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**Innovative DOTs: Identifying Critical Issues and Strategies with Broad Support**

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## **ABSTRACT**

Many state Departments of Transportation (DOTs) are engaged in strategic planning aimed at helping them improve their ability to identify coming problems and improve their ability to innovate. This paper examines common concerns or 'threats' currently facing DOTs, and identifies strategies to address them, or 'opportunities' that many DOTs support. The paper gives examples of innovative projects and programs from DOTs around the U.S., across a spectrum from leading innovative agencies to those just starting to initiate a discussion about change. Our methodology was to scan recent reports on critical issues and changing trends from a variety of experts and transportation stakeholder groups representing a broad selection of viewpoints. We then sought examples of how DOTs are currently innovating to address these critical issues and changing trends—both opportunities and threats—and identified ten main ways in which DOTs are adapting to meet them. Many reports on innovative DOTs describe small incremental changes, or lacked attention as to the timeframe over which an innovative solution might be expected to take hold. The selected examples of DOT innovation illustrate a broad range of how DOTs are currently responding and adapting to critical issues and changing trends. Within these, we identified four key factors that can help foster innovative DOTs: external pressure from state mandates; special attention to internal factors like culture, processes, and relationships with external partners; strong top level leadership that is consistent over time; and technical assistance from outside experts.

## **INTRODUCTION**

The need to identify critical issues that require adaptation and innovation has received an increasing amount of attention from state DOTs in recent years. In particular, much attention has been devoted to the erosion of the gas tax and identifying new sources of revenue and finance, integrating new information and communication technologies (ICTs) into system operations, meeting the changing needs of an ageing population, and in some states, dealing with the pressures of climate change, both mitigation and adaptation. This paper reviews the thinking on this topic in recent years, from a variety of perspectives. It identifies, from multiple viewpoints, common concerns or 'threats' that currently face public agencies as well as the strategies that have been proposed to address them, or 'opportunities' for action.

The work is based on a critical review of reports by a variety of transportation stakeholder groups, including a broad selection of viewpoints, such as academics, professional organizations, and highway and transit interest groups (Table 1) as well as interviews with key experts and stakeholders from over 60 organizations with an interest in these issues. (USDOT 2012, ARTBA 2012, APTA 2008, T4America 2009, Orski 2012, AASHTO 2011, Puentes 2008, TRB 2009, Ranger 2010, Orcutt & Alkhadri 2009, Marsden et al. 2009)

**Table 1. Reports reviewed as part of this study**

<i>Organization</i>	<i>Papers</i>
Transportation Research Board	<ul style="list-style-type: none"> <li>• Critical Issues in Transportation, 2009</li> </ul>
Brookings Institution	<ul style="list-style-type: none"> <li>• State Infrastructure Banks, 2012</li> <li>• Bridges to Somewhere: Rethinking American Transportation for the 21<sup>st</sup> Century, 2008</li> </ul>
World Economic Forum	<ul style="list-style-type: none"> <li>• Deakin personal communication</li> </ul>
Bipartisan Policy Center and the Eno Foundation	<ul style="list-style-type: none"> <li>• Consequences of Reduced Federal Transportation Investment, 2012</li> </ul>
American Road Transportation Builders Association	<ul style="list-style-type: none"> <li>• The Role of Private Financing in Meeting US Transportation Infrastructure Needs, 2012</li> <li>• Greener and Cleaner, 2011</li> <li>• Opportunities to Improve Road Safety, 2010</li> </ul>
American Public Transit Association	<ul style="list-style-type: none"> <li>• Transit Vision 2050, 2008</li> </ul>
American Association of State Highway Transportation Officials	<ul style="list-style-type: none"> <li>• Jack Basso Congressional Testimony on the Transportation Financing Crisis, 2011</li> <li>• Critical Issues in Transportation, 2010 (slides)</li> </ul>
Innovation Brief (Ken Orski)	<ul style="list-style-type: none"> <li>• InnoBrief V23, No. 24, “Confronting the Reality of Declining Federal Transportation Funding”, 2012</li> </ul>
T4 America	<ul style="list-style-type: none"> <li>• Blueprint for TEA4, 2009</li> </ul>
US DOT Volpe Center	<ul style="list-style-type: none"> <li>• The Challenge of Planning for Mega-regions, 2012 (slides)</li> <li>• Webinar videos: Gomez-Ibanez, Chase, Ritter,</li> <li>• Expert panels: Safety for Older Drivers, Human-Machine Interactions</li> </ul>
Center for Urban Transportation Research	<ul style="list-style-type: none"> <li>• The Case for Moderate Growth in Vehicle Miles of Travel: A Critical Juncture in U.S. Travel Behavior Trends</li> </ul>

## Critical issues and changing trends

### *Exogenous issues and trends*

We found broad agreement among U.S. and international transportation stakeholders on critical issues and trends that are beyond the scope of any organization to control, yet require planning and preparedness strategies to deal with. These are big picture, external trends that are forcing institutions and organizations to change how they do business and to embrace new approaches:

- **Demographic change.** In the US, an aging population, baby-boomers leaving the workforce, and a large share of immigrants.
- **Population growth.** A young and growing global workforce.
- **Urbanization.** Growth of megacities and megaregions, with more people living in cities than ever before. Cities are where the new knowledge economy is produced, and productivity is linked to transportation system performance within metropolitan regions, rather than inter-city travel.
- **Climate change.** Increased frequency and severity of storms and sea surges.
- **Energy.** Prices and scarcities due to path dependency on limited fossil fuels.
- **Economic change.** Globalization changing flows of goods and workers, shift of economic activity to developing countries (China, India, Brazil).
- **Security.** Growing risk exposure and protection against terrorist events.

Since all of these critical issues are ones that cannot be avoided, the basic challenge for DOTs is to develop responses that mitigate the severity of impacts; an additional challenge is to identify hidden opportunities. For example, the challenge of urbanization threatens to severely burden urban transport systems, but it is also an opportunity to respond to increased demand for efficient urban transport with innovative approaches like bicycle and car sharing, and by connecting and modernizing public transit systems.

### *Critical issues where DOTs could be proactive*

Another set of commonly viewed critical issues were ones over which DOTs exercise some degree of control. These are external issues such as funding or travel demand, that create internal challenges, and which the DOT may be able to respond or influence. For these issues, the challenge for DOTs is to develop proactive strategies to overcome or work around barriers and find ways to address the issues and grasp the opportunities that are emerging, ideally playing a role in shaping them. They are:

- **Finances.** Revenues are falling short of needs estimates, revenue sources are modally restricted and limit multi-modal investment, and jurisdictional funding flows favor state facilities over local ones where most travel and crashes occur. Revenues are not

readily available to support expansive new infrastructure or services even in growth areas or to experiment with new options. Many states perceive a lack of political will to develop new revenue sources. Decentralization of financing gives local governments more control in some states, but also means that DOTs have less ability to provide uniform level of service and meet national priorities. Demands for accountability and performance standards and results are vocal.

- **Infrastructure.** Most states have an enormous and deteriorating capital stock, with bottlenecks in critical areas.
- **Changing travel demand.** Total travel and its characteristics are diverging from historic trends, due to economic difficulties, fluctuating fuel prices, increased urbanization, the aging of the population, and possibly, changing values and preferences among the young.
- **Safety.** US safety performance is lagging compared to peers although new technologies have improved vehicle performance and offer possibilities for larger system gains.
- **Equity.** Disproportionate health, financial, and mobility burdens fall on the disadvantaged and transport issues are connected to all of these burdens.
- **Cities and land use.** Local control of land use and limited control of transportation funding leads to lack of integrated transportation and land use planning, at all scales. States differ in their directives on land use with some mandated to provide leadership and funding for coordination of transport and land use and others expected to leave land use to local government and the private sector.
- **Regions.** Weak authority and funding for regional infrastructure planning continues to be the norm, with some exceptions, despite increasing interdependency of cities within regions. The emerging growth of mega-regions offers a new challenge to regional approaches.
- **Institutions.** Many transport organizations are designed to deliver standard products “by the book” in an era when specialization, context sensitivity, and experimentation are increasingly demanded by business and the public. Many report difficulties in attracting and retaining the creative talent needed for innovation - to conduct research and revamp internal structures and programs.
- **Information Communications Technologies (ICTs).** A new generation of automated sensors and wireless communication allows for new methods of system performance monitoring, problem prediction and development of solutions, but funding for demonstrations and implementation is hard to come by for many DOTs.

- **Big data.** New streams of data from ICTs, flowing in real-time, are creating opportunities for strategic management and optimization assets and services. New positions for 'data scientists' are being created for people who can link together multiple sources of unstructured data and identify meaningful patterns that lead to innovation. New types of data visualization are also emerging. (HBR)
- **Economic development.** DOTs are increasingly pressured to focus on economic development and job creation since the recession. Too much focus on using transportation as a driver of economic development can create a bias toward new projects rather than system maintenance and performance.

## RESPONSES BY INNOVATIVE DOTs

### Views of “Innovation”

The literature on innovation encompasses a wide range of possibilities, from incremental improvements to transformative change. (Ranger 2010, Langdon 2007) Implementation processes also are a major focus of research and writing. In comparison, most DOT discussions of innovation are more circumscribed. We found that a substantial number of the reports on innovative DOT practices were focused on small incremental changes; indeed, many were focused exclusively on innovative financing. Several reports were aspirational, identifying needed innovations and proposing strategies to achieve them, but without a specific plan for moving forward. Likewise our interviews found that many DOTs had been investigating new approaches but had not necessarily implemented them fully.

We use the term “innovative DOT” in this paper broadly, to refer to a DOT engaged in some level of discussion—and perhaps, but not necessarily—some degree of implementation or change. The efforts outlined in this memo serve to illustrate the spectrum of responses by DOTs to the critical issues outlined above.

### Innovative ways that DOTs are addressing opportunities and threats

Many DOTs are currently taking action to respond to these critical issues. A flurry of recent reports document DOT planning and evaluation processes. In these efforts, high level DOT leadership often works with a research organization such as Brookings or the State Smart Transportation Initiative to convene an expert panel and engage stakeholders in a process of thinking through challenges and opportunities. The resulting reports usually begin by stating the motivations of the DOT to produce them. These can all be drawn from the list of critical issues above, particularly the first three—constrained financial resources, crumbling infrastructure, and changing transportation demand. For example, in 2011, the Tennessee Department of Transportation found itself with nine times as many projects in its workplan than it had funding to realize. (SGA & TDOT 2012)

The solutions proposed in these reports go well beyond technical fixes – the Tennessee report and others like it emphasize the need to change standards, processes, and cultures within DOTs that serve as barriers to smarter transportation investment.

We found ten main ways that innovative DOTs are adapting to current issues:

1. **Increased private financing.** Moving away from total dependency on taxes and fees, toward user fees paid by individuals, and private sector financing through public private partnerships.
2. **Institutional process changes.** Becoming more data driven and outcome-oriented by aligning core activities with environmental, safety and system performance targets.
3. **Expanding institutional capacity in finance and asset management.** Developing in-house expertise working with alternative sources of financing like PPP contracts, infrastructure banks, and tolling.
4. **Focusing on system efficiency.** Emphasizing transportation system efficiency gains over new construction and maintenance; emphasizing movement of people over movement of vehicles, as in re-defining level of service; planning for an area or a corridor rather than by mode, with all modes integrated; reforming planning and funding processes to reward inter-jurisdictional cooperation and collaboration.
5. **Improving operations (outcome) efficiency.** Monitoring and managing system operations by geography and user type (i.e., driver, transit rider, freight, rather than mode), to find where efficiency in outcomes could be gained.
6. **Focusing on performance toward policy goals.** Evaluating investments and system efficiency against economic, environmental, safety and public health policy goals rather than operations goals. Reforming level of service metrics to be oriented around movement of people and goods, and compliance with environmental and other regulations.
7. **Eliminating modal silos.** Evaluating projects by performance potential rather than modal program, and measuring success by system performance metrics of the transportation system as a whole, from a user perspective - across modes, jurisdictional boundaries, and including off-peak hours.
8. **Eliminating program silos.** Evaluating projects by performance potential rather than eligibility for specific programs – increasing flexibility rather than formulas, and removing barriers to off-system investment.
9. **Increasing cooperative and collaborative partnerships.** Developing agreements across levels of government and with transit providers in urban areas to implement

strategic corridor management and land use policies, and support municipal efforts to improve bicycle and walking facilities and safety.

- 10. Integrated land use and infrastructure planning.** Coordination of land development with infrastructure availability and planning across municipal and state agencies.

### **Examples of innovative projects and programs**

A number of states provide examples of innovative projects and programs. Pennsylvania is a prime example of a DOT responding proactively to constrained finances and infrastructure crisis to implement institutional process changes, increase collaborative partnerships and improve coordination with land use planning. Washington and Minnesota are among DOTs that have a track-record of experience adapting to respond to critical issues, yet still struggle with innovation. Oregon offers an example of how a DOT can create an in-house innovation lab to leverage private-sector resources for pilot projects. California, Florida and Missouri are examples of DOTs that have successfully developed innovative solutions to specific problems, rather than agency-wide change. Finally, Colorado and Tennessee are representative of DOTs seeking technical assistance and initiating a conversation about change in their state.

#### *Pennsylvania: Financial constraints spur agency-wide change*

The Pennsylvania Department of Transportation (PennDOT) serves here as our primary example of a DOT that has managed to transform itself in recent years. It illustrates how the direction of large public agency like a DOT may be slowly and steadily changed.

The Smart Transportation program is an initiative begun by PennDOT in 2004 to respond to the state's crisis of crumbling infrastructure and limited revenues to address it. A focus of the effort was to better align transportation investments with community revitalization and local land use policy. The program serves as a model of fiscal and asset management, up-to-date design and development guidelines, and effective collaborations between the DOT and local and regional governments. In 2011, SSTI conducted a review of the Smart Transportation program, at PennDOT's request, to assess how effective it has been in integrating land use considerations into decision-making on transportation projects. The report concludes, "Smart Transportation has transformed the very culture of PennDOT from top to bottom, at district offices as well as at headquarters." (MacDonald et al. 2011)

The Smart Transportation initiative should be understood "as a theme affecting the culture and functioning of the agency, rather than as the sum of various specific actions and programs." (MacDonald et al. 2011) Indeed, it was integrated into PennDOT's strategic mission from 2004 onwards, with specific goals of changing the culture of the organization and changing

expectations held by colleagues in government, local partners, and citizens. Beyond publishing reports, PennDOT has also focused on day-to-day processes within the agency to make sure these changes get integrated into everyday decision-making.

Three outcomes of the Smart Transportation program are highlighted in the report. First, there has been a significant shift in PennDOT's capital investment strategies. This effort was aided by the Governor, who appointed a Commission in 2005 to assess unmet transportation funding needs and potential funding sources. The Commission's report recommended a fix-it-first policy and led to the passage of state legislation to reform Pennsylvania's transportation finance policy. Passed in 2007, Act 44 created a state transit trust fund, funded by revenues from Pennsylvania Turnpike tolls. Having an action strategy in place was especially important when critical bridge failures in 2005 and 2008 affected the operations of major state highways. (MacDonald et al. 2011)

The new emphasis on system preservation has reduced the number and scale of new capacity projects. "At one point the department struck more than two dozen capacity expansion projects from its program. Over the course of a decade, it reduced its spending on capacity projects from 25 percent to less than 4 percent." (MacDonald et al. 2011). It began in 2004, when Secretary Biehler announced a "rightsizing" process which sent 26 major projects, some of which had been in the pipeline for decades, back to the drawing boards. Most of the re-design work fell to DOT district offices, who worked together with local officials and citizen groups to revise project scope and design. Allowing greater flexibility in design criteria enabled several capacity-expanding projects to move forward at a lower cost and better aligned with local and regional planning objectives.

These changes required the cooperation of the state legislature, particularly members who had to deliver news about the downsizing or cancellation of long-awaited projects in their districts. PennDOT supported legislators by providing outreach and communications services and helping them communicate the hard fiscal facts. There was little pushback from Pennsylvania's "highway lobby," in part because builders are diversifying to pursue multi-modal project work, and also because the Smart Transportation initiative was perceived as moving projects to the bid stage more quickly. (MacDonald et al. 2011)

PennDOT operationalized its new fix-it-first policy by revising project selection criteria. A new emphasis on no-build and low-cost solutions means these are considered first, with large and capacity expanding projects considered as a last resort. Early collaboration with external DOT partners, such as local officials, local agencies, and citizen groups, is rewarded. Projects tend to be developed more quickly and cost less. They tend to be simpler, have a smaller footprint, and face less local opposition, making them cheaper to mitigate. The overall outcome is a faster approval and permitting process.

The second major shift at PennDOT is a fundamental change in project design and development guidelines. A major goal of the Smart Transportation Initiative was to better integrate land use considerations into the agency’s transportation planning. The agency has gone deep into the core manuals setting standards for roadway design and construction, to update and revise them for contemporary needs. PennDOT drew upon national design standard reform efforts (i.e., complete streets, context sensitive design, linking planning with NEPA), and collaborated with New Jersey DOT to produce a new design standards manual, the Smart Transportation Guidebook. (PennDOT & NJDOT 2008)

Intended for use in urban, suburban and rural areas, the manual sets roadway design standards according to changing land uses along a corridor. For instance proposing an alternative roadway typology to simple functional classification that accounts for land use. For example, the classification for “collector” was split into “Community collector” and “Neighborhood collector.” (PennDOT & NJDOT 2008) A before and after example of these revisions is shown in Figure 1. The Guidebook also proposes alternative performance measures beyond traditional level of service, such as ‘right sizing’ projects to achieve a high value to price ratio. Ultimately, achieving better integration of transportation and land use requires supportive measures by local governments, and so PennDOT helped disseminate model language for local land use and noise ordinances.

**Figure 1. Changes to the PennDOT roadway design manual**



Source: PennDOT & NJDOT 2008

To achieve implementation of the new guidelines required internal compliance by staff. A great challenge to the Smart Transportation Initiative was changing the culture of the agency. “New directions required not only new tools but also new states of mind for many of the agency’s people. Established ways of doing things can be deeply rooted, even in very good highway planners and engineers. Smart Transportation is a new way of thinking about how a project serves accessibility needs and how a project scope and purpose should guide design, plans, and specifications.” (MacDonald et al. 2011) This cultural issue was directly addressed by agency leadership. PennDOT developed training manuals and adopted new processes and software to support the effort. For instance, a process called Value Engineering/Accelerated Construction Technology Transfer (VE/ACT) was used to facilitate internal collaboration in project reassessment and redesign. A decision-making software called Decision Lens was deployed throughout the agency, to assist capital planning and asset management efforts. Perhaps most importantly, guidance documents and handbooks for staff clearly authorizing new practices like increased design flexibility and provided examples of how to implement it.

Finally, PennDOT has been innovative in creating a competitive funding program for Smart Transportation projects, often used to support community revitalization efforts. The Pennsylvania Community Transportation Initiative invites local governments to compete for funds for small-scale multi-modal projects. The program is modest, but highly visible—in 2010 and 2011, more than 90 projects from around the state were awarded funding. Giving local communities a direct way to engage with the DOT to accomplish desired local projects has enhanced the agency’s image and credibility. (MacDonald et al. 2011) A notable ‘soft’ outcome of the Smart Transportation initiative is that it has significantly enhanced PennDOT’s public credibility by becoming more responsive to public concerns and increasing its level of collaboration with local governments.

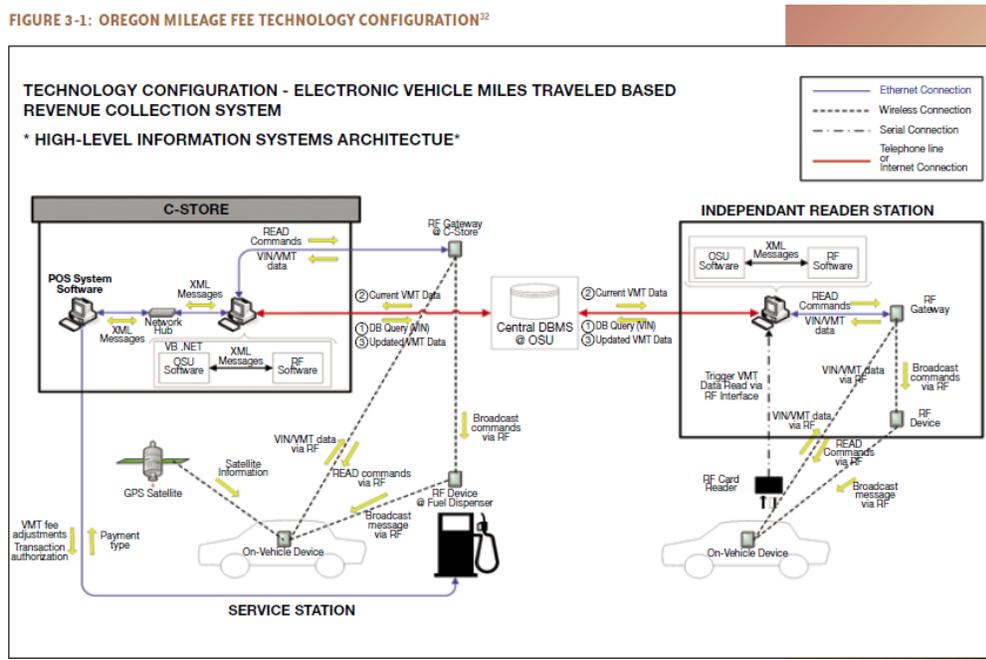
#### *Oregon: An office for experimentation*

The Oregon Department of Transportation (ODOT) is given as an example of a DOT that has created a special space within itself for innovation, a special office charged with experimental projects to serve long-term needs.

The Office of Innovative Partnerships and Alternative Funding (OIPAF) represents a long-term and focused effort by the agency to develop innovative solutions in-house through public-private partnerships. Functioning as a “research and development” laboratory for ODOT, the office leverages private funding to test new ideas. It began in 2001, when the Oregon legislature formed a task force to consider alternative transportation revenue sources. ODOT was subsequently directed to develop a feasible replacement for the gas tax, a mileage-based fee collected at fueling stations. Today there are three major experiments being conducted by the OIPFA, the road usage charge pilot program, the solar highway project, and the electric vehicle charging network project.

ODOT’s experiment with road pricing, a mileage-based user fee pilot program, is perhaps the most widely known. While other states are increasingly studying road pricing as a potential revenue source, this full-blown multi-year pilot project remains unique. Launched in 2006, the year-long mileage-based user fee program involved 300 volunteer participants in Portland, Oregon. The pilot program tested new technologies to non-invasively record mileage and bill for road use when participants fueled their cars. Figure 2 shows a diagram of how the system works. The summary report for the pilot concludes that existing technology could be used to make the switch from a gas tax to a mileage-based tax, and the system was acceptable to participants. (Whitty 2007). Subsequently, additional pilot projects tested the feasibility of the mileage-based fee system to introduce congestion charging into the fee structure, as a way to influence the time and route of motorists’ travel.

**Figure 2. Oregon’s mileage-based road user fee pilot program**

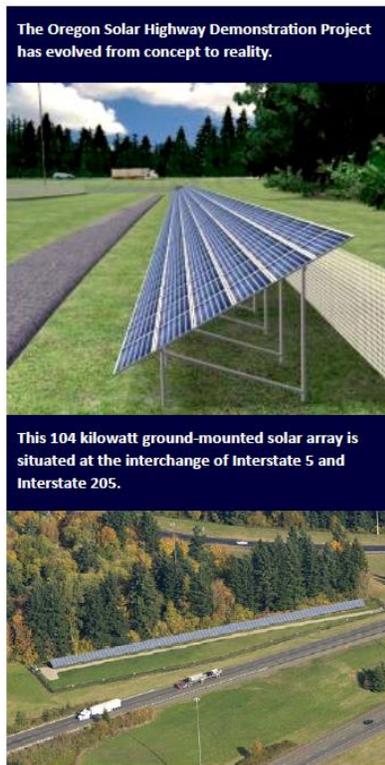


Source: Whitty 2007

In 2008, ODOT completed construction of its first “solar highway,” another project out of the OIPFA. The demonstration project aims to reduce operating costs and CO2 emissions associated with lighting highways at night. Shown in Figure 3, the solar highway demonstration project uses a solar photovoltaic system to provide power at the highway interchange of I-5 and I-205, with excess power feeding into the local power grid. ODOT is in the process of working with its private partner on this project, Portland General Electric, to install similar solar installations at rest stops along I-5. The project report describes this initiative as a change of thinking about agency-owned assets, “Innovative DOTs are now looking at other agency property and assets, including highway rights-of-way and rest areas, for opportunities to develop larger-scale

renewable energy projects.” (Ponder, Proudfoot & Luftig 2011) Installation of solar generation capacity is an opportunity to not only increase the operational efficiency of the agency, but a potential source of revenue, if sufficient power is generated to sell excess to a power utility.

**Figure 3. Oregon’s solar highway installation**



Source: Ponder, Proudfoot & Luftig 2011

Another OIPFA program is the Electric Vehicles and Infrastructure Program, which aims to create a network of rapid electrical charging stations throughout Oregon to increase the feasibility of electrical vehicle ownership. This program is in part a public private partnership with Oregon power companies, and it is also supported by federal grants. Program staff work directly with local officials to find appropriate sites for this infrastructure.

*Washington and Minnesota: Sustaining an agency culture of innovation*

Washington (WSDOT) and Minnesota (MNDOT) Departments of Transportation both have a track record of innovation in the arena of environmental policy, achieved via a long, slow process of aligning agency practice with environmental policy goals. They are credited with being at the forefront in the areas of demand management, context sensitive design and performance measurement, having developed tools that serve as a model for others. For instance, WSDOT's “Gray Notebook” performance monitoring system, which is used by departments to

report project status and track progress toward benchmark goals, has received national recognition as a model of project accountability and transparency. (Meyer et al. 2011)

In 2011, WSDOT undertook an external assessment of their sustainability efforts, to assess whether policy goals were being met. A panel of experts was convened, composed of professional and academic experts, including people who have led transformative initiatives at DOTs. They reviewed documents and conducted interviews within WSDOT and among government and constituent stakeholder groups. This peer review concluded with a report assessing where WSDOT has succeeded and how its sustainability efforts could be strengthened. (Meyer et al. 2011)

The report concluded that WSDOT could be more innovative in the area of sustainability. The top recommendation was to make fiscal sustainability part of the 'sustainability umbrella'. This would entail a greater focus on asset management, and developing new methods of prioritization among new projects. They also felt that WSDOT had a lot further go injecting multi-modalism and land use integration into their sustainability efforts.

The report identified three main drivers of success that have helped WSDOT earn a reputation as a sustainability leader. First, state legislation in the early 1990s forced the agency to develop certain programs and in-house expertise, such as the Commute Trip Reduction Law and the Growth Management Act. Other significant state laws pushing the agency to change were a gas tax increase in 2003 that created a multimodal account, and legislatively adopted VMT reduction goals in 2008. These legislative mandates created initiatives that were not otherwise part of the WSDOT agenda. At the same time, public initiatives constraining legislative spending on a variety of transportation projects forced the agency to put many major construction projects on hold. Both of these factors created pressure for the agency to adapt and innovate. (Meyer et al. 2011)

The other two drivers of change identified in the report were external pressure to engage in partnerships, and internal staff initiatives. For instance, a variety of executive orders in the 2000s forced WSDOT to engage in cross-agency collaborative partnerships and the creation of public task forces and advisory boards, (e.g. the Commuter Trip Reduction Board). (Meyer et al. 2011) Internally, pressure for change was created by top agency leadership and staff-initiated actions. A succession of DOT Secretaries have been consistent in pushing the agency to position itself as an environmental leader. Many staff carried over an environmental ethic from their personal lives to their work, and were receptive to integrating sustainability practices into day-to-day operations and demonstration projects. Others wanted a clear explanation of the agency's sustainability practices 'on the ground', and training as to land use laws and engaging with land use actors. Ultimately, it was a combination of inside and outside pressure that slowly transformed WSDOT into a more environmentally-oriented agency.

MNDOT harnessed its own employees as a source of ideas for innovation. In 2009, the agency established a web-based program, the “Emagination Jam (E-JAM)” that allowed employees to submit ideas for improving the organization and to comment and vote on submitted ideas. (SGA & SSTI 2012) The E-JAM initiative resulted in three ideas rising to the top, which were then adapted into initiatives within the agency. The three initiatives were called Technology Connections, Workplace of Choice, and Sustainability. Project managers were then hired to develop and lead each initiative.

*California, Florida, and Missouri: Pockets of innovation*

The California, Florida and Missouri Departments of Transportation, known respectively as Caltrans, FDOT, and MoDOT, represent a diverse range of state needs and institutional capacity. They have been selected for discussion because within each of these agencies, an innovative project or program has taken hold. Rather than examples of agency-wide change, these agencies have fostered pockets of innovation at the district level. They illustrate how opportunities for innovation may be more readily recognized and acted upon by having the flexibility to develop localized solutions. In California, this has been done with ITS and traffic operations, by devolving funds and leadership responsibilities to the district level. (SGA & SSTI 2012)

FDOT and Caltrans have responded to the issue of congestion at freight hubs with innovative solutions. Recognizing the need to cluster freight land uses like warehouses and logistics centers around infrastructure like ports and intermodal transfer points, FDOT’s statewide freight strategy plan calls for ‘freight villages.’ (FHWA 2009a) This idea emerged from the agency’s collaborative work with the Orlando MPO and Port Canaveral. It enables FDOT to work together with local governments to assess local land use and development patterns to identify an area with excellent transport network access as a potential freight village. Local jurisdictions may then create a zoning designation for warehousing and logistics, and FDOT sets roadway design standards according to the needs of freight users, for instance, signal timing and road geometry.

In California, the ports of Long Beach and Los Angeles serve have been increasing rapidly and becoming more congested, creating pressure to extend hours of port operations. In 2004, the California legislature passed a law requiring congestion charging at the port, as a way to make operations more efficient. Introduced in 2005, revenues from the port congestion fee are used to reduce the higher cost of nighttime port operations. As a result, daytime truck traffic fell by one third, reducing congestion on port access roadways and improving turnaround times for drivers. (FHWA 2009b)

Missouri offers an example of adapting innovative ideas to suit practical concerns. Like many agencies, MoDOT was faced with funding shortfalls and a lack of new revenue sources in 2004. In response, it developed ‘practical design’, essentially an adaptation of context sensitive design under constrained resources. The approach allows for flexibility in design standards, according to

need. For example, in the past, bridge rehabilitation would require current design standards to be applied, usually resulting in a higher cost replacement project. With the practical design approach, repairs and improvements can be made simply to improve safety, at much lower cost. (MoDOT 2006)

*Colorado and Tennessee: Initiating a discussion about institutional change*

In 2009, the Colorado legislature passed a law mandating that long-range transportation plans address greenhouse gas reductions and environmental stewardship. (SSTI & CDOT 2012) The Colorado Department of Transportation (CDOT) struggled to respond, first by hosting a workshop in 2010 to open dialogue on the topic. At the conclusion of the workshop, there was an agreement that more inter-agency collaboration was needed, but no strategies and an action plan. Therefore CDOT sought technical assistance and in 2011 launched a collaborative initiative called “EnergySmart,” aimed at improving energy efficiency in the transport sector. (SSTI & CDOT 2012)

The initiative brought together various state and regional agencies to strategize ways to work together for energy efficiency. Participants included the federal highway, transit, and housing and urban development agencies, CO state departments of public health and local affairs, the Denver MPO, COG, and air quality district, and several other COGs from around the state. They were divided into three workgroups: Smart Systems/Trips, Planning Processes, and Data and Measurement. Each work group developed lists of 20 to 60 strategies to improve energy efficiency in their area. These were then prioritized for action in the near term. (SSTI & CDOT 2012)

Several actions were taken as a result of the EnergySmart initiative. A new pilot program for truck stop electrification was funded, as well as a grant program to assist companies purchase add-ons to make their trucks more aerodynamic. A real-time trip planning application for mobile phones was developed, using data from the CoTrip website, to make the state’s transit systems easier to use. Also as a result of this effort, Colorado signed a Memorandum of Understanding, together with nine other states, agreeing to joint procurement of natural gas vehicles for state fleets, and coordinated development of supportive infrastructure. (SSTI & CDOT 2012)

In 2011, the Tennessee Department of Transportation (TDOT) found itself with nine times as many projects in its workplan than it had funding to realize. It sought technical assistance to conduct an assessment of its project list and suggest strategies for prioritization. The resulting report presented a general set of recommendations, mainly modeled after the experience of PennDOT. One outcome of this effort was the establishment of a new TDOT Office of Community Transportation, charged with outreach to local partners. The goal is for TDOT to develop relationships with local level agencies and officials, and become familiar with local plans, in order to better understand and anticipate upcoming local development and coordinate transportation investments with land use changes. An important outcome of this effort was to

initiate a discussion within the state. Key aspects that contributed to the success of PennDOT's effort, like cooperation with the state legislature, may not exist yet. (SGA & TDOT 2012)

## **Discussion**

Many DOTs are currently taking action to respond to these critical issues, particularly the first three—constrained financial resources, crumbling infrastructure, and changing transportation demand. We considered examples of innovative DOTs across a spectrum, from agencies achieving slow transformation over many years, to agencies just initiating discussions of how to responding to critical issues. We found several common factors to the success of these efforts.

First, external pressure is a very important motivating force. We named a variety of external issues that provide such pressure in the first section of this paper, but these alone seemed insufficient to spur agencies to action. The most effective pressure seems to be state legislation mandating some sort of action that the DOT must respond to, as illustrated in Washington state.

Secondly, for change to be effective and lasting, special attention must be given to internal factors at the agency: culture, processes, relationships with external partners. In the cases where DOTs were successful at achieving transformation, there was a combination of internal and external pressure making it happen. For WSDOT, a combination of inside and outside pressure served to slowly transform WSDOT into a more environmentally-oriented agency.

A related point is that strong top level leadership which is consistent over time is key. High level DOT leadership are increasingly working with outside experts to convene stakeholders and develop solutions. PennDOT is an example of how strong leadership sustained over many years, together with attention to everyday operational details and political sensitivity can combine to achieve fundamental change, rather than small incremental shifts.

Third, The California example points to an alternative way to enable innovation – allowing subareas of the state to try new ways of doing things rather than requiring statewide consistency on all policies and programs.

And finally, it seems that agencies may have trouble initiating processes of adaptation and change alone. We saw in the case of Colorado that while a legislative mandate was present, and top leadership was pushing, it still took three years and the assistance of an external advisory team for the DOT to take effective action. Outside experts seem to play a key role in helping transformation processes and innovations grow beyond just a spark.

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