Costs and Benefits of Transportation Technology Investment

Hearing: " The Potential of Transportation Technology“
Transportation and Housing Committee and
Sub-Committee on Ports and Goods Movement
(Senator Lowenthal, Chair)
State Capitol Room 4203
1:30 - 4:30 pm, May5, 2009

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What's Technology?

- Not just devices, but also processes:
  - the set of tools both hardware (physical) and software (algorithms, philosophical systems, procedures) that help us act and think better.
  - Human innovation in action that involves the generation of knowledge and development of devices, skills and processes to develop systems that solve problems and extend human capabilities

Traffic Management Technologies

Intelligent Transportation Systems

- Traffic Management : Congestion, Incidents, Weather, Emergencies
- Security Sensors
- Electronic Payment & Pricing
- Traveler Information Systems
- Electronic Data Collection

Vehicle Technologies

Intelligent Vehicles

- On-Board Phones, Maps, Info
- Collision Avoidance Systems (warning, braking, anti-tipping)
- Collision Notification & Service Calls
- Vehicle Locator Systems
- Vehicle Performance Reports
- Driver Performance Reports
- Driver ID and Performance Checking
- Fleet Management & Vehicle Tracking

Transit Applications

- Electronic Fare Collection
- Passenger counting
- Automated Vehicle Location (AVL)
- Communications
- On board surveillance (security)
- Information systems (passenger ratings)
- Scheduling systems
- Asset management systems

Freight Applications

- Mobile Communications
- Asset Management Systems
- Dispatch Software
- Vehicle Routing Systems
- Real-Time Navigation Systems
- Electronic manifests, bills of lading; multimodal transfers
- Security seals
- Vehicle Tracking
- Shipment Tagging, Sorting, Routing, and Tracking
- Online Shipment Tracking for Clients
- Operator Screening and Credentialing Systems
- Driver Log Auditing Software

Other Transportation Technologies

Intelligent Systems are not the only innovative technologies

Materials and Devices

- Advanced pavements
- Reflective strips and signage
- Jersey barriers
- Pavement grooving for drainage , lane departure warning
- Prefabrication
- Balsi Beam (Construction safety)
- Container Packaging &Sealing Materials
- Shock absorbing materials, designs
- Lightweight high strength materials
- New fuels
- Advanced catalytic converters
- Energy efficient vehicles (size, weight, power systems, design)

Systems and Procedures

- Performance-based contracting
- On-line reporting & recordkeeping
- New designs that protect water quality, flora and fauna, communities

Benefit-Cost Analysis

- Simple concept:
  - Measure all benefits over the lifetime of the project
  - Measure all costs over the lifetime of the project
  - Calculate present value of benefits and costs
  - If benefits exceed costs, project or program is justified i.e., (B-C) >0 or (B/C)>1
  - Rank projects by BCA results and implement in rank order: should maximize social welfare
- Why use BCA? Resources are scarce, and choices entail opportunity costs:
  - if we spend money on X, we don't have the money to spend on Y

Issues in BCA

- Quantifying and monetizing benefits and costs that are not bought and sold
  - E.g. the cost of global warming , the risk to ports of a terrorist attack, the value of a human life, the value of a songbird
- Must discount future benefits and costs to calculate their Net Present Value:
  - discount rate is the rate of return that could be earned on an investment in financial markets with similar risk
  - the discount rate chosen can make a big difference - and is debatable (e.g., lower rate for govt. because investments are relatively secure? variable discount rates?)

Benefits of New Technologies

- Better, cheaper, faster
- Real-time system management – more responsive, more flexible
- Improved security
- Data collection in electronic format, easier to process

BUT

- needs to be considered compared to existing practices, technologies: often incremental improvement

Costs of New Technologies

- Costs of purchase and installation
- Costs of early retirement of legacy systems (in some cases)
- Costs of maintenance (including retooling for maintenance)
- Risk of short “shelf life” where technology continues to improve rapidly
- Costs of organizational change – in staff qualifications or training needed, contracting procedures, operating procedures, decision-making

Costs that Might Be Avoidable

- False starts due to lack of clear understanding of user needs
- Not enough off-the-shelf products
- No plug and play
- Onerous procurement requirements
- Systems constantly retailored to meet specific desires of clients / purchasers; project by project approach
- Technologists understate costs, overstate benefits, readiness,
- R&D going on during application
- Upgrades cause failures
- On-going costs higher than expected

Ideas for Reducing Costs

- Standardized industry certification (e.g., APTA or AASHTO or federal agency)–everybody gets a lot, nobody gets everything
- Certification performance based rather than detailed technology specifications
- Consortium purchases (multi-agency, multi-state)
- Warranties, maintenance contracts, PPPs

Findings from Empirical Studies

http://www.itsbenefits.its.dot.gov/its/benecost.nsf/

- Advanced traffic signal timing reduced fuel use, delays, travel times by 7-30%, BC ratio averaged 17:1 (CA studies and field measurements)
- Traveler information systems reduced fatalities by 3%, emissions by 3-5%, congestion by 2-5% (Cincinnati modeling)
- Road weather stations have a BCA of 1.1:1 to 1.7:1 but only for heavily traveled roads (Finland field studies)
- Ramp metering increased freeway speeds by 13% (Long Island), saved fuel 2-55% per ramp (Minneapolis)-modeling
- Freeway- arterial coordination reduced travel times 2-3% (Seattle modeling)
- Electronic credentialing of freight has a BC ratio of 0.7:1 to 718:1 (Studies in Midwest, CA, Texas)

Limitations of Available Studies

- Results are highly context-specific – an application can work well in one set of conditions, not in another
  - E.g., freight credentialing benefits huge at international border, less valuable for state crossings
- Many results are modeling only, relatively few field measurements (latter usually smaller)
- Deployment strategy and market penetration rates determine flow of benefits and costs
  - E.g., benefits and costs if toll tags are required is very different than if toll tags are individual option
  - Some projects require corridor, area, or system-level deployment, others can be incremental

Limitations of Available Studies (cont.)

- Scale of analysis matters –
  - LI ramp meter study: delay reduced on freeway but may have transferred the wait to ramps
  - CA HOV lane travel time benefits for buses can be greatly reduced by delay at one badly configured intersection/ signal once bus leaves lane (Bay Area express bus study)
- Many reports present benefits, but not costs, or vice versa
- Reports often omit costs of contracting and administration, monitoring, evaluation; sometimes ignore or assume longevity of benefits

California-Specific Issues

- Research focus on technology development and deployment (IT and engineering); less attention to policy, planning, organization and management issues: strategy needs to consider all aspects
- State contracting and procurement not very flexible (better for self-help counties?)
- Data limitations – can't do good CBA without good data

  e.g. statewide survey needed of sufficient depth and size to model investment choices such as HSR, airport/air system issues, and highway technology options

Resources

- **TCRP Report 84: e-Transit: Electronic Business Strategies for Public Transportation**
- **Summary of the ITS America 2005 Transit GM Summit**
- http://www.itsbenefits.its.dot.gov/its/benecost.nsf/