

# Measuring Productivity, Competitiveness & Economic Growth Impacts of Transportation

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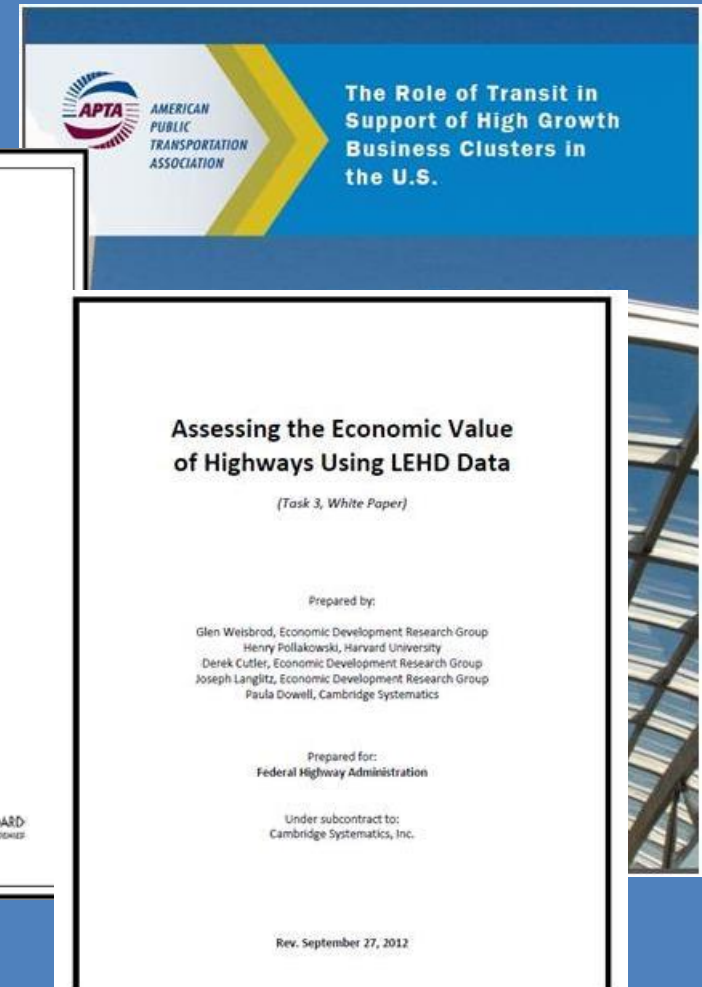
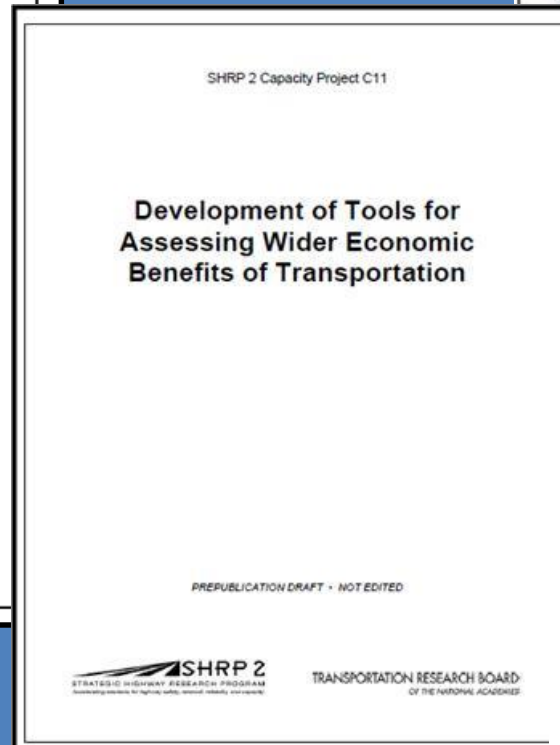
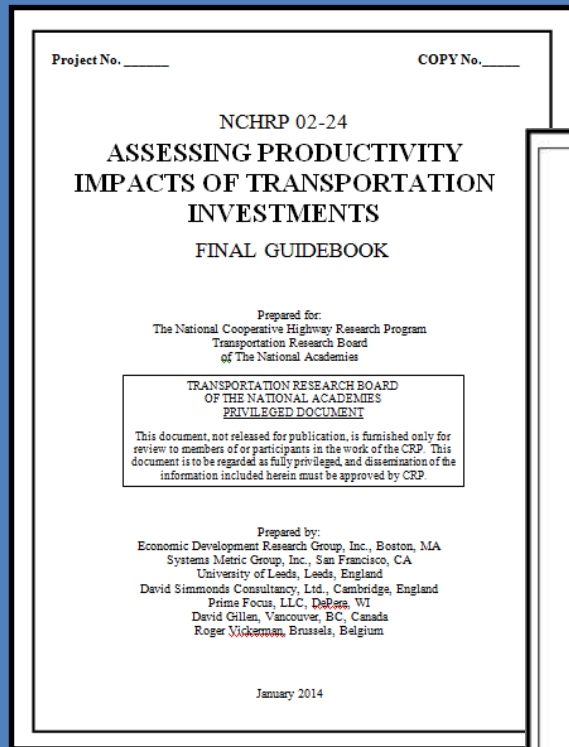


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# Recent Studies



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# Topics

1. **Definition of Interlocking Concepts:**  
*Productivity, Competitiveness, Economic Impact, Benefit-Cost, Wider Economic Benefits*
2. **When Wider Benefits Occur:**  
*Roles of Reliability, Accessibility and Intermodal Connectivity*
3. **Application of Productivity & Wider Benefit Measurement:** *Uses in BCA, EIA and MCA*



# DEFINITIONS



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# Reasons to Calculate Wider Econ Benefits

- **Add Factors** *not in traditional Benefit/Cost analysis* that can affect investment justification  
(UK Transport Appraisal Guidance)

VS.

- **Recognize Factors** *not in traditional travel impact analysis* that can affect strategic planning & prioritization decisions  
(US Economic Impact Model Uses)

→ *Each Leads to a Different Way Of Defining Wider Economic Benefits*



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# Terminology

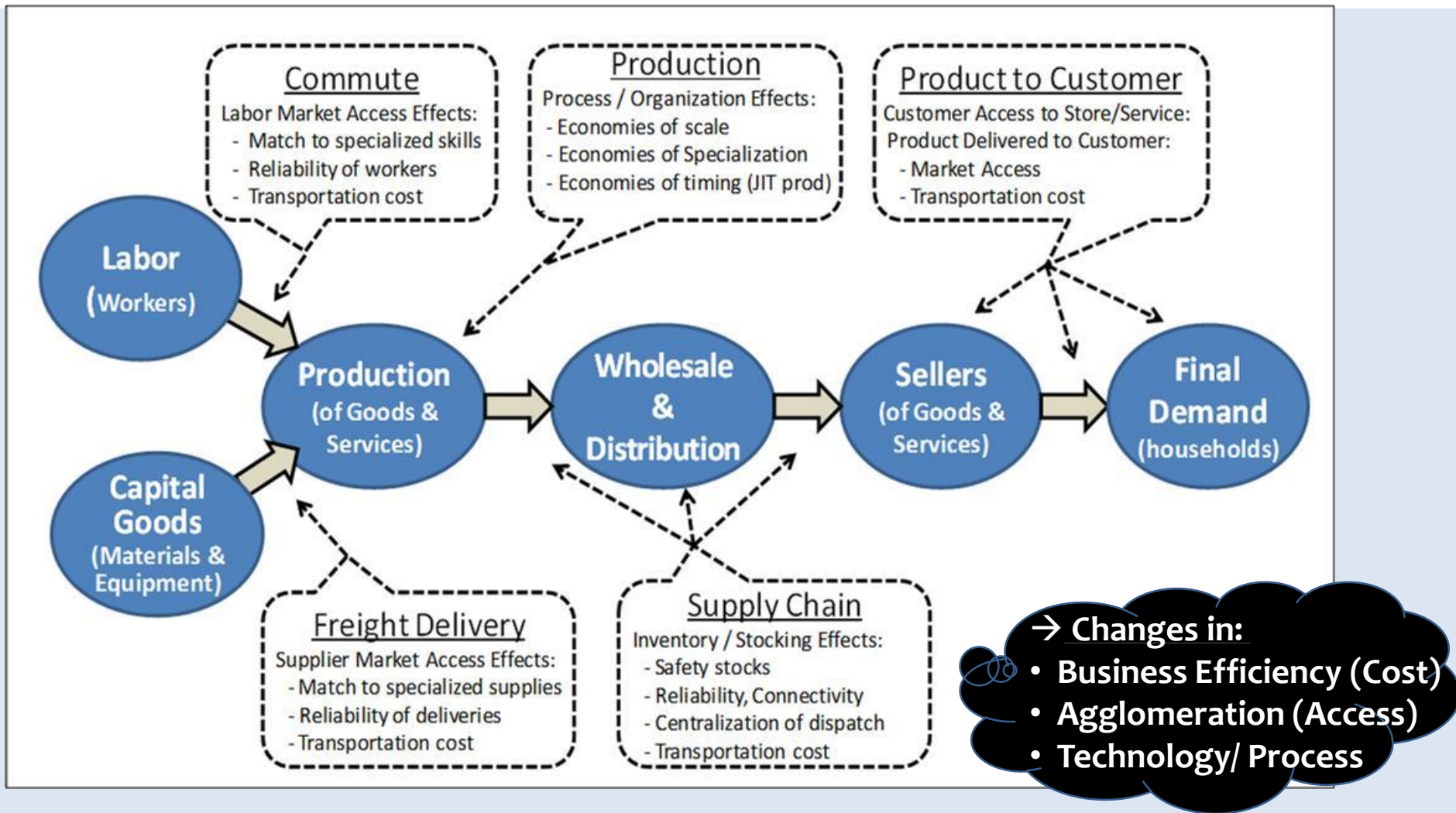
- **Economic Productivity** = Output \$ produced per Input \$
- **Cost Competitiveness** = Input \$ cost per Output \$
- **Economic (Development) Impact** = growth in economy  
*(from greater competitiveness through 3 mechanisms):*
  - **Δ Productivity** → *More Income Generated*  
*(per existing base of labor & capital)*
  - **Δ Export Sales** → *More Inflow of Income & Investment*  
*(expanding business base, due to greater competitiveness)*
  - **Δ Import Substitution** → *Less Outflow of Income (to purchase inputs, as local production becomes feasibility & competitiveness)*

→ *These are motivations for strategic investment*

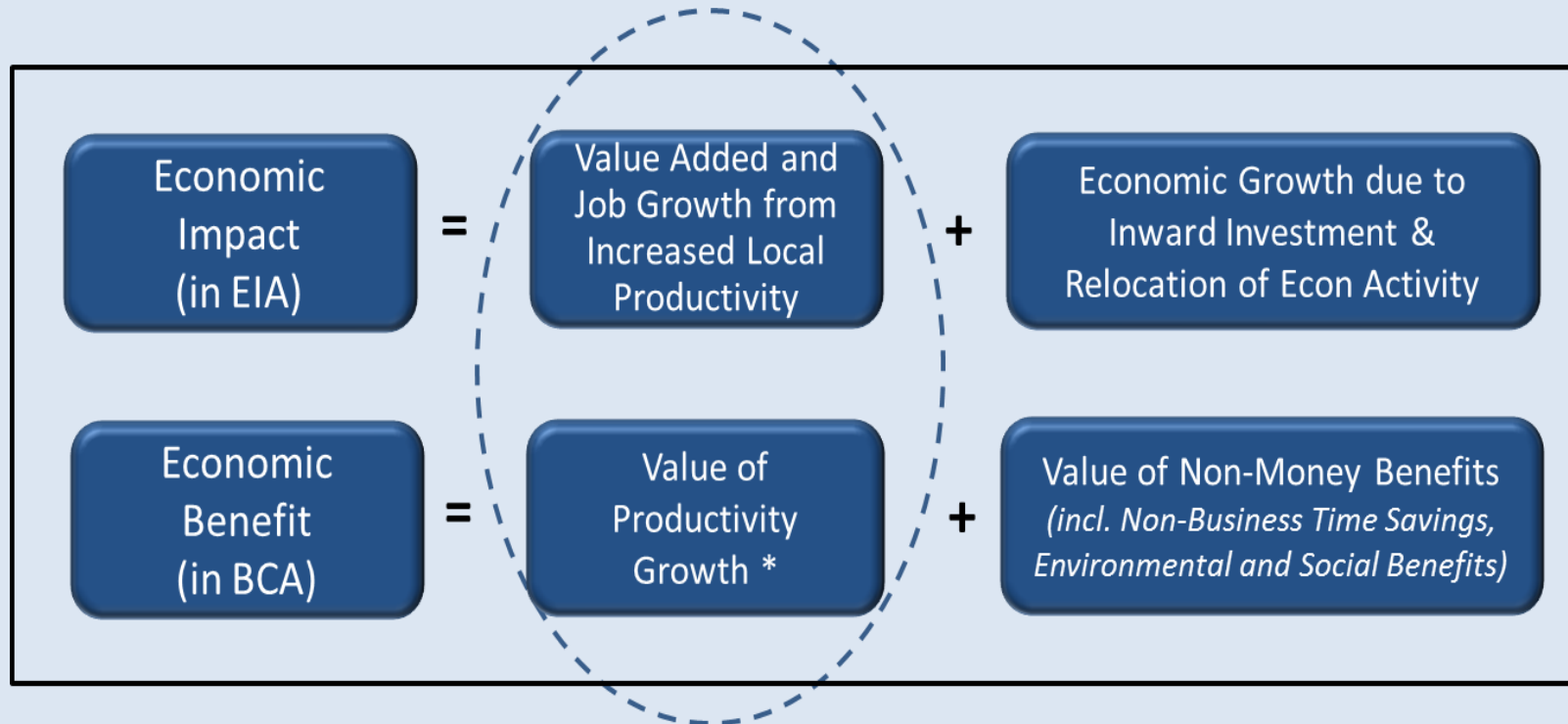




# Transportation Effects on Productivity



# Central Role of Productivity in Impact and Benefit Metrics



*\* The value of productivity growth used in BCA is measured as the "value added" (additional labor and business income) generated in the economy.*



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# WHEN WIDER BENEFITS OCCUR



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# Classifying Projects by Drivers of Productivity

## (A) Little or No Productivity Impact

Projects Addressing **Social, Environment, Safety** Factors, and **Personal Travel**

## (B) Productivity Gain from Traditional User Benefit

Projects that reduce **Time Cost** for Business-Related Travel:  
*speed, vehicle capacity, frequency, dwell time*

## (C) Productivity Gain from Wider Benefits

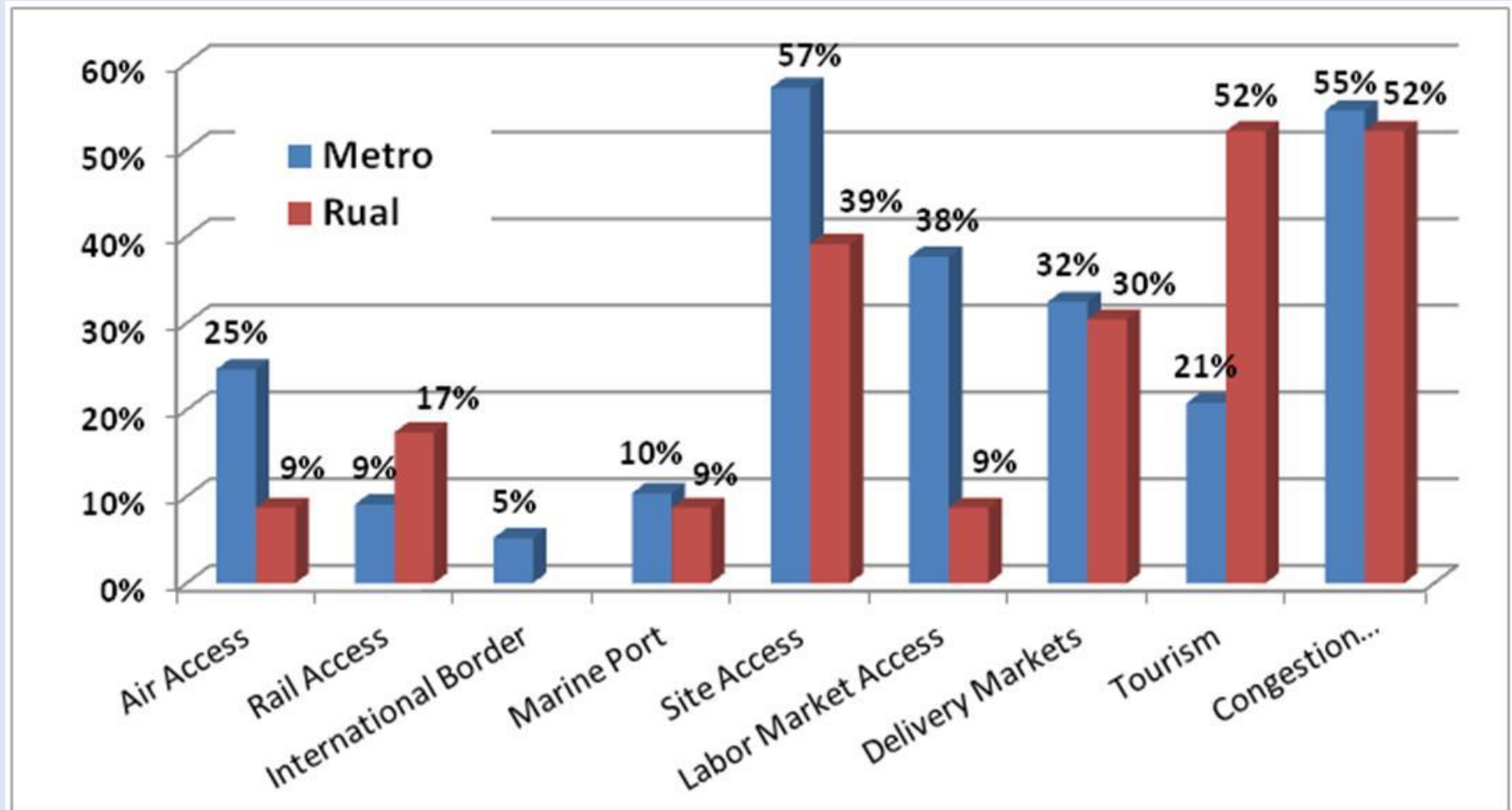
Enhance **Reliability** for Business-Related Travel:  
*congested bottlenecks, product inventory & delivery processes*

Enhance **Accessibility** for Business-Related Travel:  
*labor market, material supplier market, customer market  
routes between clusters or communities in a region*

Enhance **Intermodal Connectivity** for Business-Related Travel:  
*ground access to, or service at, intermodal terminals*



# Motivation of Highway Capacity Project



Source: SHRP2 Project C11; source: Economic Development Research Group, 2013



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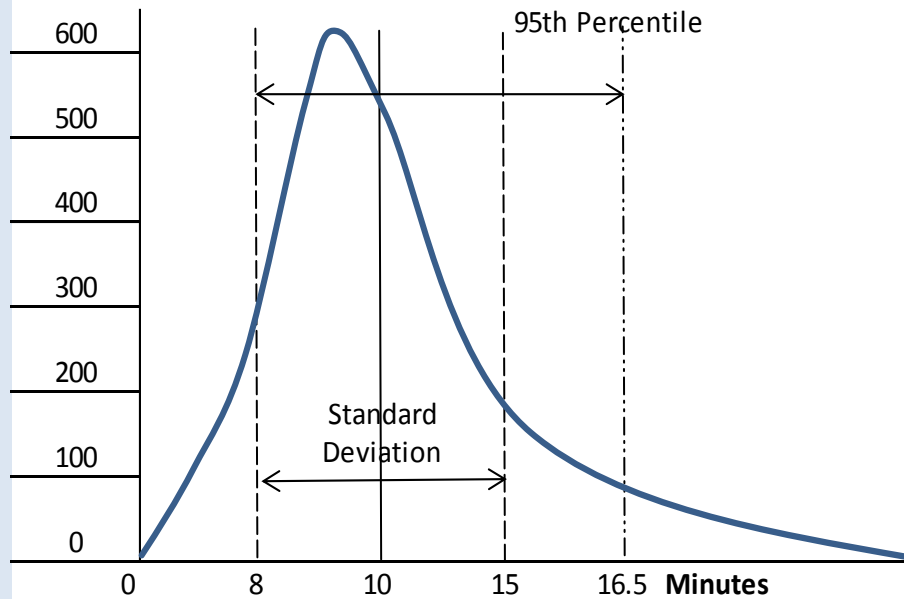
# Reliability: Buffer Time & Inventory Cost

→ *Effect on business operations & technology: (a) Deployment of vehicles, drivers, loading dock & stocking workers; (b) Lean inventory and Just-in-Time production technologies*

## Buffer Time to ensure 95% on-time delivery

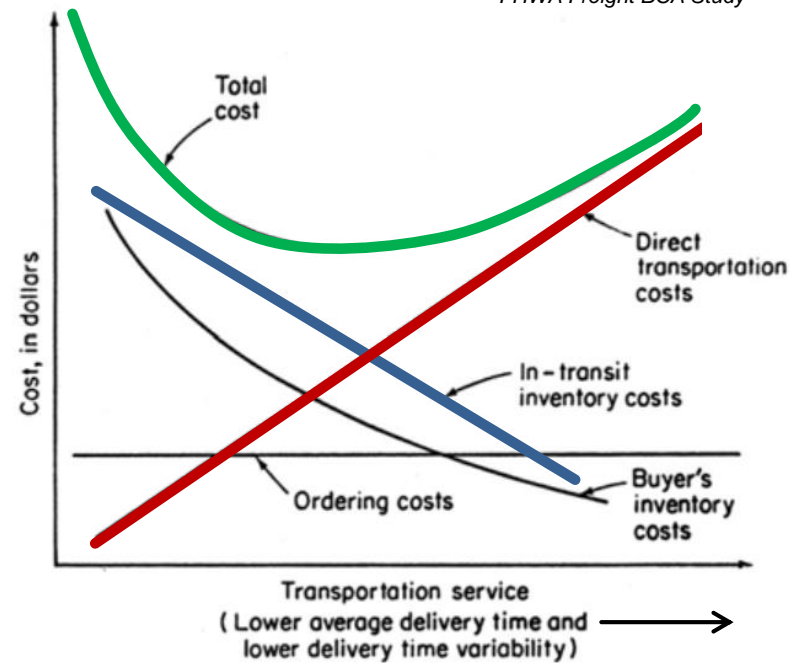
SHRP2 C-11 Final Report

Trips (in 000's)



## Trade-off of delivery & inventory cost

FHWA Freight BCA Study



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# Accessibility → Agglomeration Economies

Concept of **agglomeration economies** as cause for *disproportionate concentrations of specific industries* at specific locations, enabled by *access* to wider markets, including:

- Labor markets: “commuting”
- Intermediate markets: “supply chains”
- Product customer markets: “delivery”

Concept of **centripetal** and **centrifugal** forces

- Centripetal Forces: urbanization, economies of scale & scope
- Centrifugal Forces: dispersion economies, congestion avoidance
- Localization Forces: knowledge spillovers, proximity to R&D



# Intermodal Connectivity:

→ *Intermodal (rail–air-marine ) terminals provide access to broader customer markets, depending on ground access, connecting services (volume, destinations, frequency & speed), and connection dwell time.*



(cities within 2 hours total travel time from downtown Boston, based on driving a car or flying to destinations that have hourly or more frequent air service during business hours)



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# Business Activity & Location

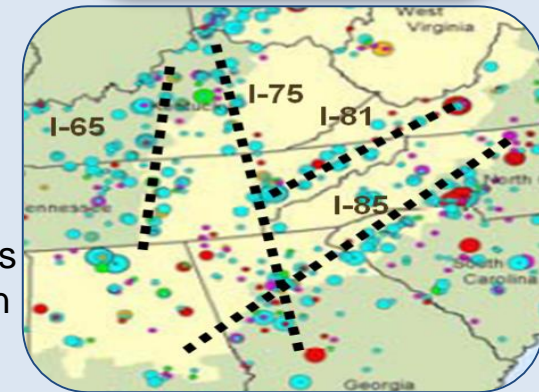
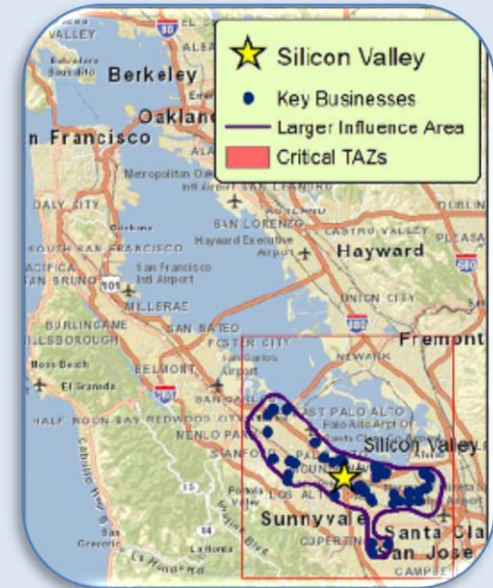
## Sensitivity to Transportation Factors

Business Cluster Type	Typical Location	Centripetal (urbanization) access forces	Centrifugal effects	Cluster (localization) forces
<b>Financial Center</b>	Core, large metro	Central Location, Skilled Labor Mkt.	--	High density, areas with intl. air service
<b>High Tech</b>	Non-core, urban	Skilled Labor Mkt. (45 min)	--	Mid density, with Univ./ R&D access
<b>Distribution</b>	Periphery	Same Day Truck Delivery Mkt. (3 hr)	Minimize land cost	At hwy crossroads between cities
<b>Auto parts manufacturing</b>	Non-metro	Same Day Truck Delivery Mkt. (3 hr)	Minimize land cost, congestion	On hwys, near rail, Along supply chains
<b>Agriculture, Raw materials</b>	Non-metro	--	Dispersed farm-land, resources	--
<b>Neighborhood Shopping</b>	Urban	Customer Market (15 min.)	--	--



# Spatial Scales of Agglomeration Impact

- 1) **Large Multi-State Clusters**  
(supply chains, 150 miles across)
- 2) **Sub-Metropolitan Clusters**  
(technology clusters, 10 miles across)
- 3) **Downtown Business Districts**  
(2 miles across)
- 4) **Neighborhood Retail Clusters**  
(0.5 sq. miles across)



US Auto Parts  
Supply Chain  
Corridors



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# USING PRODUCTIVITY & WIDER BENEFIT METRICS



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# Specific Projects can have Unique Wider Econ Benefit Claims



← MassDOT: South Shore Rail to expand job and labor market access

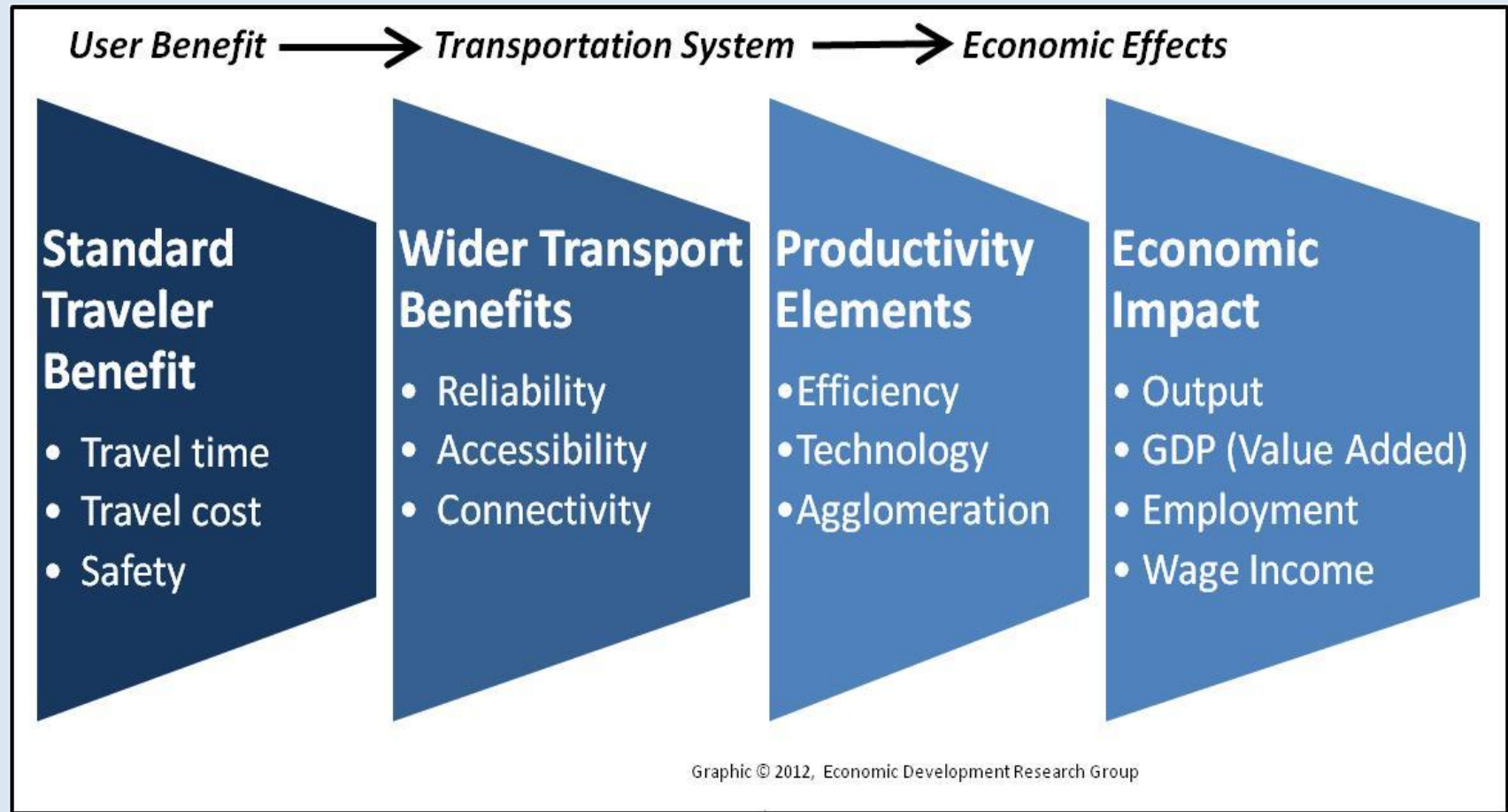
↪ Vancouver, BC: Multimodal plan to expand international trade and freight connectivity



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# Communications Need: Translating Alternative Impact Perspectives



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# Productivity in Multi-Criteria Analysis

Multi-Criteria Rating Factors Used by State DOTs	Corresponding Productivity Related Metric
<ul style="list-style-type: none"> <li>Freight Productivity (WI)</li> </ul>	Overall Productivity
<ul style="list-style-type: none"> <li>Travel time &amp; cost reduction (OH, WI, NC)</li> <li>LOS improvement (WI)</li> <li>User Benefit (WS, KS)</li> </ul>	Element: Efficiency
<ul style="list-style-type: none"> <li>Volume/Capacity (OH, NC, OR)</li> <li>Congestion Relief (MO)</li> </ul>	Element: Reliability
<ul style="list-style-type: none"> <li>Promotes Freight Movement (MO, OR)</li> <li>Promotes Exports from State (WI)</li> </ul>	Element: Accessibility
<ul style="list-style-type: none"> <li>Multi-Modal Impact (OH)</li> <li>Intermodal Connectivity (MO)</li> <li>Connections to Network (WI)</li> </ul>	Element: Connectivity
<ul style="list-style-type: none"> <li>Job Growth (OH, WI)</li> <li>GDP Growth (NC, KS)</li> </ul>	Outcome of Productivity





# Two different perspectives

UK: Transport Appraisal Guidance , WebTAG (statistics & heuristics for BCA)	US: NCRP - SHRP2 Tools and TREDIS , REMI Econ Models (productivity , econ impact factors)
<ul style="list-style-type: none"><li>• Agglomeration Effect (elasticity applied to change in effective density, reflecting zonal employment &amp; inter-zonal costs)</li><li>• Output in “imperfectly competitive markets” (adder to business \$ benefit)</li><li>• Labor Market: Gain from workforce participation &amp; more productive jobs (from commuter benefits)</li><li>• Govt. tax impact of greater workforce participation and more productive jobs</li></ul>	<ul style="list-style-type: none"><li>• Commute/Labor Market Access</li><li>• Buyer -Supplier Market Access</li><li>• Business Reliability Benefits</li><li>• Logistics / Supply Chain Benefits</li><li>• Intermodal Connectivity: Terminal Access and Connecting Service</li></ul>



# For More Information

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Slides and Links at:  
[www.edrgroup.com/ited2014](http://www.edrgroup.com/ited2014)

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