IH-95 to demonstrate
  - Begin with *Maryland Mobility Report* data sources

Fluidity Considerations: Some Challenges (for the group to consider)

- Truck speed data acquisition
  - Data completeness
    - Particularly for long origin-destinations
    - "Ping rate" to complete matrices
    - Truck ID anonymizing
    - Urban vs. rural, arterial vs. freeway
- "Polygon" definitions
  - TAZ approach initially going forward
  - Tradeoff of
    - "too big" (not useful – to much variability) vs. "too small" (privacy)
- Multi-modal data acquisition
  - Possible phase 2 activity

Next Steps

- Demonstration of procedures using directly measured origin-destination travel time data
  - To better understand impact of regional O-D patterns on regional freight bottlenecks
- Expanding procedures to other modes
- Investigating commodity values along demonstration roadway
- Investigate/quantify highway resiliency components