Thank you for inviting me to join this panel. My perspective on this panel will be on the future trends that could potentially impact the demand side of freight transportation. I think this will complement the input from Bob Costello from ATA and my other panelists.

Specifically, I will focus on 4 mega-trends and discuss how it might impact shippers and then the implications for future transportation infrastructure or policy in 5, 10 + years.

My take on these mega-trends come from a few sources (to give you my biases and background):

- NCHRP 750 Report – Future Freight Flows
- Scenario Planning with >20 firms and other organizations on FFF
- Work with partners at CTL (>50 firms)
- Work with Chainalytics (Analytical SC and Transp)

The mega-trends in decreasing importance are:

1. Autonomous Trucks
2. Diversification of Retail Channels
3. Digitization & Decentralization of Manufacturing
4. Changing Face of Products & Product Ownership
Autonomous Vehicles

- Question is not if, but to what and when, and where and how it will impact supply chains.
- What and the When –
  - Tied together and where I am least knowledgeable
  - Boiling a frog – safety [collision mitigation systems, Integrated Safety Systems, Lane Departure Warning, and Blind Spot Detection]
    - No Automation (Level 0).
    - Function-Specific Automation (Level 1).
    - Combined-Function Automation (Level 2).
    - Limited Self-Driving Automation (Level 3).
    - Full Self-Driving Automation (Level 4):
  - When – faster than originally thought:
    - Otto (uber trucking) in Dec for first summit on Uber Freight
    - First paid autonomous delivery occurred in Colorado in Oct (ABI)
    - Initial window was 15 years, but they are releasing SW 2-3x weekly, and hardware weekly. Window shrinking to single years.
- Where – think of three environments for freight
  - Long haul corridors – later – but could be used for pool point distribution (terminal 2 terminal)
  - Shorter haul local moves – shuttle runs (on closed or semi closed links)
  - Intra Facility (Yard) moves – extension of automation in the DC/WH/Factory

Impact on Firms:

- ATs: single day range will increase from 450-500 miles to ~ 1,000
- Many FMCG and retail networks designed for 1 day coverage
- Reduction of 5-6 DCs for National Coverage to 2-3 DCS
  - Larger national DCs
  - Push to many smaller, local DCs
- Able to provide ubiquitousness of TL with low cost of IM
- Lower fuel costs – drop speed [get #] (platooning 4-7%)

Transportation Implications

- Increased demand for truck only lanes
- Significant concentration of feeders to national NW (congestion)
- Increased amount of trucks
- Potential change in nature of trucking firms (why have carriers?)
- Connected to “vanilla” trailer concept
Diversification of Sales Channels (OmniChannel)

- Mixing the 4 key retail tasks (search, order, pay and receive functions) across different formats: at-home, in-store, on-line fixed, and mobile
- Examples:
  - Find in store, order on phone, have delivered to home
  - Find and order on-line, pick up at store pay in cash
  - Find on line, retailer picks from own store, delivers to home

Impact on Firms:

- Facility roles changing:
  - Stores become forward stocking points
  - Employees need mixed skills
  - Dark stores – keeping customers out (like having drunks . . .)
  - Forcing increased size of backroom after decades of shrinking
    - Selected stocking of critical items
    - Pack and sort and prep in-store pick up
- Requires unified and integrated management
  - Inventory management across channels (how much is where – phantom inventory)
  - Common pricing strategy (how much to charge)
  - Merged incentives (who gets credit)
- Added need to provide last mile delivery
  - Lots of experimentation (taskrabbit, instacart, uber, courier, fleet)
  - Swarm routing
  - Portfolio of vehicle types, sizes, and capabilities

Transportation Implications

- Greater last-mile delivery emphasis
- Zoning issues (perverse policies Sao Paulo truck size restriction)
- Vehicle size and implications
- Delivery hours and night-time restrictions
Digitization & Decentralization of Manufacturing

- Lowering cost of automation enables smaller scale operations
  - Example: Kiva now Amazon Robotics (775 M in 2012)
    - Robots that bring product (on shelves/pods) to pickers instead of vice versa
    - Robots handle lifting and are coordinated via integrated software
    - Benefits of automation – at lower costs, enables smaller DCs
  - Example: ReThink Computers (Baxter and Sawyer)
    - Allows use of automation with humans – complement
    - Lower cost – again,
  - Net effect – potentially smaller operations with efficiency of larger scale plants
- Advanced manufacturing – merging of traditional and additive processes
  - Moved through the hype curve – finding correct niches
  - GE – compliments traditional manufacturing and Moved from replacing components to systems
  - Moving into selected manufacturing areas -

Impact on Firms:

- Lower economies of scale mean more smaller plants dispersed across markets
- Able to meet customized demand

Transportation Implications

- Dispersed operations means less concentrated network
Changing Face of Product Ownership

• Economics in many areas are shifting from ownership to renting/sharing
  o AND, products themselves are increasing in value density
  o AND, consumers are connecting products with each other (IoT)
• Common Example: Car Sharing (TCRP Report 108, 2005)
  o Each car in a sharing system replaces ~5 vehicles
  o Millennials moving to more ease of renting vs. ownership
• Example: Recorded Music
  o From 1970 to 2000 format changed from LPs to 8Trk to Cassettes to CDs
  o Density increased from 7 to 24 minutes/ounce (ton-miles drop 65%)
  o 2000-2014 – CD’s replaced by downloads
  o 2015 – Downloads flat, CD’s 1/10 of peak, and streaming revenue exceeds purchase.
  o Artists starting to move from big album release to smaller more frequent

Impact on Firms:

• Impact on Companies
  o Total output reduced (on a per capita basis)
  o Continuing shift from product to services
• Demand for faster response time
• Advanced signaling
  o Smoother demand – but offset by faster response time requirements –
  o Reduced inventory – OnProcess “Voice of the Machine” project
• If you had guaranteed, readily available mobility – why would you have own assets or make long-term contracts? (Uber Freight question)

Transportation Implications

• Potential reduction in ton-miles hauled
• More responsive, closer to consumer facilities – last mile congestion