Future Freight Flows: Using Scenario Planning to Assist in Long-Term Planning

Measuring the Transportation System from a Supply Chain Perspective Workshop
Irvine CA
11 July 2012

Dr. Chris Caplice
Executive Director, MIT CTL
Freight Transportation Planning is hard.

- Hard for shippers,
- Harder for carriers,
- **Hardest** for government planners!
  - Infrastructure planning timeframe is decades
  - Diverse and vocal constituents (NIMBY, BANANA)
  - Pallets don’t vote
  - Both *modal* and *jurisdictional* silos
  - Revenue sources are decreasing dramatically
  - Removed from the system users

Recognized by AASHTO & NCHRP – thus the NCHRP 20-83 Projects
NCHRP 20-83(1) Project Objectives

• Two Objectives
  1. “Provide decision makers [state DOTs] with a critical analysis of the driving forces behind high-impact economic changes and business sourcing patterns that may effect the US freight transportation system [in the year 2030 & beyond].”
  2. “Better enable informed discussions of national, multi-state, state, and regional freight policy and system investment priorities.

• Two Key Lessons
  1. Macro-economic and technology forces are impossible to predict and can have tremendous impact on supply chains
  2. **Preparing** for potential effects is more effective than **Predicting** future events
Different Methods for Planning

But what about very long term (10+ years) planning?
Longer term planning is impacted by events.

Poor Forecasting is not a thing of the past . . .
Classic Cases of Short Sightedness

Great Horse Manure Crisis of 1894

- More than 150,000 horses in NYC producing over 2,000 tons of manure per day
- Estimates of manure reaching 3rd floors by 1930 & nine feet in London by 1950
- 1st International Urban Planning Conference held in NYC in 1894

Interestingly, over 4000 cars were sold in the US in 1900. By, 1916 more cars than horses were registered in NYC
Classic Cases of Short Sightedness

The Quartz Crisis/Revolution

- Swiss watchmaking industry dominated the global market after WWII
- In 1960, they held over 50% market share
- New quartz technology was introduced in the late 1960’s- Swiss firms ignored
- By 1970’s, US & Japan firms dominated and Swiss firms had less than 10% of market

Interestingly, the Quartz technology was first developed by Max Hetzel, a Swiss engineer!
US Technology Adoption Rates from 1900 to 2005

Adoption (% of US Households)

Suspend Disbelief: Technology

The red button in a IBM 3380 cabinet is as big as three

1980

Eight 2.5GB IBM 3380 Disk Systems: 20GB
Estimated value: $648,000 - $1,137,600
Weight: 2,000,000 grams (4,400 pounds)

2010

One MicroSD Card: 32GB
Estimated value: $100 - $150
Weight: 0.5 grams (0.001 pounds)

Suspend Disbelief: Economics

• Global Trade 1981
  • Just under 2/3 of all containers came via East Coast ports
Suspend Disbelief: Economics

• Changes in Industries
  • Large ones have fallen - Bookstores
  • New ones have emerged (and are changing) - Amazon
  • Some have come and gone – VHS Rental
Suspend Disbelief: Political

- **Deregulation of Transportation**
  - 1980 - Staggers Act, Motor Carrier Act
  - 1986 - Surface Freight Forwarder Deregulation Act

![](chart.png)

Index of Revenue per Mile for US. Trucking in Real $
Different Methods for Planning

Shift focus from prediction to preparation

But what about very long-term (10+ years) planning?
So many potential futures, so little time . . .
Preferred vs. Probable vs. Plausible

Possible Futures

Preferred Future - VISION
Probable Future - PREDICTION

Now

Because we can’t explore ALL possible futures, we must create a handful of plausible, alternative futures that together contain the most relevant uncertainty dimensions.
Scenario Planning

• **Criteria for a good set of scenarios**
  - Decision Making – capture right decision
  - Plausibility – within realistic limits
  - Alternatives – no favorites or preferred (Unofficial/Official)
  - Consistency – internal logic is aligned
  - Differentiation – structurally different
  - Memorability – easy to recall after event (name helps)
  - Challenge – push against established wisdom

• **Accuracy of event forecasting is not important**
  - The skill we are developing is preparation not predicting
  - The focus is on effects not on individual events
Effects versus Events

14 April 2010
Eruption of the Eyjafjallajökull Volcano

Summer 2008
Manufacturing moratorium in Beijing
Translating *Events* into *Effects*

**Freight Flow Patterns**

**Impact on sourcing patterns**
Where are raw products and WIP sourced from? Are materials sourced in or out of the region?

**Impact on flow destination**
Where is the demand located? How are final destination locations distributed?

**Impact on routing**
How is freight moved within the region? Are there intermediate shipment points or mode switches?

**Impact on flow volume**
How will the total volume of freight shipped in and through the region change?

**Impact on value density**
How will the product characteristics change? How does the value density change?

**How can an event impact freight flows?**

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*MIT Center for Transportation & Logistics*
The Real Value of Scenario Planning

• Forecasting Challenges
  • Without step changes, forecasting would be easy!
  • Step changes are driven by events, and . . .
  • Events are next to impossible to predict, but . . .
  • Planners do a pretty good job preparing, so . . .

• Scenario planning allows us to shift from

   Predicting future Events

   To

   Preparing for potential Effects
Future Scenarios

We created four scenarios for November 2, 2037

ONE WORLD ORDER

MILLIONS OF MARKETS

Naftástique!

Global Marketplace
# Differences Between Scenarios

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>High</th>
<th>High</th>
<th>Low (physical)</th>
</tr>
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<tbody>
<tr>
<td>Global Trade</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Low (physical)</td>
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<tr>
<td>Resource Availability</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>High</td>
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<tr>
<td>Energy Cost Level</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
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<tr>
<td>Energy Cost Variability</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Low</td>
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<tr>
<td>Level of Environmental Awareness</td>
<td>Same as Today</td>
<td>High</td>
<td>Low</td>
<td>High</td>
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<tr>
<td>Population Dispersion</td>
<td>Growth in SW</td>
<td>Growth in Biggest Cities</td>
<td>Growth in Biggest Cities</td>
<td>Rise in Mid Tiered Cities</td>
</tr>
<tr>
<td>Energy Sources</td>
<td>Majority NA</td>
<td>Mix Foreign &amp; Domestic</td>
<td>Majority Foreign</td>
<td>Majority Domestic</td>
</tr>
<tr>
<td>Level of Migration</td>
<td>High w/in Bloc, Low between</td>
<td>High</td>
<td>High</td>
<td>Low</td>
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<tr>
<td>Migration Policy</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Currency Fluctuations</td>
<td>Low w/in Bloc</td>
<td>High</td>
<td>Moderate</td>
<td>Low</td>
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Workshop Structure

Introduction & Overview (ALL)

- Global Marketplace
- Naftastique!
- Millions Of Markets
- One World Order

Investments
- Global Marketplace
- Naftastique!
- Millions Of Markets
- One World Order

Feedback &/or Evaluation
- Global Marketplace
- Naftastique!
- Millions Of Markets
- One World Order

Debrief (ALL)
- Global Marketplace
- Naftastique!
- Millions Of Markets
- One World Order

Scenario Immersion

Evaluation Mechanism

Convergence & Reconciliation

- • No Brainers
  • No Gainers
  • No Regrets
  • Contingencies
Initial Learnings

• **Process & Method**
  - Attendee selection is key – group dynamic dictates discussion level
  - Group facilitation is the most critical skill
  - Positive/Negative voting mechanisms work
  - Immersion works with portfolio of collateral – videos especially
  - Debrief in same day is difficult – and not totally worthwhile

• **Insights & Outcomes**
  - System connections (intermodal) were always robust
  - Flexible use of existing facilities frequently robust
  - Robust perceptions of the four scenarios
    - Global Marketplace – viewed as most like today and most probable to occur
    - One World Order & Naftastique! as “evolutionary”
    - Millions of Markets – revolutionary and most drastic future

• **Challenges to Overcome**
  - How can we enable DOTs to conduct these workshops by themselves?
  - How can scenario planning be incorporated into existing processes?
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To see more on the project: http://ctl.mit.edu/research/futurefreightflows
To find out more: future@mit.edu