PD-14

ITS for System Operations

Goal

Improve the efficiency of transportation systems without adding infrastructure capacity in order to reduce emissions and energy use, and improve economic and social needs.

Sustainability Linkage

Intelligent Transportation Systems (ITS) applications support all of the triple bottom line principles by improving mobility, reducing congestion, and improving safety while avoiding environmentally—and economically—costly capacity increases.

ITS can be used to influence and induce changes in trip making (e.g., route, mode, and time of travel), which helps shift demand to where and when capacity may be available, improving overall system utilization and efficiency. Compared to roadway widening and other capacity increasing alternatives, which take longer to implement due to high initial costs and environmental considerations, ITS and management/operations strategies can be implemented much faster and require relatively lower up-front costs. This allows economic benefits to be realized sooner, enhancing the overall economic value of these investments. Taken as a whole, Transportation Systems Management and Operations (TSM&O) and its associated ITS elements can offer significant economic, environmental, and social benefits without the impacts and expense of additional paving.

Potential TBL Cost Savings*

$$ - DOTs can save by avoiding expensive capacity investments.

$$$ - User benefits from reduced congestion/ improved reliability.

$ - Greenhouse gas and pollutant emissions as well as traditional capacity impacts avoided.

$$ - Improved safety, mobility, and emergency response.

**Order of magnitude dollar equivalent potential savings: $~1M, $$~10M, $$$~100M*

Basis for Savings

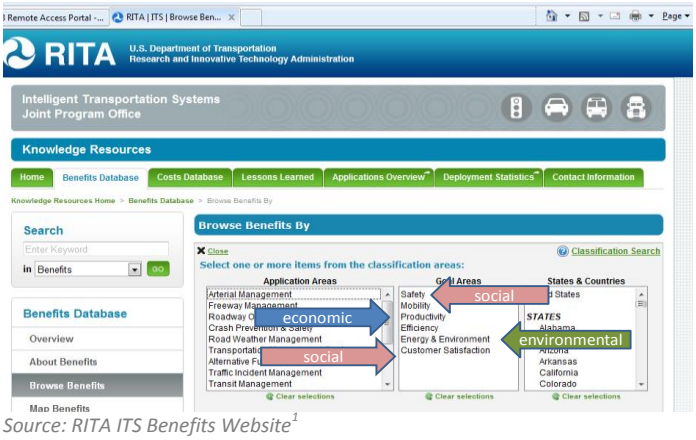
As detailed on the Research and Innovative Technology Administration's (RITA) ITS website, the application of ITS technology to transportation can yield a myriad of low-cost, high-value benefits across the triple bottom line. An extensive database of ITS benefits and costs is available through the links provided in this section.[i]

ITS investments can produce dramatic improvements for a small fraction of the costs needed to build additional travel/turn lanes. For more information visit RITA's online ITS cost database.

Reducing vehicle miles traveled (VMT) improves mobility by providing smoother, safer travel conditions, which can result in fewer crashes and resulting delays for improved system reliability. For more information visit RITA's online ITS database for economic benefits.

Reduce emissions generated by traffic backups attendant to poor travel conditions by tens of percentage points. For more information visit RITA's online ITS database for environmental benefits.

Improve safety and access associated with otherwise avoidable cost of crashes. Do so by providing safer travel conditions on a more reliable system for personal vehicles, buses, and commercial and emergency users. For more information visit RITA's online ITS database for social benefits.

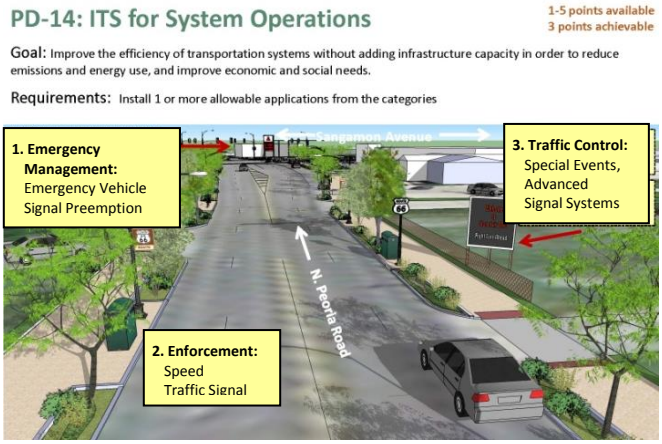


Source: RITA ITS Benefits Website[i]

i The database is derived from reported before and after results of ITS deployments throughout the country. Although it can serve as a useful source to estimate the range of benefits that could be expected for a particular ITS application, caution should be exercised in assuming similar results for your implementation. More advanced analysis, modeling, and simulation should be considered to estimate the impacts of specific ITS strategies utilized in particular settings.

Agency Experience

An INVEST case study by the Springfield Sangamon County Regional Planning Commission (SSRPC) employed ITS practices for emergency signal preemption, speed enforcement, and special event signage:[2]



Source: INVEST Case Study Springfield Sangamon County Regional Planning Commission (SSRPC)[3]

Other ITS applications include Arterial Management, Freeway Management Crash Prevention & Safety, Road Weather Management, Transit Management, Traffic Incident Management, Emergency Management, Information Management, Commercial Vehicle Operations, and Intermodal Freight. Each of these applications typically provides several techniques to improve efficiencies.

For instance, one of the many successful techniques is observed with the application of a real-time, decentralized traffic signal system pilot test developed by the Robotics Institute at Carnegie Mellon University called SURTRAC (Scalable Urban Traffic Control) in the East Liberty area of Pittsburgh, PA. In this pilot program the significant triple bottom line benefits of a relatively modest investment are listed below:

Arterial Management > Traffic Control > Adaptive Signal Control

	PERCENT IMPROVEMENT[4]				
Period	Travel Time	Vehicle Speed	Number of Stops	Wait Time	Emissions, Fuel Consumption
AM Rush	30%	34%	29%	48%	24%
Mid-day	33%	49%	53%	50%	29%
PM Rush	23%	27%	9%	36%	18%
Evening	18%	28%	35%	28%	14%
Overall	26%	34%	31%	41%	21%

Assumed values used to calculate benefit estimates for the nine pilot intersections are displayed in the following table:

Parameter	Value[5]		
Value of Traveler Time	12.75 ($/hour)		21.25 ($/hour)
Value Occupancy	1.59		1
Vehicle Split	98%		2%
Gas Unit Price	3.48 ($/gallon)		3.48 ($/gallon)
	CO	NOx	VOC
Pollutant Unit Price	0.0063 ($/kg)	1.28 ($/kg)	1.28 ($/kg)

Based on the previous assumptions and 261 weekdays of annual use, benefit estimates for the nine test intersections were estimated to be approximately $7,184 daily and $1,875,127 annually. If SURTRAC were to be implemented throughout all the intersections in the City of Pittsburgh, citywide benefits would be estimated to be over $125 million annually. It is also estimated that the benefit-cost ratio would be about 20:1 after five years of operation due to the negligible operational costs associated with SURTRAC's decentralized nature. Even after assuming a cost of $50,000 per intersection for technology upgrades, return on investment is realized after three months of operation.

Notes on Valuation

The range in the benefit-cost ratios and agency cost savings potential can be expected to vary across states due to:

- ✓ Highway congestion
- ✓ Labor and material costs
- ✓ Degree of system maturity

FHWA Office of Operations provides resources to help evaluate the benefit and costs of operational improvements including ITS. These resources include the Tool for Operations Benefit Cost Analysis (TOPS-BC)[6] and other relevant publications.[7,8]

Individual Assessments

States are encouraged to review the FHWA Office of Operations *Operation Benefit/Cost Desk Reference*[9] and the references shown below, and to consult the FHWA INVEST Subject Matter Expert (SME), Jim.Hunt@dot.gov, for additional working materials in assessing their own unique situations and/or if they have information that could assist others on this topic. In addition, Paul.Pisano@dot.gov is the SME for ITS applications related to road weather management.

References

[1] Research and Innovative Technology Administration (RITA). Intelligent Transportation Systems Join Program Office – Benefits Database. Accessed May 5, 2014, http://www.itsbenefits.its.dot.gov/.

[2] Federal Highway Administration (FHWA). "Springfield Sangamon County Regional Planning Commission (SSRPC)" in Invest Case Studies. Accessed May 12, 2014, https://www.sustainablehighways.org/files/490.pdf.

[3] Ibid.

[4] Smith, Stephen F. et al. Real-Time Adaptive Traffic Signal Control for Urban Road Networks: The East Liberty Pilot Test. 2012. Accessed June 4, 2014, http://www.itslessons.its.dot.gov/ITS/benecost.nsf/ID/F7DDEA5B647725C085257AF00057B0F6?OpenDocument&Query=Home.

[5] RITA. Intelligent Transportation Systems. "A decentralized adaptive signal control system has an expected benefit-cost ratio of almost 20:1 after five years of operation if deployed city-wide in Pittsburgh". Accessed June 4, 2014, http://www.itsbenefits.its.dot.gov/ITS/benecost.nsf/ID/B71185CB6B7B59B185257AF30060A0C3?OpenDocument&Query=BApp.

[6] FHWA – Office of Operations (OPS). Tool for Operations Benefit Cost Analysis (TOPS-BC) http://plan4operations.dot.gov/topsbctool/index.htm. Accessed August 1, 2014.

[7] FHWA – OPS. Benefit/Cost Desk Reference. Accessed June 24, 2014, http://www.ops.fhwa.dot.gov/publications/fhwahop12028/index.htm#toc.

[8] FHWA – OPS. Planning for Operations Publications. http://ops.fhwa.dot.gov/publications/publications.htm#pfo. Accessed August 2, 2014.

[9] FHWA – OPS. Benefit/Cost Desk Reference. Accessed June 24, 2014, http://www.ops.fhwa.dot.gov/publications/fhwahop12028/index.htm#toc.