TrafficQuest report

Scanning tour USA

Traffic management: the American blend

Colophon

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TNO innovation for life

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Ministerie van Infrastructuur en Milieu

TrafficQuest

CENTRE FOR EXPERTISE ON TRAFFIC MANAGEMENT

Scanning tour USA

Traffic management: the American blend

January 2nd, 2013

Contents

1. Introduction

In The Netherlands traffic management is being considered a serious policy option to deal with traffic congestion and its negative impact on safety, economy and livability. Building new roads is often not feasible due to a lack of space, environmental and funding issues. Also, pricing is not an option for the next couple of years due to political reasons. That leaves traffic management as the way to move forward to deal with the still increasing amount of mobility.

The purpose of traffic management is to inform, induce and, if necessary, direct road users towards a safer and more efficient use of the existing infrastructure while safeguarding the quality of the environment of those living and working in the vicinity of the road network. This can be done using a number of traffic management measures, varying from a dynamic use of the infrastructure and signals to control traffic to information about the current traffic situation. All these measures have been widely implemented in The Netherlands and are used on a daily basis to manage traffic for recurrent and non-recurrent traffic conditions (like weather, construction works and incidents).

1.1 Scanning tour questions

From 2 to 10 October 2010 members of TrafficQuest, the Centre for Expertise on Traffic Management) visited the United States of America for a scanning tour to learn about the situation at the other side of the Atlantic on four topics:

- In The Netherlands traffic management is applied locally, in the vicinity of a bottleneck. Traffic management measures are used on a specific location and operate under certain circumstances. Sometimes control scenarios are used, but coordinated (traffic management measures working together to achieve certain goals) and integrated (different networks from different network authorities, different types of measures or different modes) network management is not applied. TrafficQuest was curious whether in the US there are locations where network management is applied and where the state network is integrated with a rural or urban network. In case such locations exist, TrafficQuest wanted to know the details of the implementation and the experiences with integration and coordination.
- In The Netherlands there is much discussion about the effectiveness of traffic management. A lot of impact studies exist, but they are focused on the local effects on traffic and not on the effects the measures have on policy indicators, such as throughput, safety and livability. Studies about traffic management programs are rare and date from years back. TrafficQuest is interested in the evaluation practice in the USA. Is the introduction of traffic management measures based on ex ante research? Are the measures evaluated with an assessment study and a cost-benefit analysis? Is there an evaluation framework available or are guidelines used? Which problems are encountered and how are these problems solved?
- To deal with future developments in traffic management and to be prepared for the further introduction of in-car and cooperative systems, a functional architecture was developed. This

architecture is meant to provide insight in the structure of and the relationships between the developments. It can be used to make choices on a policy level on how available means can be deployed to achieve the best results with traffic management. TrafficQuest would like to know if the USA has a comparable domain architecture and what it looks like. Furthermore, is it used in policy making?

- In-vehicle (person cars, commercial vehicles and trucks) developments open new perspectives for traffic management. Also network management is a step forward in the application of traffic management. TrafficQuest is curious how this is valued in the USA. How do they sell traffic management and how is the principle of "see your tax dollars at work" applied in relation to traffic management? How are different policy options (building new road, pricing and traffic management) assessed? And if traffic management is applied, what is the route from pilot to large scale application? And what can be learned from this.

To answer these questions and to get a good overview of the developments in traffic management in the United States, a number of organizations and sites were visited in October 2010. In advance a questionnaire was submitted to all these organizations. The answers provided by DOT Maryland are shown in Appendix B.

1.2 Program and delegates

The program of the scanning tour was a busy one. In five days seven cities were visited while 15 organizations provided a program with lectures and site visits. The complete program is shown in Appendix A. The places we visited are depicted in figure 1.

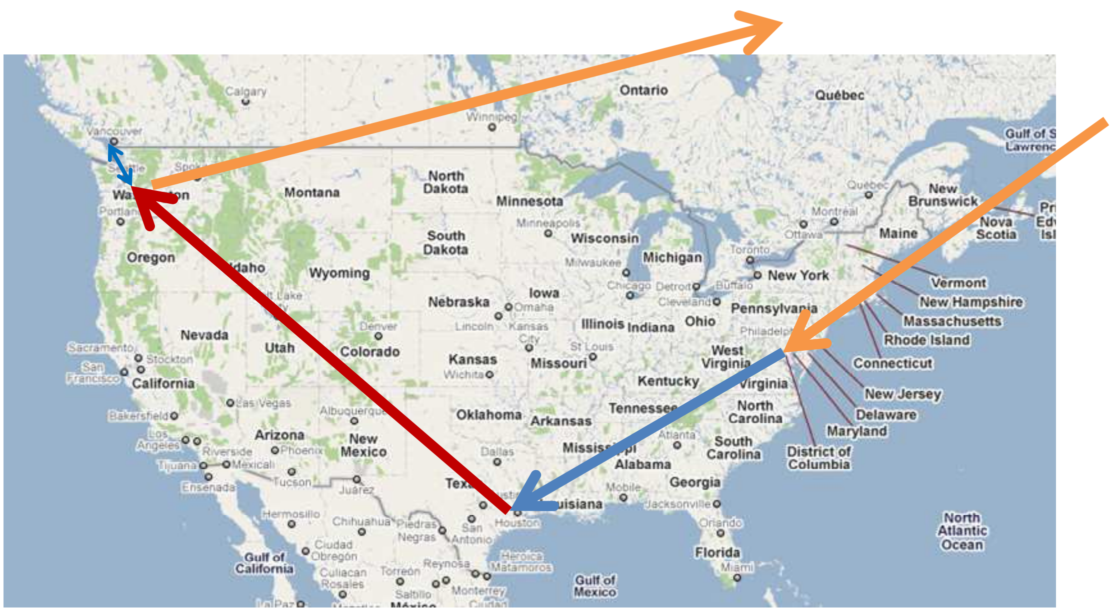

Figure 1: Map of the scanning tour

The Dutch delegation consisted of 7 persons from TrafficQuest, accompanied by Hans van Saan, the Dutch representative of Rijkswaterstaat, stationed in Washington DC (see figure 2).

Figure 2: Members of the Dutch delegation

From left to right : Aad Wilmink (Rijkswaterstaat, member of the Board of TrafficQuest), Ben Immers (TrafficQuest), Henk Taale (Rijkswaterstaat & TrafficQuest), Isabel Wilmink (TNO & TrafficQuest), Serge Hoogendoorn (Delft University of Technology & TrafficQuest), Hans van Saan (Rijkswaterstaat), Henk Schuurman (Rijkswaterstaat & TrafficQuest) and Ronald van Katwijk (TNO & TrafficQuest). Bio's of the members can be found in Appendix C.

1.3 This report

In chapter 2 a chronological overview is given of the visits, the information provided by our hosts and the lessons learned. For each day the location is mentioned and per location the presentations are discussed. In chapter 3 the findings and recommendations are presented. Some background information is given in the appendices A – E.

Figure 3: TRB hall of fame

2. Organization and site visits

2.1 Monday October 4th, 2010

Maryland DOT (Hanover MD)

Attendance:

Guests
Serge P. Hoogendoorn (Delft University of Technology)
Ben Immers (TrafficQuest)
Cornelia T. Neal (Royal Netherlands Embassy)
Henk Schuurman (TrafficQuest)
Henk Taale (TrafficQuest)
Ronald van Katwijk (TrafficQuest)
Hans van Saan (Rijkswaterstaat, Centre for Transport and Navigation)
Aad Wilmink (Rijkswaterstaat, Centre for Transport and Navigation)
Isabel Wilmink (TrafficQuest)

University of Maryland
Gang-Len Chang

Maryland State Highway Administration
Tom Costello
Dave Czorapinski
Egua Igbinosun
Alvin Marquess
Glenn McLaughlin
Steve Rochon
Mike Zezeski

Introduction
The first visit of the team immediately showed the need for traffic management. Despite an early departure, the Dutch delegation arrived late in Hanover due to congestion on I295 and I95. Upon arrival, introductory remarks were made by both TrafficQuest and the hosts.

An important topic of the meeting was CHART and the need of sharing information with other transportation agencies. CHART is about monitoring, incident management (an important part of the program), traffic management (considered to be more advanced in The Netherlands), traveler information, emergency and weather operations. There are multiple Traffic Management Centers (TMCs), but they are fully integrated, and can be operated from the Maryland TMC. The regional

TMCs are smaller and not open 24/7. The TMCs focus on freeways, but also look at primary arterials.

The information is still collected with a lot of different systems. INRIX delivers data, but the DOT also receives data from CCTV, loop detectors, cell phones and 911/emergency responders. There is not much competition when it comes to the kind of data that INRIX provides (travel times). This data is good for traveler information. For planning purposes higher quality is necessary. The INRIX data offers no volumes and gives only traffic speed. For traffic management and IM they rely on patrols (10-15 people). Cameras are used for verification. They keep track of response times and clearance times, but they do not have tracking and tracing. INRIX data are also used, but they still need to work out how to take advantage of these data.

For traffic management purposes it is possible to change traffic signals for traffic diversion. There are preplanned strategies for this. Alternative routes can be communicated to the public by VMS. The DOT is ready for deployment of HOT lanes (on the I-270). A dynamic toll rate will be applied.

Part of the CHART program is the provision of traveler information. Travel time on VMS is an example of traveler information. The website is very important and viewed by a large number of travelers everyday (an even higher number when there is an incident or an event). There are no plans to add capacity via new infrastructure; instead the focus is on better information with the aim to give travelers a choice. Travel time is accurate, but it is the real travel time and not predicted travel times.

Traffic data acquisition and management (Glenn Mclaughlin)
Glenn explains the current data sources, such as CHART event data, sensors (portable, RTMS, UASI), traffic.com (private, but publicly funded data), vehicle probe data (INRIX – I-95 and parallel roads), Bluetooth sensors and weather data. Bluetooth data needs road side stations, but they should be spaced not too close together, because that gives inaccuracies. INRIX delivers no volume data. Travel time data is okay, if enough traffic is there. The data is provided with a confidence indicator. The desired quality had an accuracy of 10 mph; in practice the INRIX data had an accuracy of 2 mph. INRIX data is considered to be very cost effective. The CHART data is event based. For every event a lot of information is gathered: the entire life cycle of the event. There are three reasons to work event based:

- operator coordination – managing resources;
- system security;
- reconstruct events and evaluate afterwards.

The University of Maryland develops RITIS: Regional Integrated Transportation Information System (www.ritis.org). All data should be available in this database. Current use of the data consists of:

- coordinate between agencies;
- traveler information on VMS;
- websites (public CHART website: 3-4 million hits per month (2 million a day during a snow storm);

- emergency/evacuation modeling;
- performance evaluation.

Future use of the data is planned for:
- 511 traveler's information;
- input for benchmarking;
- assessment of travelers information strategies;
- dynamic routing of response vehicles;
- congestion monitoring;
- text messages and streaming camera images to PDAs;

There are plans to use all the data available for evaluation purposes, e.g. to see how fast people act on the information, or to see if mobile VMS cause congestion, etc. This still requires a lot of work.

SHA performance measures (Steve Rochon)
Performance measures: Steve recommends not to give too many! They use performance measures for managing results, attainment reports (related to the funding program) and state stats, which is an informal report on a monthly basis. We do not have this kind of performance measures in The Netherlands. In Maryland, all data collected has helped them to expand their program.

Sometimes contractors are sent away if they cause too much congestion with road works. It is an open question if you can set target measures for IM. However, the evaluation is geared towards establishing accountability. For example: about 500 miles interstate are patrolled. Potential benefits are calculated and result in a high cost-benefit ratio of 50.

Evaluation (Dr. Gang-Len Chang)
Benefit estimation takes everything into account: delays, fuel consumption, emissions, also secondary incidents and risks at primary incidents sites. An important question is: what is the percentage of the delay caused by incidents. The current estimate is that this share is larger than 50%. Simulation models are used to calculate the delays for a sample of the incidents. This was initiated by a research organization. Every year MDOT asks research organizations what they would like to research. There is a budget of 100-150 k$ for this. In Maryland traffic management con-

sists mainly of coordination of signals for rerouted traffic. The public does not want active TM and politicians have a large influence on what happens. The presentation of Dr. Chang is available at http://chartinput.umd.edu.

 

Port of Baltimore (Dave Czorappinski)
Attention for truck traffic has recently increased. It is estimated that truck traffic will double in Maryland. Safety is a concern. Safety loss costs money and slows things down. For safety issues jurisdictions are important. It took a lot of effort to get different jurisdictions to work together. Permitting in and around the city of Baltimore was not well organized. This has improved; the City of Baltimore has agreed that the state does their paperwork.

In the past, trucks had to drive through the city. If a resident complained, a sign was put up (banning trucks). Now, the position of the port of Baltimore is taken into consideration and trucks are given more priority. Routing strategies have been developed which help trucks avoid driving through the city. Also parking is a huge problem. Because of large public opposition, it is difficult to build truck parking facilities. One of the few available spaces was located at an inspection site, but truckers did not want to use this location.

For the preclearance for enforcement virtual weigh station technology is used: trucks are weighed on one location and are then clear for the next 12 hours. So they do not have to stop at other weigh stations, because information on the weight of trucks is communicated between stations.

Evacuation planning (Alvin Marquess)
An example is presented about the evacuation plans for the Eastern Shore. It concerns traffic going inland from Ocean City. Cooperation between Virginia and Delaware was needed. The evacuation plans consist of routes. Travel time estimation was developed to support routing. Also, an evacuation management tool was developed. Several scenarios were tested (different types of events, scale of problem, transportation issues). With the tool it can be evaluated how much time is needed to evacuate an area. Questions can be answered like: Is there enough time? Are additional measures needed (closing roads, no left turn, adapting traffic signals)? It will include things like pedestrian movements (people running around), transit (how long does it take to get a bus going?). Macro and micro-simulation (CORSIM) is used. They also use the tool for other purposes, such as large events (grand prix).

How to optimize the plans? Models are needed for that. Strategies for evacuation are filled in by experts. E.g. what are the best routes? Then a discussion follows to get consensus on the evacuation routes. Subsequently, these routes are inserted into the model. The university works closely together on this with MDOT. It concerns a part of the university that does mostly applied research. It is important to involve all stakeholders, only then it becomes their plan as well. In addition to this Serge refers to research that concludes that the efficiency of the strategies can be improved substantially by applying an optimization model. Presentation is available at http://oceancity.umd.edu or at http://attap.umd.edu.

Figure 4: Members of the Dutch delegation at the University of Maryland

University of Maryland (College Park, MD)

I-95 Corridor Coalition (George Schoener)

The I-95 Corridor Coalition (CC) is a federal funded virtual organization, initiated to deal with the transportation problems along the I-95 corridor, which runs from Maine to Florida and crosses 16 states. The source of the problems is simple: 20% of the population is located on 6% of the area of the US. This is comparable with California, but there are more states and cities involved. Problems could not be solved per state anymore and cooperation was needed. Also, it was recognized that building new infrastructure alone could not solve the problems and that traffic management on a corridor level would be needed. Members of I-95 CC are: DOTs, toll authorities, FHWA, Amtrak, associations (ITS America), etc. The idea was to bring together people who really want to cooperate and solve problems. The I-95 CC organization should test out stuff and respond to member agencies' needs.

The I-95 CC approach is multi-modal: road, rail, maritime, etc. This means that a lot of organizational issues have to be dealt with. There is a focus on incident management, operations, multi-modal and environmental issues. Also, attention is paid to sustainability, for example what kind of infrastructure would be needed to support the use of hybrid and hydrogen/fuel cell vehicles.

The I-95 CC brings people together. There is no authority , but what about project selection and implementation and what about direct funding? A bad example of a corridor approach in the Netherlands is the Betuwelijn[1], because of unsuccessful cooperation with Germany! Cooperation and commitment is needed.


Vehicle probe project (Stan Young)
The vehicle probe project was initiated because installing and maintaining road sensors is very expensive. No road sensors are currently deployed. INRIX provides the probe data (travel times). The I-95 CC led the way and the project is running. There were no endless discussions about accuracy or provider monopolies. INRIX uses probes to collect data on more than 5000 freeway miles. Data is disseminated via the website and a portal. The price is $500 per mile per year. The fleet INRIX uses consists of trucks, taxis and delivery vehicles. However, it is not clear if and how the data is used.

The validation of the data shows good results. The validation program compares INRIX travel times with travel times measured with Bluetooth sensors. Every month data is collected and compared. It is assessed whether the data meets the requirement: an accuracy of 10 mph. The requirements were derived looking at the accuracy needed for traveler information. In practice, the accuracy is approximately 5 mph. Applications for the DoT: traffic management, travel times on the web and on VMS signs and operations planning (working hours). It is similar to the Dutch National Data Warehouse, but with less strict requirements.

New Jersey Applications (http://www.511nj.org/, Jim Hadden)
After a lot of preparatory work, state police, state road authority and the NJ Turnpike authority work together in the state-wide traffic management center (TMC). All employees can work on any of the workstations in the room. And when people from different organizations sit next to each other, they'll start talking to each other and cooperation comes naturally. They use a combination of data sources (INRIX, toll tags), as well as a data fusion engine. The aim was not to have a nice looking TMC, but the aim was to push information out to the public. For that, it is necessary to

[1] Railway line connecting the harbor of Rotterdam with the German border

have a good idea about what you want to communicate to the public and of course data is needed. There is a database with data from Philadelphia to Connecticut in a common format. For storage of the information in a database they developed their own database. The data comes from INRIX, and their end product goes back to INRIX, who uses this information again (which then comes back in some form to them). They prefer to get raw data from INRIX. At the moment there is a discussion ongoing about the way their data is being used and they are not completely comfortable to present the INRIX data to the travelers directly.


They wanted to involve a media partner, such as ClearChannel, but there were no parties interested, because the information was too transparent. The media companies did not see how they could add value and what the business model could be. New Jersey keeps control of the information going out. Because the information comes from the same database (I-95 CC), it can be distributed via several channels (VMS, internet, apps, etc). The usefulness of this database is evident. Traffic information is apparently that important that no business case is needed. They also used the travel time data for information about construction zones.

Delaware Traffic Management Center (James Clacher)

The interstates in Delaware are crucial links in the network. If something happens on the interstates, a large area feels the consequences. According to DelDOT, 25% of all congestion is caused by incidents. DelDOT (www.deldot.gov) manages almost all transport routes in the state, except rail. This is quite unique. Delaware TMC is not satisfied with the INRIX data, especially during low flow traffic situations and incidents. Therefore, they also use loop detectors, radar, cameras and weigh-in-motion. They push out a lot of information to the public via the website. Also, people can subscribe to twitter feeds. There is no integration of systems in the TMC.

Delaware had an integrated transportation plan in 1997. It fits with the multi-modal corridor approach. If emergency management is necessary, the people involved are based in the TMC ("co-located"). This can be in the case of snow storms or flooding, but also for event management. They are called a Transportation Management Team (TMT): organization for event management. Example is the race track in the city of Dover. The DOT developed its own wireless communication network. This is partly because of homeland security issues. The network will be connected with Maryland, Pennsylvania and New Jersey to share data.

There are a lot of complaints about poor timing of traffic lights. Adjusting traffic signals is the most cost effective way of traffic management. Training of traffic engineers is important, but there is a high turnover of personnel, so too much effort would be needed to properly train them. Adaptive control (which needs better trained engineers) is therefore not an option. Outsourcing the work is also not an option, because engineers need to be available at all times of the day (and should also be able to react to large incidents). Also, then there might be the need to deal with the "not invented by me" syndrome. They used to have a SCATS system, but it was removed, because of the lack of capacity to train people. Delaware DOT operates 889 signal controlled intersections. 228 of them are not part of the computerized traffic signal control network.


CATT Lab (Michael Pack)
The Center for Advanced Transportation Technology Laboratory (CATT Lab) was started by the Maryland State Highway Administration. They started small, working on traffic information. It is applied research (focus on implementation rather than on publications). Their niche is data analysis and gaming. The lab is mainly financed by DOT's/State Highway Administrations, The I-95 CC also funds projects. Other organizations that are contributing are: the military, Department of Homeland Security and private companies. A part of the budget (25%) is not labeled. What they do with this budget usually turns out to be the favorite stuff.

Things the CATT Lab works on: ITS, data archiving, data visualization, user interface design, serious gaming (for IM training and defense), data fusion and forecasting, IM and traveler information. User friendliness and usability are important. Designing the systems this way means that users do not need a lot of training to work with them. However, they find that the current systems are so engrained that the TMCs find it difficult to change to new systems. Also the coordination between TMCs is hard to establish. The TMCs are busy with a lot of things and there is no time to communicate with other TMCs to tune operations. Also the systems are not connected. One of the things they do in the CATT Lab is fusing information from different sources and giving a complete picture back to the different organizations involved. The aim is to make data usable, and to prevent that organizations need to "hunt for information". RITIS (www.ritis.org) integrates data and makes is available for all connected organizations. The database is open source! CATT Lab develops applications. They license a few of their products. They prefer to develop together with other organizations.

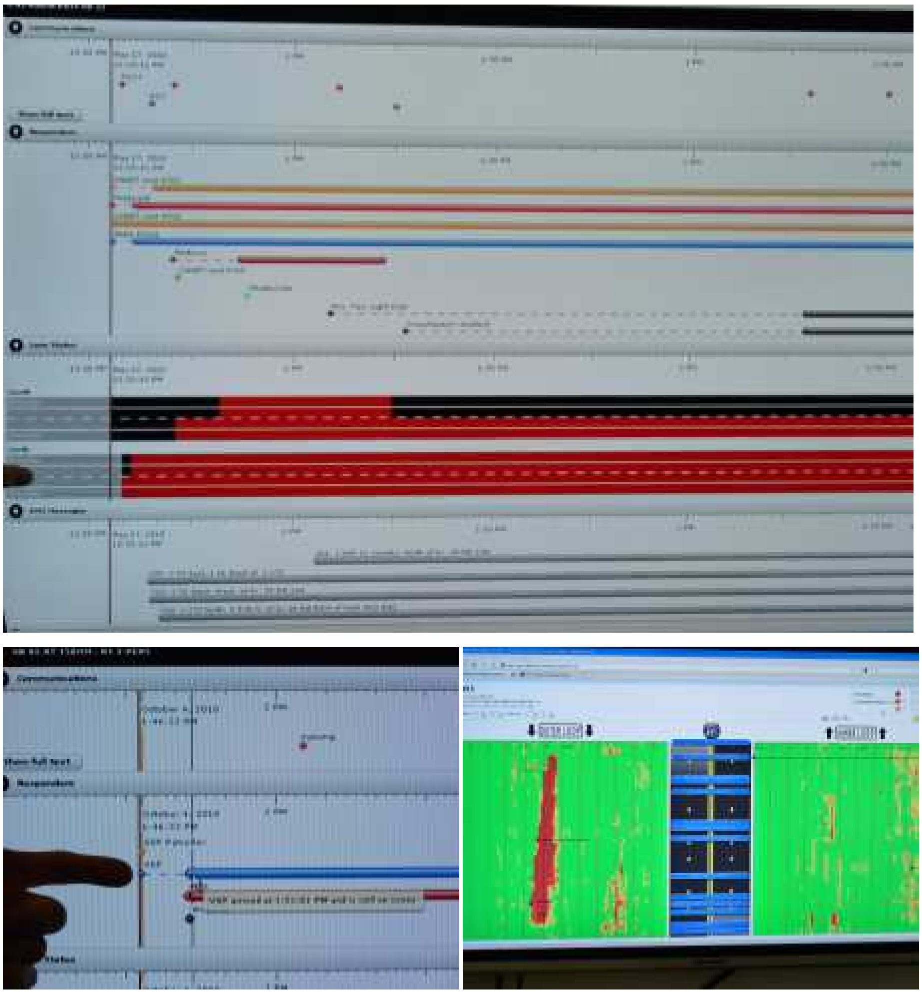

Figure 5: Visualization of the timeline of incidents

The people of CATT Lab show a visualization of the timeline for incidents. This can be used in incident management. The strategies for dealing with incidents are pre-planned (scenarios for most road sections, including re-programming of traffic signals). The visualization of the incidents could be very useful, also for evaluation purposes. They also have tools to visualize a stretch of road, and compare the traffic flow on a certain day to the average situation (e.g. based on data from a couple of weeks). In this way, it is possible to see whether congestion is recurring or non-recurring. Speed contour plots are also available, from INRIX data but also from other sensors, so volumes are also available. They can also show speed contour plots and the difference between actual speeds and normal speeds (based on historical data). Within the speed contour plots individual vehicle trajectory can be shown. They do that on the basis of a rudimentary car following and lane changing model. They asked operators what they would like to have if the budget was unlimited, and that was helicopter data. Therefore, they simulated this and asked students who want to become game developers to program this. Included in the simulation are: roads (with cars driving on them), metro lines, flight paths. FEMA is interested in this for instance for modeling of security zones.

A good example of an I-95 CC sponsored project is serious gaming to train for incident management. The project looks very nice: 50 persons can be on-line at the same time. They can move, make gestures and talk to each other and to the TMC. They do not have to be at the location. A trainer prepares a scenario with an incident. Everything the emergency responders do is recorded. It is third-party game software (not open source).

This setup could be useful to the Test center training facility. It seems that a combination of CATT Lab for computing and ITS Edulab for traffic engineering knowledge would be perfect for the Dutch situation.

Figure 6: Visualization of the incident Management process

Highlights:

- Cooperation with the university is important: it allows for the application of theory in practice.
- I95 Corridor Coalition; a virtual organization, dealing with the transportation problems along the I-95 corridor (multi-state, from Maine to Florida), applying an integrated, coordinated and multi-modal approach.
- CHART database: sharing information with other stakeholders
  - Coordination between the different stakeholders involved;
  - Information for road users on variable message signs;
  - Website;
  - Evacuation modeling;
  - Evaluation.
- Traffic management: coordination of traffic signals for rerouting.
- CATT Lab: Intelligent Incident Management data analysis and gaming

Interesting web sites:

http://www.chart.state.md.us/

http://chartinput.umd.edu/

http://oceancity.umd.edu

http://attap.umd.edu

http://www.ritis.org

http://www.mdot.maryland.gov/

http://www.cattlab.umd.edu/

http://www.i95coalition.org/

http://www.deldot.gov

http://www.511nj.org/

http://www.deldot.org

http://www.its-edulab.nl/

http://www.Mdot.maryland.gov

http://www.Sha.maryland.gov

http://www.Fhwa.dot.gov

http://www.Montgomerycountymd.gov

http://www.Transportation.umd.edu

http://www.DOTS :: Home Page

2.2 Tuesday October 5th, 2010

Virginia DOT (Fairfax, VA)

Figure 7: McConnell Public Safety and Transportations Operations Center

Figure 8: VDOT Traffic Control Center

VDOT participants

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Connie Sorrell	Chief of Systems Operations	Connie.Sorrell@VDOT.Virginia.gov
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Location

At the McConnell Public Safety and Transportation Operations Center (MPSTOC), the Virginia Department of Transportation (VDOT) and Virginia State Police are collocated with Fairfax County's Police. Fire, and 911 Dispatch units in an impressive facility. At this facility, VDOT operates its Transportation Operations Center (TOC) which is responsible for managing Interstate and key primary and secondary routes throughout the Northern Virginia region. VDOT's previous TOC was one of the oldest in the US and was located just blocks from the Pentagon. In addition to day-to-day management of the roadway network in Northern Virginia, the MPSTOC also serves as the region's Emergency Operations Center (EOC) during major natural and man-made events or disasters.

Infrastructure and demand

The Commonwealth of Virginia has a population close to 8 million people of which over 1 million live in Fairfax County where the MPSTOC is located. VDOT owns and manages about 57,000 centerline miles of road of which 40.000 miles are county roads. This amounts to about 90% of all roads in Virginia. Most roadways within Virginia's towns and cities are managed by those localities. The fact that VDOT also owns the county roads including all traffic signal systems is rather unique.

Fairfax County alone has 1,200 traffic signals. There is a large naval base and recreational area in the Hampton Roads region of Virginia that is largely only accessible through two large tunnels. VDOT's Hampton Roads TOC shares information with local tunnel facilities but does not control the tunnels. A recent flooding event at one of the tunnels created significant congestion throughout the region. An external committee investigated the event and produced several recommendations for addressing key safety issues at the tunnels.

The share of Public Transportation in Virginia is about 10%. The High Occupancy Vehicle (HOV) lanes in Virginia carry more people than the adjacent general purpose lanes. High Occupancy Tolling (HOT) lanes are being developed, but due to recent economic setbacks they are delayed. With respect to the severity of congestion nationwide, the metro DC area (which includes Northern Virginia) ranks second, right after the Los Angeles area. The last two to three years reliability has become a big issue. In 50% of the cases, congestion is caused by incidents. Incidents are the prime source of the decrease in travel time reliability. VDOT generally considers two customers: those that live within the state and those that drive through Virginia.

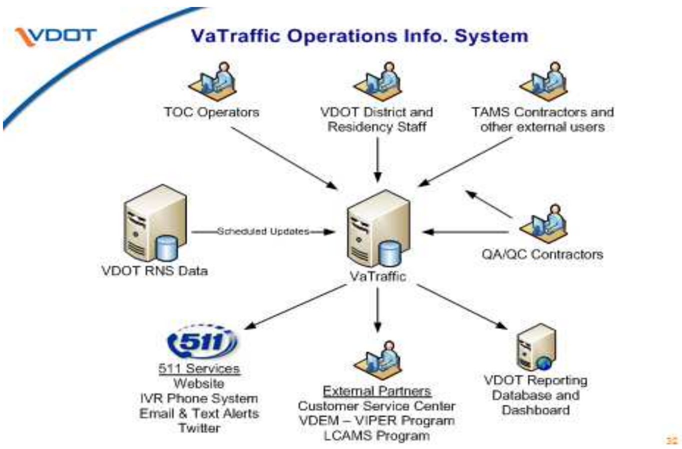


Figure 9: VDOT Traffic Operations and Information System

Organization

Maintenance and construction in Virginia is organized into 9 Construction Districts and these duties are generally performed through contracts with private sector firms. Traffic Management and Operations functions are organized into 5 Operating Regions. Each of these regional directors report to the District in which they are located. VDOT's Central Office (headquarters) is located in Richmond. Key units within Central Office that support Regional Operations, include the Operations and Security Division, Traffic Engineering Division, and the Operations Planning Division.

Inter jurisdictional cooperation

Washington DC is the number one tourist attraction in America and the second largest commuting area after New York City. For this reason, cooperation between the jurisdictions of Maryland, Virginia and DC is not optional, but required. Furthermore, there is cooperation between these jurisdictions with respect to two key corridors: I-95 North/South (10 to 20% heavy traffic) and I-81 into Tennessee (40% heavy traffic). I-95 is used both for long distance travelers and for daily commuters. Although I-81 is perceived by the public to be unsafe, given the share of heavy truck traffic, I-95 is in fact less safe.

Cooperation with other, not necessarily neighbor states is done through organizations such as ITS America and AASHTO of which Connie Sorrell is a member of the board. One of the initiatives led by VDOT is the IntelliDrive Pooled Fund program, which focuses on cooperative system development (Examples: bringing traffic signal control into the vehicle, car as a sensor for pavement maintenance, new traffic signal control algorithm using in-car information). An MOU is being developed between USDOT and VDOT for the development of real-world pilot projects. Whereas the USDOT focuses primarily on V2V applications in their Connected Vehicle program, the Pooled Fund Study generally focuses on V2I applications. The Pooled Fund Study is funded by commitments from member DOT's.

Funding

VDOT has one budget for both maintenance and operations. This also includes any technology that must be acquired. Each year VDOT determines how much money goes to maintenance and how much to operations based on a six year operation investment plan. The different districts get money based on their needs. There is no common divisor.

Funding, given the economic fallback, is difficult. In order to still be able to realize certain needs and desires, creative ways were sought to save money. Some examples of these solutions include:

- Resource Sharing Partnerships: VDOT allows telecommunications providers to gain access to limited-access portions of right of way, and in return VDOT receives fiber optic infrastructure along the routes were the provider installs. VDOT has acquired over 1,000 miles of resource sharing fiber from multiple providers.
- Reuse: In cases where original manufacturers of Dynamic Message Signs (DMS) were no longer in business, VDOT moved forward on an initiative to "refurbish" the interior components of the sign rather than replacing the entire sign and structure. This refurbishment method is approximately two times cheaper than a full replacement of signs.

Dealing with Major events

Evacuation plans have become very important as became apparent during 9/11. During 9/11 many school managers decided to send their children home and so everybody had to return from the office to pick up their children. By itself 9/11 did not cause problems as no evacuation was necessary, human decisions caused problems. Cellular and phone networks were down. Last year as a consequence of what was popularly called "snowmageddon", VDOT spent 20% of the total budget on removing snow. VDOT's Surface Meteorological Services contract proved critically important for planning and responding to such events.

Figure 10: Fairfax County: Office of Emergency Management

Highlights:

- Traffic control center is shared with the police, fire department and 911;
- VDOT manages all roads, except in the cities;
- HOV lanes are successful, HOT lanes are in development;
- Evacuation planning has become very important;
- Policy issue: integration of policy programs and the organization of maintenance;
- Challenge: to deal with growth in delays and reliability of travel times.
- Pooled Fund Program: Cooperation with other states (member DOT's) based on simple MOU. The Transportation Pooled Fund (TPF) Program allows federal, state, and local agencies and other organizations to combine resources to support transportation research studies.

Interesting web sites:

http://www.virginiadot.org/default_noflash.asp
http://www.cts.virginia.edu/IntelliDrive.html
http://www.fhwa.dot.gov/research/partnership/pooledfund/
http://www.pooledfund.org/
http://vtrc.virginiadot.org/
http://www.virginiahotlanes.com/

USDOT and FHWA (Washington, DC)

Introduction (John Obenberger)

John briefly explains the role of USDOT: it sets policies, provides guidance, and is responsible for pool funding.

Transportation planning (Harlan Miller)

The planning process in the U.S. is a decentralized (USDOT (1), State DOTs (50), MPO's (384)) and 3C (Continuing, Cooperative, Comprehensive) process. The planning cycle is done every 4 years and culminates in a TIP (Transportation Improvement Plan) with a foresight of 20 years. The Federal Highway Administration approves these TIPs and checks specifically for environmental impacts and any changes relating to changes/access interstates.

Traffic Analysis (John Halkias)

USDOT provides a 10 volume handbook on the use of traffic analysis tools. The handbook describes a process to come to a choice of a tool and how to use it. It does not provide a qualification of the tools. The outcome is considered trustworthy if this process is followed. The idea is to add a chapter on active traffic management to the Highway Capacity Manual 2010.

Integrated Corridor Management Program (Dale Thompson)

ICM is the proactive, joint, multimodal management of transportation infrastructure assets along a corridor by transportation system operators and managers. ICM seeks to optimize the use of existing infrastructure assets, making transportation investments go farther. With ICM, the corridor is managed as a system, rather than the more traditional approach of managing individual assets. ICM is seen as a promising tool in the congestion management toolbox that combines advanced technologies and innovative practices. The ICM program is a 40 million dollar program that aims to stimulate ICM. Twenty proposals were received. Eight sites were selected of which two will be demonstration sites and three will be modeled. Criteria for selection were whether the necessary ITS systems were already in place, and whether a transit partner and MPO were involved.

ITS Evaluation Program (James Pol)

The Purpose of the ITS Evaluation Program is to assess ITS research products and program outcomes, evaluate the status of ITS products' deployment, and conduct periodic evaluations of the effectiveness of the overall ITS Research Program. The objective is to determine the effectiveness and benefits of deployed ITS, and the value of ITS program investments. Its vision is to be regarded as a worldwide thought leader in the rigorous evaluation and assessment of ITS technologies, services, deployments, outcomes, and ITS research program effectiveness. Its mission is to apply creative and cutting edge ITS evaluation analysis and rigorous, sound evaluation practices to advance the ITS state-of-the-practice and state-of-the-art

Active Transportation and Demand Management (Bob Sheehan)

Regarding Active Transportation and Demand Management (ATDM) the US has started deployment of some of the ideas and insight gained during a scanning tour to Europe. Two U.S. cities, Seattle and Minneapolis, have implemented ATDM through federal congestion relief programs. The goal of the ATDM program is to enable agencies to improve trip reliability, safety, and throughput on the transportation system by dynamically managing and controlling travel and traffic demand, and available capacity, based on prevailing and anticipated conditions, using one or a combination of real-time operational strategies. The purpose of the Federal ATDM program is to identify the challenges to the adoption of ATDM and provide the necessary guidance, tools, and research to overcome the challenges. Furthermore, a lot of research is being done on frameworks for the analysis, modeling and simulation of ATDM. Examples of measures within the US that are considered ATDM are: HOT-lanes, HOV-lanes, Dynamic pricing, Variable Message Signs, Incident Management, Travel Time information (web), Managed lanes, and Dynamic ride-sharing.

University Transportation Centers Program (Curt Tompkins)

The University Transportation Centers Program has three pillars: research, education and technology transfer (valorization). The different transport groups of the universities have to compete for funding. The benefits and outcomes have to be shown for each of the projects to get funding. As universities commonly focus more on output than on outcome this is challenging. These groups that apply for funding are often interdisciplinary. The different transport groups as the universities represent over 80 different disciplines.

Highlights:

- Transport planning is important for all stakeholders.
- The process used for planning has a lot in common with the Dutch Handbook 'Sustainable Traffic Management'. It includes a model to predict 20 years ahead.
- The choice between building new roads and traffic management is also in the US a dilemma. A framework to found these decisions is in development.
- The overview of traffic related tools has no judgment.
- The evaluation program has a lot in common with the Dutch evaluation program.
- Universities participate in tenders for research.

Interesting Web sites:

http://www.dot.gov/

http://www.fhwa.dot.gov/

http://international.fhwa.dot.gov/pubs/pl07012/ (report on active traffic management)

http//www.itsdocsfhwa.gov/JPODOCS/REPTS TE/14412.htm

www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/14412.htm

Figure 11: US Department of Transportation, Washington D.C.

2.3 Wednesday October 6th, 2010

TranStar and Texas Transportation Institute (Houston, Texas)

Tour Emergency and Operations Room (Dinah Massie)

The Houston area is a rather spacious area with more than 5.7 million inhabitants and consisting of 13 counties (approximately the size of Randstad Holland).

Figure 12: TranStar: Houston Transportation Center

The Houston Transportation & Emergency Management Center was patterned after the control room at NASA Mission Control at Johnson Space Center. Four governments are working in one building: Harris County, Texas DOT, METRO (Transit), and the City of Houston. All Traffic Management and Incident Management Service Providers are located on the control room floor. A current expansion project on the floor will allow 70 consoles to be available connected with over 730 cameras in the field. Transit (Bus and Rail) dispatch, Police; Texas DOT (TxDOT), City of Houston, Motorist Assistance Patrol, Mobility Response Team, SafeClear quick-tow dispatch, and private traffic reporting services are located on the floor. There are 15,000 incidents per year which are dealt with by the Regional Incident Management System, which is a combined incident management system.

SAFEClear

SAFEClear quick towing services receives 60,000 calls per year (disabled/stranded vehicles). Maximum response time goal is 6 minutes.

The City of Houston, in response to concerns voiced about the SAFEClear program, has made the following changes to the program:

- Any motorist who stalls or experiences a flat tire who is not in a moving lane of traffic has the option of receiving a free tow to a destination of their choice within one mile of the nearest exit. If the motorist believes he or she has run out of gas, the destination can be the nearest gas station, even if it is beyond a mile after the nearest exit. If the motorist has a flat tire and a good spare, the tire will be changed for free as well, if the motorist wants.
- If a tow results from a police investigation, i.e. accident or arrest, or if the vehicle has been abandoned, the tow fee will be the city rate, currently $140.00.

Broadcasting Companies/Media

Information is streamed to the media. They do have access to all camera images in the Traffic Control Center. Data supply is for free (mutual agreement) and they provide information back (images collected via helicopters).

Traffic control

Dynamic message signs (218 devices) are programmed from the traffic control center; they also cover special events e.g. during the Houston Rodeo they post information regarding parking lots. There is permanent supervision of 28 P+R lots. Toll tags (and now Bluetooth reader) are used for speed sensing; installation costs of Bluetooth reader are $1000 - $2500 each compared to $75,000 for regular toll-tag based speed sensor (including poles and wire).


Mobility Response Team

Members of the Mobility Response Team (civilians who assume a support role to law enforcement personnel) are supervising the arterial road system. The MRT works in two shifts that together cover the time frame between 5 a.m. and 9 p.m., during which hours the officers patrol assigned areas for traffic snags, pot holes, minor accidents, broken signals or stranded motorists. They also help direct traffic at events such as parades and conventions, to ensure a smooth flow.

Rerouting

Just recently a new concept for rerouting has been installed. In case of an incident traffic is rerouted to parallel arterials. In such cases traffic signals will be synchronized or HOV lanes will be open to all traffic (except for heavy loads, 18 wheels).

There is a 3-tier administrative structure of Houston TranStar: an executive committee (4 members representing the 4 government agencies), a leadership team (technical managers) and agency managers (staff members, representing the agencies, responsible for day-to-day operations located at the TranStar facility).

Houston TranStar and the Role of Research

Introduction (Tony Voigt, Beverly Kuhn, Richard Zientek)

The TTI (Texas Transportation Institute) is located at Texas A&M University with a local office in Houston. TrafficQuest is introduced by Aad Wilmink.

Texas Transportation Institute (TTI): overview (Tony Voigt)
TTI is a research institute whose mission it is to solve transportation problems through research, technology and knowledge transfer. TTI is 60 years in operation and evolved from collaboration between Texas Highway Department (later Texas DOT) and Texas A&M University. It's contract research expenditures currently are about $50 million per year. In 2001 it was $28 million. TTI has 700 staff members and is one of the largest (based on research budget) Transportation Research Organizations affiliated with higher education in the USA. TTI staff consists of professional staff (350), undergrads' (120), graduate students (99) and support staff (50).


Another important task of TTI is to educate the future transport specialist / workforce development. TTI staff teaches at different educations, but also has its own professional education program. Over 4000 transportation professionals worked for TTI and/or were educated at Texas A&M – of which 2800 in Texas.

TTI primary research areas are: mobility, infrastructure, security, economics, freight movement, workforce development, safety, human factors and environment. TTI initiated landmark research on the following topics: traffic management centers, ground penetrating radar, break-away signs and crash cushions, HOV lanes and performance monitoring (e.g., Urban Mobility Reports (comparison of 101 cities)). Within Texas, TTI does not compete against consultants; outside it will.
It is important to have insight in impact of investments in research (see presentation); each $1 million invested in transportation research results in: 5 lives saved, 460 traffic crashes avoided, 500,000 person-hours of traffic delay eliminated, $6 million in reduced operating expenses to TxDOT, 5 graduate students trained, resulting in an overall cost to benefit ratio of >5 to 1.
TTI has a Traffic Management Laboratory and test beds for sensor technology. Current areas of research are: perimeter barriers, environmental and emissions research, hydraulics, sedimentation and erosion control, ground penetrating radar, measuring urban congestion, presented in Urban Mobility Reports (collaboration with INRIX for data, see http://mobility.tamu.edu/ums/) and safer and better highways.

Effectiveness of Different Approaches to Disseminating Traveler Information on Travel Time Reliability (Beverly Kuhn)
Travel Time Reliability information is used by transportation professionals for: mobility performance measures, planning and project prioritization and transit system performance monitoring.

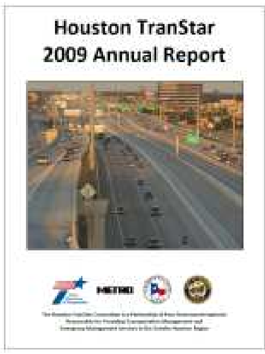
Travel time reliability seems more important than travel time itself. People are willing to pay for a reliable trip (e.g. using a HOT lane). The research primarily focuses on the way people perceive and understand travel time reliability and how you can bring the reliability of the travel time across to the public. This has strong ties with mobility management. A short discussion follows on the value of reliability and reliability information, the differences between reliability of information and information reliability and distracted driving (using hand-held devices).


Incident Management in the Netherlands (Ben Immers)
Ben gives a presentation on IM in The Netherlands. The questions, suggestions and remarks made by TranStar are:

- Why not make an automated system to see where the road inspectors are (with GPS, is the inspector already at the site, etc.).
- Who is the main responsible party, given conflicting objectives of the different IM service providers?
- Average Incident Clearance Time (in Houston area) is 35 minutes (if lane is blocked, not on hard shoulder).
- Discussion about the difficulties to make changes in organizations and procedures.
- Houston police has recently shifted in their approach by using Mobility Response Teams to manage the traffic at the incident site.

Houston TranStar Annual Benefits Report (Tony Voigt)
In the Houston TranStar Annual Benefits Report an estimate is presented of the impact of the Houston TranStar Center on:

- Mobility
- Travel time & delay
- Travel speed
- Customer satisfaction
- Productivity
- Energy and environmental benefits



Benefit calculations are conducted by TTI for TxDOT and (primarily on freeway & toll way operations) are based on congestion and delay savings (quantitative) at ramp-meters (89 in operation) and several qualitative measures; in many cases, high level estimates of the measures are used to compute the benefits. A "cost" of $20/vehicle-hour is assigned to the estimated savings in vehicle-hours. The estimated related fuel savings are based on delay savings using an average annual cost of fuel. The estimate of environmental benefits is based on the reduction in emissions of Hydrocarbons (HC), Carbon Monoxide (CO) and Nitrogen Oxides (NOx). Safety is not explicitly used in the quantification.

The cost-benefit ratio is almost 10! ($274 million savings in user costs and fuel costs and $27.7 million annualized system operating costs). Automatic reporting is built into the system.

In the Houston area there are 60 major events per year (e.g. rodeo, super bowl) and Houston TranStar is involved at some level in most of these events.

Traffic information is provided using the Houston TranStar Traffic Mapping System. It allows users to toggle traveler information map features on and off, view detailed maps of the Houston region, zoom in and out of specific map areas, and click on hot links to various traveler information directly from the maps. Embedded into the maps are "hot links" which give users direct access to other web-based traveler information. Click on the airport icons to visit each respective airport's website or the boat icon to get current Galveston-Bolivar ferry wait times. The "Statewide" map offers links to other Texas Traffic Management Center web sites. The website has 420,000 unique visitors per month. User survey indicates that regarding how website information is used:

- 25% change travel pattern;
- 50% had left earlier or later;
- 70% save up to 30 minutes;
- 90% say information is reliable and accurate;
- 95% say information is useful.

Figure 13: Emergency room TranStar

ITS Pilot Projects: Bluetooth-Based Travel Time Monitoring (Tony Voigt)
First there is a short discussion on the use of loops and the use of Automatic Vehicle Identification (AVI) system, which is currently used by TranStar. Since 1996 agencies in the Houston, Texas region have used an AVI system, using electronic toll tags, to provide real-time travel time and speed information for freeways, toll ways and HOV lanes. However, AVI-related capital and maintenance costs become prohibitive when considering monitoring on arterials and rural highways. On the other hand data produced by AVI are of great value to traffic management, traveler information and planning applications. Therefore research into more cost effective and efficient methods was required.

In Houston loops are not considered due to the high costs. They are replaced by radar, Bluetooth, etc. Some experiments are also conducted with Infrared cameras, but that is still expensive. Tony presents the use of Bluetooth, which uses (part of the) MAC address at two points to determine the travel time. From the traffic flow 5-10% is being detected (sometimes up to 30%), which is enough to calculate travel times. TxDOT is beginning to transition from AVI to Bluetooth-based travel time monitoring currently. It is expected that travel time monitoring in Houston may be exclusively Bluetooth-based within three years. Costs involved in deployment of Bluetooth data are about $250,000 - $400,000 for 880 miles of roadway. The costs involved in deployment of INRIX data are $750-$1000 per mile (both directions). There is also a Bluetooth-based travel time monitoring pilot performed on an urban arterial network that became part of the public website in March 2011. In the near future 2000 miles (I-10/US-59/US-290) 300-400 arterials in Harris County and 200-1200 arterial intersections in the City of Houston may be equipped with Bluetooth technology, with an additional 400 – 500 units by Harris County. The big advantage is that agencies own the data. TTI and the Texas A&M University system has commercialized the licensed Bluetooth technology to Post Oak Traffic Systems. The TTI Bluetooth Travel Time Monitoring system works differently by using patented asynchronous MAC address reading, resulting in more accurate calculation of segment travel times. Bluetooth technology is also used for monitoring other activities e.g. large concerts (measuring speed and density of the crowd) or detecting ghost-drivers.

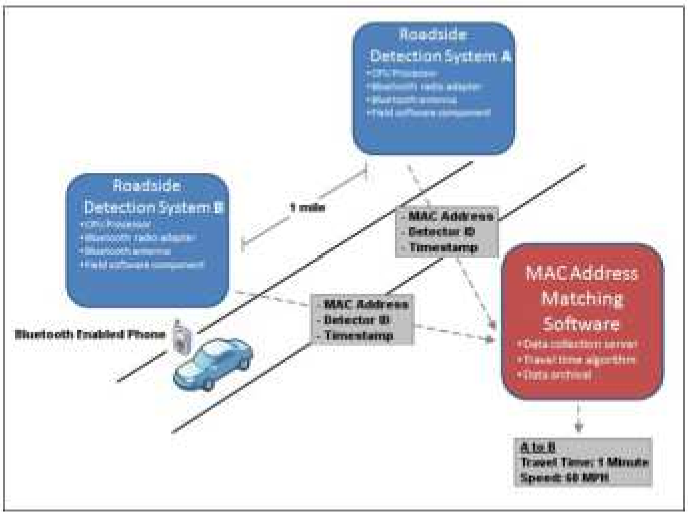


Figure 14: Bluetooth Traffic Monitoring Concept

In most cases, initial investments in new technology are paid by TxDOT, based on MOU with other parties (Harris County, Metro and Houston). In a later phase distribution of costs is discussed based on an exploitation model. Additional information on the TranStar Home Page (www.houstontranstar.org) is presented in appendix D.

Highlights:

- TranStar Website: www.houstontranstar.org
- Various stakeholders sharing the same control room
- 4 governments working in one building
- Continuous and immediate data streaming to the media
- Mitigating actions in case of an incident: opening HOV lanes and rerouting (since recent, high-ways and arterial);
- Longstanding collaboration between Texas DOT and TTI
- Impact of investments in Transportation Research: overall cost to benefit ratio of > 5 to 1.
- Cost-benefit analysis Traffic Management Operations: Houston TranStar Annual Benefits Report
- Deployment of Bluetooth in traffic monitoring concept
- Texas Barbecue

Interesting web sites:

http://www.dot.state.tx.us/
http://www.houstontx.gov/safeclear/
http://mobility.tamu.edu/ums/
http://tti.tamu.edu/
http://www.houstontranstar.org/
http://traffic.houstontranstar.org/layers/

Figure 15: Barbecue Texas Style

2.4 Thursday October 7th, 2010

WSDOT (Seattle, WA)

Tour in TMC

Upon arrival at the WSDOT traffic management center, we first had a tour of the emergency room and the traffic management room. A lot of activities carried out at the TMC were explained and discussed during this tour.

Skilled staff (Bill Legg)

WSDOT develops, installs and maintains all systems in-house, except the HOT lanes. In this way, they don't have to rely on different consultants who need to learn about the systems before they can do any work on them. This is cheaper and they can do it because they have good ITS specialists, who can also do the programming. They hope that they can keep doing it this way. In order to get employees to stay, WSDOT offers them flexibility so that the good people want to stay. This way WSDOT has been able to keep their skills in place - which is important because once they lose these people, it is very hard to get people with the right skills back.

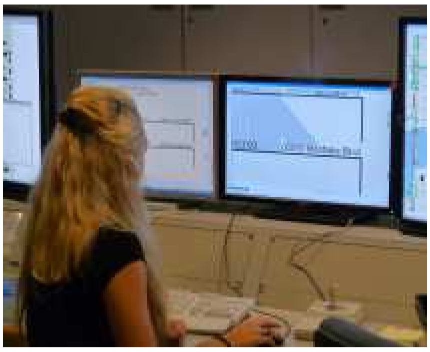
Some of the employees in the traffic management centre are students of the University of Washington. WSDOT and the university cooperate: students receive a scholarship and $13 per hour. Working late and early hours is convenient for them. At this moment they have 8 students. They only stay a few years, but they bring in new ideas.


Active Traffic Management system (Bill Legg)

WSDOT applies an active traffic management system. It sets speeds automatically, using individual vehicle data from loop detectors and microwave systems. The lowest speed shown is 40 mph. A variable message sign explains to the drivers what is going on: "slow traffic ahead", "reduced speed limit". Due to this explanation, there is a good compliance to the signs. There is not much enforcement. The WSDOT signs are individually lane based for the HOV lane and collectively lane based for the General Purpose (GP) lanes. So, the speed in the HOV lane can be posted different then the speed in the GP lanes. However, all of the GP lanes always have the same posted speed, just as it is in The Netherlands.

They have approximately 140 ramp metering installations. They see benefits almost equivalent to adding a lane: 30% less incidents, 25% better throughput. Spillback on the city streets happens, but this is not always due to the ramp meter. They try to prevent gridlock, but this is also a task of the city engineers. They work together to better coordinate the traffic lights, or put up ”no right turn on red” signs. There have been experiments with the fuzzy logic algorithm, like in The Netherlands.

They also operate about 500 traffic signals. There is still a lot of room to coordinate traffic signals, within and over jurisdictions. The traffic signal control system is provided by Siemens. There are two systems that are not interoperable. Making them work together would cost a lot of money and effort. Alternative routes are coordinated with the city. They have pre-planned strategies for this. Collaboration with the state patrol is good, although they are not present in the control centre.

Active Traffic Management (Morgan Balogh)
Morgan Balogh is from the regional office of the State DOT. They carry out work like painting stripes, but also incident management (deploying tow trucks, panel vans, pick-up trucks), and the integration of ITS systems and applications. Morgan gave more insight into the Active Traffic Management system as applied in Seattle.

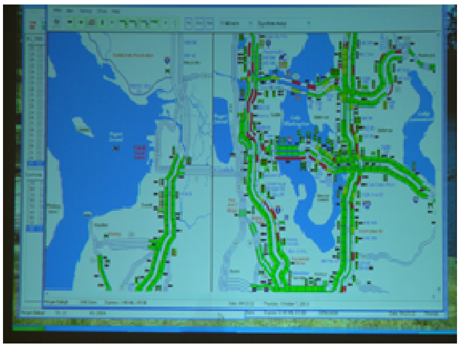
The active traffic management system was introduced to reduce congestion by reducing the number of accidents. It is a three-part strategy:

- adding capacity strategically;
- managing demand;
- operating roadways efficiently.

The idea to implement the system was a result from the scanning tour to Europe they had in 2006. The system was introduced on a 6 mile stretch of I-5. The road section was chosen on the basis of the number of collisions that took place here. The I-5 corridor has a traffic volume of about 200,000 vehicles per day. The system has 14 sign bridges (portals) and cost about $ 23 million. In contrast to what is done in the Netherlands, they show not only what the drivers need to do (drive at the speed displayed), but also why they have to do it. They use graphics for that. This is considered to be a cultural thing (the Washington drivers appreciate the explanation). New symbols were tested with simulator studies. They use a red cross for closing a lane to make merging easier, similar to what is done in The Netherlands. Drivers seem to accept the system. Some cartoons were published after the introduction, but there was not much negative publicity.

Variable speed limits are also applied on Snoqualmie Pass. The speed limits vary according to weather and road conditions. The system was installed 12 years ago. Here, cause and effect are also communicated to the drivers. On SR 520 and I-90, the system will also be introduced and evaluated. In total there will be 300 overhead signs, 50 new cameras and 90 new traffic sensors. The new sensors are placed between existing ones.

The effects were evaluated directly after introduction. The first, substantial, effects (50% less collisions, based on a small and early sample) will be compared to the effects after 12 and 18 months[2]. They will include data on incidents. A consultant will do the evaluation and WSDOT will also do a part. They will also look at throughput, but they do not expect much improvement on that aspect.

WSDOT is looking at how to fund the active traffic management system in the future. A lot of infrastructure that needs to be maintained is involved. This means a long term maintenance commitment. The current budget for maintenance of the system is $150,000.-. All maintenance is done in-house. (There are more states that work this way.) Failures are reported by the signs themselves, WSDOT personnel and feedback from the public. The GNB, named 'grey notebook' because the first version had a grey cover, is used for accountability. The GNB can be found here: http://www.wsdot.wa.gov/accountability/

In addition to the variable speed limits and ramp metering, traffic signals are optimized. In the region about 5% of the congestion is caused by bad signal control. In WSDOT, signal control has a lot of attention, but it is only a small part of the problem.

[2] WSDOT has not seen this high level of collision reduction maintained as more time has passed since the installation of the system. This is not a surprise since they did not anticipate they would see such a high reduction level as time passed.

Website WSDOT and information provision

WSDOT is very active on the internet. Drivers can consult a website (www.smarterhighways.com) that gives information on the active traffic management system and the variable speeds. The WSDOT website (www.wsdot.wa.gov) gives information about traffic conditions. It also gives agency information (this part of the website is less popular). The WSDOT website gives average and current travel times (these are also given on TV). They also give the 95% reliable travel times. The media tap into this and use it. However, they don't expect everyone to understand this. The travel times are measured, not predicted. Weather data are not yet part of it. The University of Washington, in the person of Mark Hallenbeck, looks at the effects of weather on congestion.

Many DOTs contract out traveler info, but not WSDOT. WSDOT feels that it is an important part of the identity of the company, so they put a lot of effort into the website and social networking. If you want the public to think that you are progressive (and understand the way people progress), you need to do things like twitter (15,000 followers; website has 2 to 5 million page views per day). WSDOT also operates a 511 phone system that receives 65,000 to 600,000 monthly called depending on weather conditions and their impacts to travel. They also have Blog, YouTube, and Facebook presences and an ongoing photo sharing effort on Flickr. WSDOT also provides email alerts about road conditions and major project impacts via subscription which sends out over 500,000 emails a month and they have both iPhone and Android traffic information applications. In addition they have extensive coordination with local media which allows for our information to reach a much broader audience. The public actually expects this from WSDOT, because WSDOT has always been progressive. It is part of the culture in the region, with all the IT companies around (e.g. Microsoft, Google, Amazon) there is a concentration of high tech people. There is a trend to shift towards mobile devices. This changes the way people access information. Apps for these devices were built by WSDOT themselves.

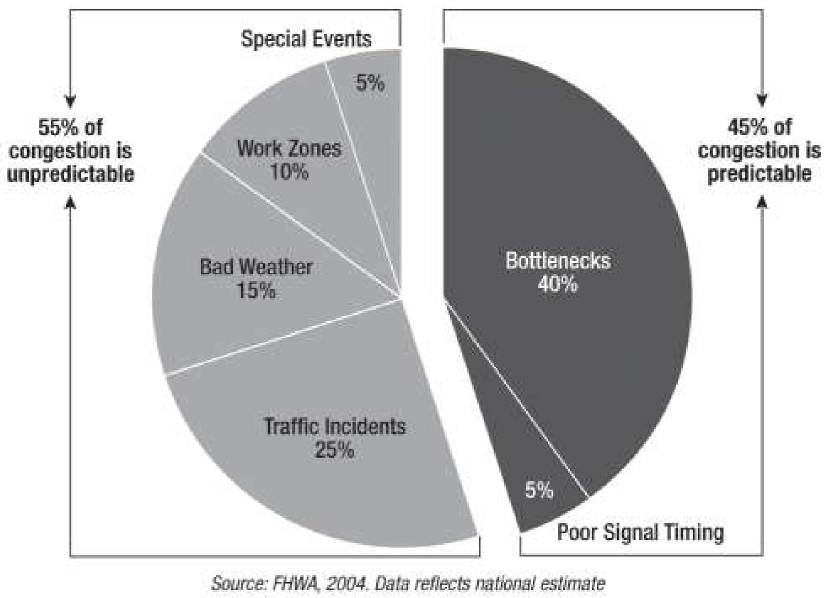


Figure 16: What causes congestion?

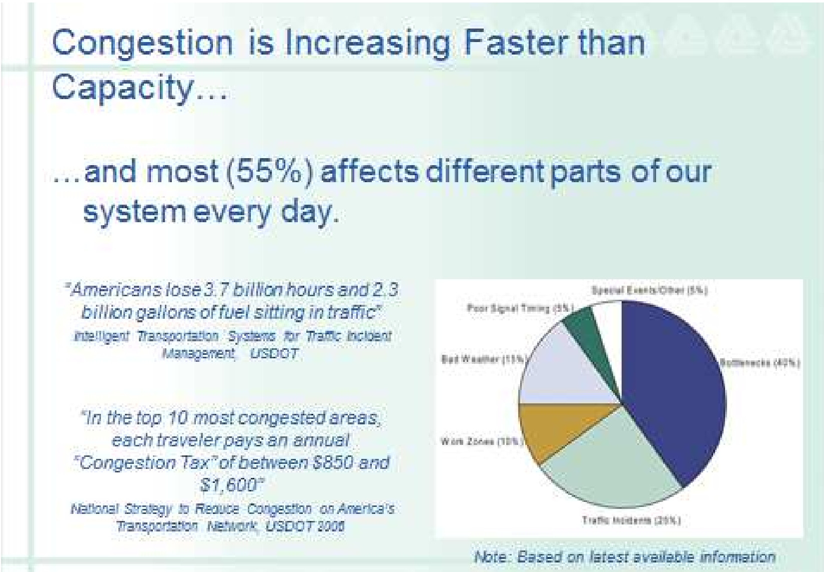


Figure 17: Impact of congestion on America's Transportation Network

Highlights:

- WSDOT takes responsibility for the maintenance of systems and programming of algorithms. A part of that work is done by students.
- WSDOT has been able to keep their skills (skilled employees) in place by offering them flexibility, nice work and good facilities.
- Initiatives also come from own personnel and are stimulated
- Active Traffic Management: motorway traffic management combined with explaining signs.
- A lot of communication (also via Twitter, Four Square, Facebook, LinkedIn, etc.) is done to explain ATM to the public.
- Traffic information on the website: important for the image of the organization.
- Performance measures are very important.
- New program for corridor management, including the urban network.
- A lot of parties involved means a lot of different systems. That is why a corridor is already difficult enough to handle.
- Pilot with a HOT lane with dynamic tolling: improvement of traffic flows, also on other lanes.
- Tolling on bridges is needed to finance a new bridge.

Interesting web sites:

http://www.smarterhighways.com

http://www.wsdot.wa.gov

http://www.washington.edu/

http://www.wsdot.wa.gov/Tolling/SR167HotLanes/default.htm

MoT British Columbia (Vancouver, Canada)

Introduction

The afternoon was spent at the offices of the British Columbia Ministry of Transport in Burnaby, BC, Canada. There, we were informed about the transportation and traffic management measures implemented for the Olympic Winter Games in 2010.

BC Ministry of Transportation and Infrastructure (Peter Peng)

Peter gave some information about MoT traffic management and ITS activities. The ITS Canada Architecture is used as a blueprint. The architecture is considered to be functionality based, because technology changes over time. However, for those people used to the Dutch ITS architecture, it still seems to be more like a technical architecture. Traffic and traveler information dissemination via a central website (www.drivebc.ca) is also considered important here. The website shows the streams of webcams at key highway locations. Privacy is an important issue in doing this.

In terms of infrastructure for traffic management and ITS, there are several activities and projects going on:

- There are two reverse lane systems in operation in the area.
- The DOT runs a project called Weigh2GoBC. It is about weigh-in-motion and automated vehicle identification technologies. The purpose is to select trucks beforehand the weighing and controlling process.
- The Gateway Program is about 4 major projects to build roads, fully equipped with ITS.
- A regional TMC will be built and it should integrate all functions, including monitoring. It will have tolling facilities and there is a link with Translink (and other partners). Completion is scheduled for March 2012.

TransLink (Keenan Kitasaka)

TransLink is Metro Vancouver's regional transportation authority. TransLink is responsible for (among other things) Intelligent Transportation System programs. TransLink was founded in November 2007 as a transport authority. TransLink plans, finances, operates and maintains the transportation system, partially integrated with transit. They are responsible for the major regional roads (including some bridges) as well as various other modes of transport. TransLink and BCMoT are closely linked.

The choice has been made to give transit, cycling, walking, and freight transport priority over single occupant vehicles. Environmental goals were set. Strategies were developed to achieve the goals, closely coordinated with the plans of BCMoT. This involved also stable funding, taken into account personnel and maintenance of the fleet. Buying new busses is quite a job. A noteworthy quote: "Congestion is not so important. They should have taken the bus!" Another quote: "How to get people in Public Transport? Offer quality!" Efforts to improve transit have paid off. The transit share has risen from 10 to 12% (20% increase), which was larger than expected. During the Olympics, the shares were much higher. They worked with a PPP construction, and the money earned during the Olympics was used to pay back some of the debts incurred. There was a 14 billion (Canadian dollar) transit plan. For transit research, they use automated passenger counters (infrared sensors). Translink also have a Regional Traffic Data service. They use cell phone tracking to derive average speeds.

Traffic signals are coordinated. The Integrated Regional Signal System works across jurisdictional boundaries, linking signals from different municipalities. There is transit signal priority on major arterials. A pilot project is started to integrate the regional signal system (ICONS). The purpose will be to automatically trigger special timing plans.

Traveler and traffic information is given to the public in several ways. The younger generation wants information via social media such as Facebook and Foursquare. So they deliver user services like iMove, bridges, SMS text messaging, transit using social media (Facebook, Google Transit, etc.). iMove is a web portal (www.i-move.ca) and will also be developed for other media and in the long term for in-vehicle systems. TransLink is responsible for iMove, also for the funding. TransLink spends a lot of time on branding. They have a large marketing department.


Host City Olympic Transportation Plan (Winston Chou)

As the Netherlands are preparing a bid book for the 2028 Summer Olympics, the Dutch delegation was interested to learn about the Olympic Transportation plan used for the Vancouver 2010 Olympics. Winston Chou indicated that an important aspect of the transportation plan for the Olympics was to promote green modes. An example is to provide separated bike lanes. A spin-off of the plan was 3 km of bike facilities. Obviously, the aim was to have the Olympics run smoothly, but the aim was also to have a better functioning transport system afterwards – "a lasting transportation legacy". Part of that legacy was the provision of 400 Dutch bikes from 'OV fiets'[3] to the organization. Transport was a key element, it should be green and sustainable, and the city should function well.

They started with the plan in 2006. The challenges they faced were increased demand and reduced capacity, as roads would be closed in the city center. To deal with the reduced capacity a number of measures were taken: parking bans, closing roads, changing signal timing plans, traffic control via extra personnel, installation of extra camera's and VMS signs with route advice. There were 24h parking restrictions in place to reduce the amount of traffic. All parking meters needed to be bagged and hooded. They also looked at the traffic signals – centralized traffic control systems. But not many adjustments were needed, except in locations where the infrastructure had been adapted or closed. They then looked at traffic control (by police or civilians). A lot of manpower was needed. Of course, ITS systems were applied. E.g. traffic cameras, placed in strategic locations. They had about 30 dynamic message signs, which were used to announce alternative routes. Detector data was also used (but not loops). Some sensors were wireless systems and battery operated.

There were "Olympic lanes". It took a lot of effort to convince the organizers of the Olympics (VANOC) that these lanes should be open to buses as well. It was thought that it would not be good to have empty lanes most of the time. Also, some demands were not granted, like traffic through residential streets. During the Olympics, the transport network accommodated 44% more person trips, mostly transit. Trips downtown by walking, cycling and transit more than doubled. People were allowed to drive, but there were no parking spaces. Residents were supportive of the changes; they supported the Games (even though early on people were cynical about it). Vehicle trips downtown decreased with 29%. There was also an increase of truck traffic during the Olympics. Trucks were deviated and encouraged to deliver their loads at the back of buildings, or at night if noise was not a problem.

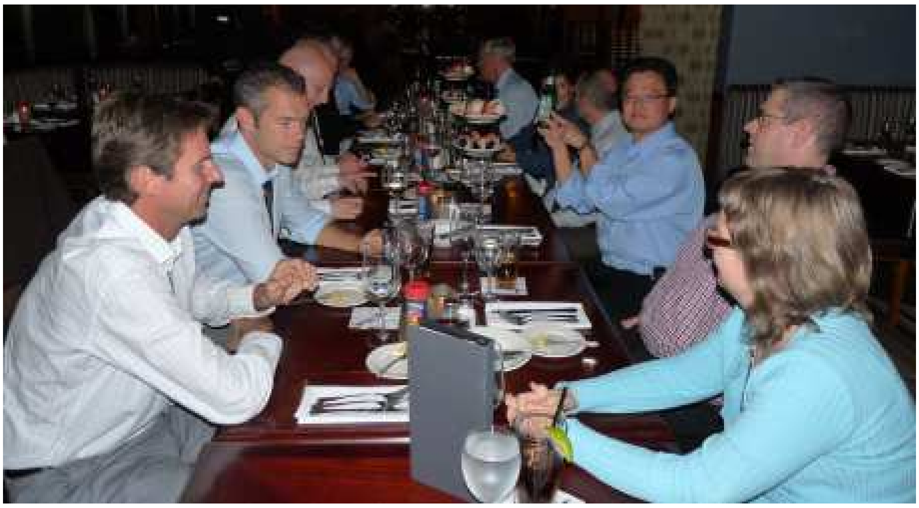
Reversible lanes were used on the road to Whistler. The switch (of direction) was made manually. In the end, it turned out not to be necessary, but it was in the Bid Book so it needed to be implemented. There were further special arrangements for the Whistler mountain resort (used for some Olympic events): a parking ban and the use of bridges. Parking was the bottleneck. Most of the transport was done by busses. To improve the trip to Whistler they implemented traffic signal priority through the city of Squamish.

The conclusion is that for the Vancouver Olympics, basically only existing systems were used (and a lot of tape).

TransLink and the Olympic Transportation (Norm Fraser)
Norm gave some more information about the Olympic transportation plan and the role of various organizations involved. To create a good transportation experience for all (athletes and visitors), cooperation was needed between the different cities (Vancouver, Richmond, Burnaby etc.). The role of TransLink was to accommodate existing and new transit customers. The prediction was 1

[3] Multi-modal (train – bicycle) concept launched by the Dutch railways

million trips; it turned out to be 1.6 million trips per day. The budget was very limited due to the economic crisis, but the people involved made it work. Although the Olympics are a unique event, they had many opportunities to practice with other events, such as the races and a firework festival (a 4 day event attracting 450,000 people). Some additional transit management was needed: the SkyTrain stations were so overcrowded during the Olympics that crowd management was applied. People had to wait outside the stations. To keep the crowds happy, entertainment was provided and there were food dispensers. WSDOT and BC coordinated efforts to provide border crossing information at the key international border crossings between Washington state and BC. This is provided via the web at: http://www.wsdot.wa.gov/traffic/border/.



Highlights:

- Website is essential to distribute traffic information.
- TransLink: integration of different modes and managing a few (toll)bridges.
- Policy goals formulated for public transport and the environment.
- Congestion is not important: "They should have taken the bus"!
- There are plans for an integrated traffic management system.
- Big marketing department: image and visibility are important.
- Olympic Winter games: a lot of extra public transport (predominantly buses) and dedicated lanes for public transport.

Interesting web sites:

http://www.drivebc.ca

http://www.i-move.ca

http://www.gov.bc.ca/tran/

http://www.olympic.org/vancouver-2010-winter-olympics

http://www.wsdot.wa.gov/traffic/border/

2.5 Friday October 8th, 2010

WSDOT (Seattle, WA)

Introduction

For the morning session, we went again to WSDOT for further discussion of Active Traffic Management (ATM). ATM and tolling are the actively pursued instruments for congestion management and mobility.

ATM in Seattle (Charlie Howard, Stephany Ross, Pete Briglia, Bill Legg and Craig Stone)

The ATM focus is on applying the I5 system (variable speed limits) to the entire region. The system is coordinated with other agencies – the metropolitan area of Seattle comprises 4 counties, 82 cities and 6-7 transit agencies. In Seattle, HOV and HOT lanes are applied. The pricing of HOT lanes is chosen such that the speed of 54 miles/per hour is maintained and that there is maximum utilization of the lane. Automated toll collection is used, with tolls varying according to how busy it is. The toll revenues do not cover the costs of operating the HOT lanes, but this was not the aim. The aim was to improve efficiency of the corridor; however, the HOT lane pilot has been criticized for the fact that the costs are not covered.

Volumes on the road stretch that includes the HOT lane increased, while it decreased at other locations. At the HOT lane toll gate, it has to be determined whether a vehicle is a HOV vehicle or needs to pay toll. Fees range from 50 $ cents to 9 dollar. HOV lanes can be a stepping stone for

HOT lanes. HOV lanes irritated people because they were often empty. HOT/HOV lanes improved utilization of those lanes. As HOV lanes were used too often (which threatened to bring down the speed to below the desired level) they changed the requirement from 2+ occupancy to 3+ occupancy. Dynamic tolling (such as is done on HOT lanes) is considered to be appropriate when people still have the choice not to pay. Both travel times and toll prices are made known in advance so people can make an informed choice. In cases when drivers do not have a choice, like river crossings, dynamic tolling is not acceptable for the public. Converting HOV lanes to HOT lanes involved similar efforts as the conversion of general lanes to HOV lanes.

Coordination of the traffic signals in the area is not easy. While it would be desirable to do so to enable some routes to be alternatives for freeways, different, incompatible standards are used. NTCIP could be a common standard, but signal systems are procured and often the cheapest bid is chosen. Seattle has one of the busiest networks in the country, and featured high on the list of most congested cities (in the 2010 TTI congestion report). WSDOT felt that they did better than the report suggested and came up with their own report. TTI adopted its procedures Seattle dropped to number eleven.

Transportation demand management and sustainability

Apart from Active Traffic Management, WSDOT also works on TDM = transportation demand management. They try to balance capacity, ITS, and TDM. Part of TDM is the van pool system of Seattle, which is one of the largest of the country. Operating costs are paid by the individuals using it. It is sometimes subsidized by employers. Transit is less efficient in comparison, as transit vehicles also make many trips with few passengers. Microsoft operates its own van pool system. If a company has more than 100 employees, it usually has its own ride share coordination. Other companies can use the area wide ride share coordinator.

Half the states in the US have reduced greenhouse gases as an objective. Washington State passed a law on this topic two years ago. The approach is to intensify land use, to introduce pricing, improve and promote transit, and work on improved efficiency of the combustion engines.


Funding

To improve traffic efficiency, some bottlenecks are improved, but for the large part funding for infrastructure is spent on a few large 4 billion dollar+ investments (bridges etc.). The innovation budget is spent on tests that are proposed to the organization by innovative individuals. As already stated, innovation is more cultural than institutional. Funding is becoming increasingly hard, because it comes from the gas tax and that hasn't been raised since the Clinton Administration. With more fuel efficient vehicles, revenues from the gas tax are going down. The question is thus how to get sustainable funding (on the one hand, you want to encourage the purchasing of fuel efficient vehicles, on the other hand this means less funding). One of the options for sustainable funding is tolling. WSDOT is the first to commit to this on paper. An innovative way of paying for the improvements on the I-5 was to include it in the financing of the construction of a viaduct. The construction of the viaduct puts extra stress on the system and the I-5 could serve as an alternative.

Figure 18: HOT Lane in Seattle

Figure 19: HOV Lane in Seattle

INRIX (Kirkland, WA)

Introduction

The last afternoon we visited INRIX. INRIX is a provider of traffic information, directions and driver services. They offer their services worldwide (100 global customers), mostly in America, Europe, the urban areas of Canada and Australia. Although their primary business is still as a data provider, they now add more layers to provide additional information to customers.

INRIX Overview (Ted Trepanier and Kush Parikh)

INRIX has a focus on traffic information: real-time, predictive and historical flow. They are working on 3rd generation routing: with direct routing in the vehicle. It incorporates real-time, predictive and historic traffic info. Everything is centrally computed. They also work on EcoDriving: provide a route that is the least congested and saves fuel. For events predictive modeling is used: historical data is the baseline, together with the real-time flow and Bayesian models (statistical technique) a prediction can be made. INRIX did some work for the ANWB: predictive travel times on the web-site, but that is off-line.

INRIX has a contract with the Ford Company to provide their fleet with navigation. It is used to improve SYNCH, which is a voice activated in-car communication and entertainment system. This is about information and not about routing. The voice based system of Ford gives information about the route to follow. About 80% of the new Fords have the SYNC platform. The largest project for INRIX is the I-95 corridor coalition. Data for the I-95 CC is validated with Bluetooth readers. The largest app on iPhone is 'Navigon', which uses INRIX data.

In North America roadside data usually does not contribute to the quality of the probe data. There are many differences in quality between the different data sources that INRIX uses. Therefore, the sources are weighted (the number of vehicles x frequency of reporting = data density factor). In Germany, the quality is 60% to 70% of what it is in North America. It is claimed that a 2% pene-tration rate (of vehicles sending information) could be enough for good quality. There is some concern about off-peak data. That is still a weakness of the INRIX data.

SpeedWaves and Arterial Data (Ted Trepanier)
INRIX has not planned to collect or predict traffic volumes. Traditionally, probe data do not deal with stoppages very well. At this moment INRIX is working on the new product that can be used for urban arterials, called SpeedWaves. SpeedWaves is meant for arterials, taking into account stops for signals. It fits a delay function for intersections and that is used for the travel time calculations.


Traffic Services (Ted Trepanier)
The main traffic service is real-time traffic flow (in fact speed) for TMC segments. The TMC network comes from TeleAtlas. Another service is predictive traffic flow for mobile applications. The information of probe vehicles can also be used to improve maps, but this is not done yet. INRIX has a free app for traffic information, also for The Netherlands. Weather conditions and forecasts are not included into the forecasting model yet. It is said that the amount of precipitation itself does not influence the traffic speed much. Other factors such as the direction of the sun together with the amount of precipitation determine the traffic speed.

Highlights:
- Traffic information: historical, real-time and predicted travel times. Distributed via website and apps (iPhone).
- Data is collected using probe vehicles. Sometimes in combination with loop data (Netherlands).
- Everything is collected, processed and calculated in a central system.
- Largest project: I-95 corridor coalition. Travel times are validated with Bluetooth measurements.
- New algorithm for urban travel times.
- No plans to measure volumes.

Interesting web sites:
http://www.inrix.com/
http://euscorecard.inrix.com/scorecard_eu/BNL/about.asp

2.6 Other visits

In addition to all the official visits, the Dutch delegation found time to visit a number of museums in Washington DC and to enjoy views of Seattle from the Space Needle and from the Puget Sound ferryboats.

3. Findings and recommendations

3.1 Findings

Evaluation

Evaluating traffic management measures (such as ramp metering, HOV lanes) is not common practice; but much emphasis is put on performance measures and cost-benefit analysis (see e.g. Houston). Furthermore logging of (traffic related) data has high priority. Dissemination of system performance data plays an important role in convincing the public (see your tax dollars at work). Accountability has high priority at all DOT's. One should be able to show (to politicians, road users and citizens) what is being done and what the benefits are of implementing various measures. A significant part of data collection is dedicated to support accountability.

Collaboration

Intensive and longstanding collaboration exists between State DOT's and Research Institutes (Maryland CHART and University of Maryland CATT Lab, Virginia DOT and Virginia Center for Transportation Innovation (University of Virginia), Texas DOT and Texas Transportation Institute (Texas A&M University), Washington State DOT and University of Washington). There is also a good collaboration between police and the road authority (911 calls are immediately diverted to TM Center/DOT). State DOT's take the lead in introducing and/or implementing new interesting traffic management measures (e.g. Intellidrive). Via pooled funding various DOT's can collaborate (based on a simple MOU). Thus, innovative initiatives predominantly start at the state DOT level. Benchmarking serves as leverage for innovations. US-DOT supports these initiatives. Furthermore USDOT also plays an important role in initiating new initiatives (e.g. organizing a contest on corridor management).

Figure 20: Capitol, Washington D.C.

Dissemination of traffic data

Traffic information is extensively disseminated via both website(s) and infrastructure bound devices (pushing out traffic information). Increasingly, traffic information is also disseminated via smartphone, Twitter, Facebook, Four Square, etc. (to improve visibility to specific users). All state DOT's have developed an explicit/well defined strategy in informing the public/road users. Traffic information is part of the corporate identity of each state DOT visited. Focus is on data describing the actual traffic situation (no predictions). Within a split second, this data is displayed on the internet ((http://www.houstontranstar.org, http://www.wsdot.wa.gov/traffic/, http://www.chart.state.md.us/, http://www.virginiadot.org/travel/default.asp). Two million page views (hits) a day is not exceptional (only 10.000 via Twitter). It is to be expected that in the near future each DOT will be equipped with a Marketing Department.

DOTs are self-confident and operate in a very natural way with external parties. This also explains why the media have access to the emergency room and in this can broadcast certain information directly. This aspect gets hardly any attention in Dutch traffic control centers. Furthermore, compared to the situation in the USA, traffic information provision in The Netherlands is restricted. Road authorities have left the provision of information to service providers. In the USA DOTs are more aware of their important role in information distribution. The attitude (commitment) of the DOT employees is remarkably positive. People are not complaining despite serious cuts in labor force

Emergency and incident management

Emergency management is well developed and well structured. Each DOT has an emergency room. A professional attitude towards emergencies is obvious, because they deal with emergencies frequently. Furthermore, 9/11 has had a significant impact on the further development of emergency management, especially in the DC area.

All incident (event)-based data are being logged. Most of the data is accessible to everybody.

It was interesting to see the various innovative methods developed by CATT Lab to visualize and analyze incident data, thus significantly improving insight into the mechanisms governing incident management. When dealing with incidents and/or road repair works there is a strong collaboration (exchange of traffic flows) between the freeway network and arterials.

Figure 21: Space needle, Seattle

Step by step approach in realization TM strategy

Although there is a vision for the long-term, the realization of it happens step by step. DOT will start with the implementation of one toll road and then see how to proceed. HOV-lanes are used as stepping stone to HOT-lanes as, in the end, tolling is seen to be the solution for congestion relief (or rather, as a means to guarantee reliable travel times). As HOV-lanes are (presently) underutilized the introduction of HOT-lanes is presented as a positive evolution in the deployment of the capacity of the transport system. An important element of the transport policy is that travelers can always choose amongst various alternatives. It would be interesting to analyze what the possibilities are for deployment of HOT-lanes in the Netherlands.

If more parties are involved in a project, a simple MOU is sufficient to start. As soon as the project increases in size, costs are assigned in a fair way to the various parties involved. Furthermore, a large project will be subdivided into a number of smaller, negotiable projects. Preferably, there is a direct link between project activities and the budget available. Traffic Management projects quite often piggy back on major infrastructure investments.

Interoperability

Interoperability (technical, organizational, financial, legal) is not fully elaborated. Most problems are solved via telephone calls. The ultimate goal is to realize RFID interoperability, which is crucial for interfacing of systems. One of the reasons why interoperability is not fully elaborated could be that focus in the ITS domain architecture is predominantly on technical issues. Although most DOTs do have an ITS architecture, we got the impression that this architecture is not used.

Figure 22: The Dutch delegation at the Keck Center of the National Academies, Washington D.C.

Maintenance

Asset management (maintenance and exploitation) gets much attention. Lots of new (electronic) equipment needs to be maintained. A significant part of the budget is being assigned to asset management and the employability of budgets is flexible. In Washington State DOT the electronic maintenance group comprises 55 people. 95% of all traffic signals are inspected on a yearly basis.

Organization of Olympic Winter Games
Characteristic for the organization of the Olympic Winter Games in Vancouver was the low-budget approach (using the existing system and large scale deployment of busses). Furthermore, the organization of the Olympic Winter Games was used as a leverage for improving (public) transport facilities, e.g. through the realization of Skytrain extensions and improvements of the road to Whistler.

Human resource management
All kinds of incentives are used to improve the commitment of employees. As a result, employee turnover is low and, what is really important, knowledge and expertise stays within the organization. Quote: "We are happy to say: we do it ourselves and in that way we can do it much cheaper!"

Traffic Safety and sustainability
Improving traffic safety is an important objective but traffic safety has not been the primary objective of policy. A threat to safety is the use of nomadic devices. Because of the introduction and deployment of a great variety of nomadic devices, people are increasingly being distracted from their driving tasks (causing 6000 fatalities per year on a total of 40.000 traffic fatalities in the USA). Although the new secretary of transport highly advocates Safety and Livability, for most people this is seen as window dressing.

Legal issues
Legal arrangements may prohibit the introduction of new interesting TM measures. Therefore, changing the law should be seen as an effective option to remove legal barriers thus allowing for the deployment of interesting and cost-effective traffic management measures.

Figure 23: Monorail, Seattle

3.2 Recommendations

Incident and emergency management

In the USA, there is a lot of attention for incident and emergency management. A large amount of good incident data is available for research. The universities play an important role in this research. They investigate the data (which is not always uniform) to improve the incident management processes and to train people. Also, the operational side of things is organized very well. All parties involved (road authorities, police, fire brigade, etc.) share the same control center and therefore can communicate directly and easily. Furthermore, emergency management is well developed and well structured. Each DOT has an emergency room and a nicely structured incident management organization. However, the process of collecting incident data and making incident data available for research could be improved. It is recommended to map the process from registration to distribution and to see where improvements can be made. For the Dutch situation, it is also recommended to improve emergency management. A recent incident with a large fire in a depot with chemicals, and as a consequence the closure of two motorways, has shown how important this is.

Follow-up: improvement of instruments for incident analysis and training. Visit with VCNL and IM to CATT Lab and I-95 CC.

Figure 24: Central Library, Seattle. Design: Rem Koolhaas

Performance measures

In the USA, performance measures are important. Often budgets depend on the performance of organizations. Because of that, a lot of policy related data is available and is used for evaluations. Noticeable is the trust in figures and evaluations, although an evaluation framework for investment decisions is missing and a thorough evaluation method is often not used.

In The Netherlands, there has always been a lot of attention for evaluation. Lately, the relation with policy is becoming more and more important. The effectiveness of traffic management is questioned by policy makers. Therefore, it is recommended to focus evaluations on policy indicators that support the decision making process.

Follow-up: implementation of policy indicators in evaluation studies. Investigation on how they do this in the USA. Branding via www.rijkswaterstaat.nl.

Traffic information

Traffic information is very important in the USA. DOT's are responsible for the collection and distribution of this information. Each DOT has developed an explicit and well defined strategy in informing the public and road users. Traffic information is part of the corporate identity of each DOT. Compared to the situation in the USA, traffic information distribution in the Netherlands is in the hands of private service providers. This means that road authorities are dependent on these service providers. To be able to quickly respond to circumstances and to manage traffic in a way which is good for the traffic system as a whole, it is recommended that the responsibility for traffic information distribution is put back in the hands of the road authorities, at least in situations where traffic information matters the most, such as disasters, large incidents, events, bad weather conditions, etc. This is also vital for the visibility and image of the organization (e.g. Rijkswaterstaat and regional road authorities).

Follow-up: discussion on data collection (logging) for incidents and distribution of traffic information. TrafficQuest will contribute to this discussion.

Figure 25: Central Library, Seattle. Design: Rem Koolhaas

Collaboration with universities and research institutes

In the USA cooperation for traffic management on an operational level is very important. Road authorities work together with emergency service providers in the traffic control centers. But there is also a strong link with universities. Most of the research is done in 'traffic labs', entities within universities. Also noticeable is the use of students as part-time employees in traffic control centers.

Characteristic for this collaboration between DOT's and University Research Institutes is the length of the period during which both organizations collaborate as well as the size of the research budget allocated to this cooperation (e.g. Texas Transportation Institute is 60 years in operation and evolved from collaboration between Texas Highway Department and Texas A&M University; its research budget for 2010 is $50 million).
In the Netherlands, there is also cooperation between road authorities and emergency services for incident management. Although the parties involved are housed separately, the cooperation is well organized and strong. This is different for the relation with universities. Of course some research is done and students can do their master's thesis work within Rijkswaterstaat (www.its-edulab.nl), but the collaboration is only occasional and is never with the traffic control centers directly. Therefore, it is recommended to strengthen the collaboration with universities and research institutes. This can be done by working together on the formulation of a research program and by allocating sufficient research funding for a longer period.

Follow-up: collaboration with universities and research institutes is very important for maintaining a certain level of knowledge in organizations. Discuss this with the Ministry of Infrastructure and Environment, also the consequences for European programs. The Ministry of Infrastructure and the Environment is busy with a new approach for the traffic management program, but research institutes are not involved from the beginning.

Year	Event	Year	Event
1993	Blizzard	2001	Bristol Flood
1994	Ice Storm	2001	President's Day Storm
1994	Ice Storm	2003	Hurricane Isabel
1995	Central VA Floods	2004	Southwest Flooding
1996	Blizzard	2004	TS Gaston
1996	Spring Flood	2006	June Flooding
1996	Hurricane Fran	2006	TS Ernesto
1999	Hurricane Dennis	2006	Nor'easter Flood
1999	Hurricane Floyd	2009	Nor'easter Flood
1999	Ice Storm	2009	December Snowstorm
2000	Blizzard	2010	February Snowstorm
2001	Southwest Flooding		
2001	9/11/2001 (Pentagon)		

Figure 26: VDOT: historical challenges and declared Disasters

Paying for the use of infrastructure
In the USA, toll roads are a normal (although not uniform) phenomenon in the traffic system. People are used to pay for certain traffic facilities, such as bridges, tunnels or roads. That includes the so-called High Occupancy Toll (HOT) lanes. These lanes were originally designed for carpool vehicles, but they can also be used by single occupant vehicles under the condition that drivers are

prepared to pay for the right to use this lane. In Washington State the toll rate for using the HOT lane can vary between $0.50 and $9 dependent on the traffic situation.
In the Netherlands some efforts have been made in the past to facilitate certain user groups. That has led to a truck lane and a (reversible) carpool lane. The truck lane still exists, but the carpool lane failed due to legal objections from the public. After that, policy makers were unwilling to do more for certain user groups, but instead focused on measures for all motorists, such as peak hour lanes (dynamic shoulders). For the Dutch situation, pricing is debated for decades, but not implemented so far, due to political reasons. To overcome this deadlock and to give motorists more choice, it is recommended to start with a trial with a HOT lane or a toll lane. The idea is to design a peak hour lane (an existing one or a new one) as a toll or HOT lane. In this way road users are given the choice to queue up or to flow freely, sharing the car with others or, as a single occupant, by paying a price which is dependent on the traffic conditions. This way people get used to paying for the use of infrastructure (instead of getting paid for not using it, as is the current policy approach!).

Follow-up: make a proposal for Rijkswaterstaat.

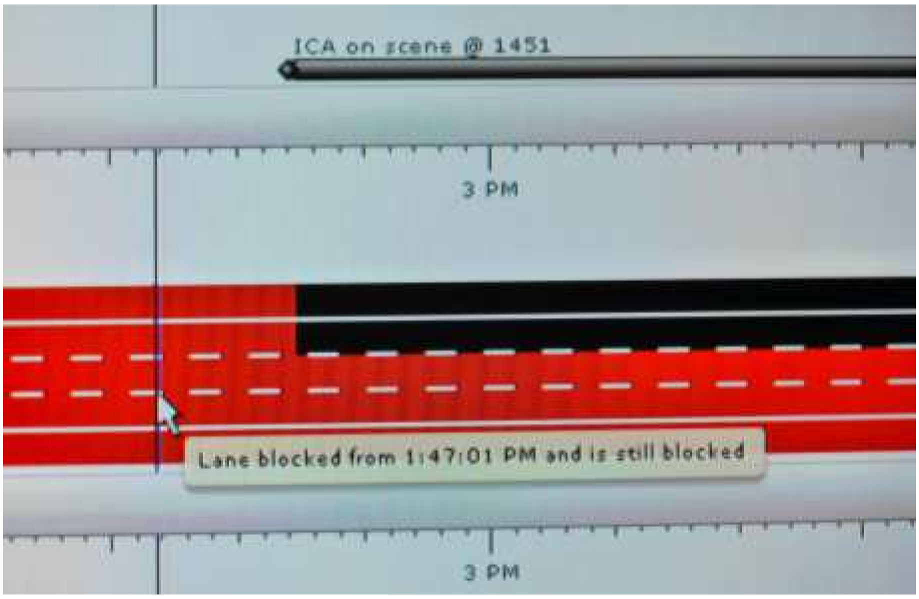


Figure 27: CATT Lab: Logging of incidents

Organization and culture

The organization of transportation in the USA is similar to the situation in the Netherlands. On the federal level, the US Department of Transportation (USDOT) is responsible for the federal policy and allocates portions of budgets to state DOT's to run the state transportation system. It is also possible that the DOT's together deal with issues themselves. These small initiatives are known as 'pool funding'. Based on a mutual interest state DOT's just start things to see what happens. Important conditions to be able to do this are that employees are loyal to the organization, that they have traffic engineering knowledge and that they can do a lot of things in-house.
In the Netherlands, the Ministry of Infrastructure and the Environment is responsible for the policy making and Rijkswaterstaat (divided into regional directorates) is responsible for the realization. In

the last couple of years, Rijkswaterstaat has been organized to function in a more corporate way, and that means also that the regional directorates are less independent. On the one hand that is a good thing, because of interoperability issues, but on the other hand fewer innovations and new ideas have been implemented. Therefore, it is recommended that the regional directorates of Rijkswaterstaat start working together on innovation. Together they can finance and implement new ideas and take care of the interoperability as well.

Follow-up: discuss this for the new strategic plan of RWS for 2015.

Organization of Olympic Games

The Netherlands have expressed their interest in organizing the 2028 Olympic Games. The organization of the Olympic Winter Games in Vancouver may serve as an interesting example of a low-budget approach in organizing the transportation issues of such a huge event. Interesting features of the Vancouver approach are making optimal use of the existing system combined with large scale deployment of busses. Furthermore, the organization of the Olympic Games was used as a leverage for improving (public) transport facilities.

Follow-up: discuss this with the Dutch Olympic Committee

Figure 28: Space Needle reflected on Experience Music Project designed by Frank Gehry, Seattle

Abbreviations

- AASHTO: American Association of State Highway and Transportation Officials
- ANWB: Dutch Touring Association
- ATA American Trucking Association
- ATDM: Active Traffic and Demand Management
- ATM: Active Traffic Management
- AVI: Automatic Vehicle Identification
- BCMoT: British Columbia Ministry of Transportation
- BCR Benefit Cost Ratio
- CATT Lab: Center for Advanced Transportation Technology Laboratory
- CCTV: Closed-Circuit Television
- CHART: Coordinated Highways Action Response Team
- CORSIM: CORridor SIMulation
- CTP Consolidated Transportation Program
- DDOT District Department of Transportation
- DelDOT: Delaware Department of Transportation
- DMS: Dynamic Message Sign
- EOC: Emergency Operations Center
- FHWA: Federal Highway Administration
- FEMA: Federal Emergency Management Agency
- FTA Federal Transit Administration
- GNB: Grey Notebook. see: http://www.wsdot.wa.gov/accountability/
- GPS: Global Positioning System
- HOV-lane: High-Occupancy Vehicle Lane, lane reserved for vehicles with a driver and one or more passengers
- HOT-lane: High-Occupancy Toll Lane, lane reserved for tolled vehicles or for vehicles with a driver and one or more passengers (excluded from paying toll). Toll will vary based on demand or time of day
- I95 CC: I95 Corridor Coalition
- IAAP ITS Architecture Advisory Panel
- ICC Inter-County Connector
- ICM: Integrated Corridor Management
- ICONS: pilot to integrate the regional signaling system
- IEEE Institute of Electrical and Electronics Engineers
- IEN Information Exchange Network
- INRIX: Traffic Information Supplier
- ITS: Intelligent Transportation Systems
- KPA Key Performance Areas
- MAARS Maryland Accident Analysis Reporting System
- MAC: Media Access Control
- MAP: Motorist Assistance Program
- MATOC Metropolitan Area Transportation Operations Coordination

- MDOT: Maryland Department of Transportation
- MDSHA Maryland State Highway Administration
- MDTA Transportation Authority
- MoT: Ministry of Transportation
- MOU: Memorandum of Understanding
- MPO: Metropolitan Planning Organization
- MSP Maryland State Police Maryland
- MPSTOC: McConnell Public Safety and Transportation Operations Center
- MRT: Mobile Response Team
- NCR National Capitol Region
- NEMA National Electrical Manufacturers Association
- NTCIP: National transportation Communications for ITS Protocol
- OHSEM: Office of Homeland Security & Emergency Management
- PDA: Personal Digital Assistant
- PPP: Public Private Partnership
- PSTOC: Public Safety and Transportation Operations Center
- RFID: Radio Frequency IDentification
- RIMS: Regional Incident Management System
- RITA: Research and Innovative Technology Administration
- RITIS: Regional Integrated Transportation Information System
- RTMS: Radar Traffic Monitoring System
- SCATS: Sydney Co-ordinated Adaptive Traffic System
- SOC Statewide Operations Center
- SOP Standard Operating Procedure
- SYNC: In-car Connectivity System
- SHA: State Highway Administration
- TAPT: Texas Association for Pupil Transportation
- TFHRC: Turner-Fairbank's Highway Research Center
- TM: Traffic Management
- TMC: Traffic Management Center
- TMC: Traffic Message Channel
- TMT: Transportation Management Team
- TNO Netherlands Organization for Applied Scientific Research
- TRAIL Research School for Transport, Infrastructure and Logistics
- TRB: Transportation Research Board
- TSTOP: Optimization of signal settings at intersections
- TTI: Texas Transportation Institute
- TxDOT: Texas Department of Transportation
- UASI: Urban Areas Security Initiative
- UMD: University of Maryland
- USDOT: United States Department of Transportation
- UVA: University of Virginia
- VDOT: Virginia Department of Transportation

- V2I: Vehicle to Infrastructure communication
- V2V: Vehicle to Vehicle communication
- VANOC: Vancouver Olympic Committee
- VII: Vehicle Infrastructure Integration
- WMATA Washington Metropolitan Area Transit Authority
- VMS: Variable Message Signs
- WSDOT: Washington State Department of Transportation

Figure 29: Houston downtown

Appendix A - Program

Date	Activity
Sat 2 Oct	Arrival at Washington DC
Sun 3 Oct	Scan kick-off meeting, TRB, 500 5^{th} Street NW, Washington DC
Mon 4 Oct AM	SHA Maryland DOT (Hanover, MD) (SHA, CHART, MDOT/UMD evaluation studies, Baltimore City Harbor)
Mon 4 Oct PM	University of Maryland CATT Lab (College Park, MD) (CATT Lab, I-95 Corridor Coalition)
Tue 5 Oct AM	VDOT TMC Northern Virginia (Chantilly, VA near Washington DC) (VDOT TMC, UVA, TMC Hampton Roads, Pooled Fund Study)
Tue 5 Oct PM	FHWA, USDOT (Washington DC) (FHWA, FHWA TFHRC, RITA, "DC wrap up session")
Tue 5 Oct Ev	Travel to Houston TX
Wed 6 Oct	TranStar and Texas Transportation Institute (Houston TX)
Wed 6 Oct Ev	Travel to Seattle, WA
Thu 7 Oct AM	WSDOT (Traffic Management Center, Seattle, WA)
Thu 7 Oct PM	MoT BC, Translink, City of Vancouver (Canada)
Fri 8 Oct AM	WSDOT, Puget Sound Regional Council (Seattle, WA) (Site visits Seattle, Regional transportation planning)
Fri 8 Oct PM	INRIX (Kirkland, WA near Seattle)
Sat 9 Oct	Scan wrap-up meeting
Sun 10 Oct	Departure to The Netherlands

Appendix B - Questions tour and answers Maryland DOT

General questions:

- How do (public and private) organizations work together in traffic management and ITS?

  Response: Traffic management and ITS continue to be areas of Transportation Systems Management and Operations that require cooperative efforts between the public and private sectors. While the public sector owns, operates and maintains most (if not all) of the traffic management and ITS infrastructures on the highways, the private sector owns and provides most of the technical "know-how" or expertise that is needed to develop and construct the infrastructure. The private sector is usually compensated for their expertise by the public sector. There are also various public/private partnerships between both sectors that enable the private sector to bring their resources and expertise to the table, at no cost to the public sector, to work on and find solutions to traffic management problems and ITS Programs together.

  The Maryland State Highway Administration's CHART (Coordinated Highways Action Response Team) program provides some examples of how such public/private partnerships work to address traffic management and ITS-related problems. The CHART program is a cooperative effort between the Maryland State Highway Administration (MDSHA), Maryland State Police (MSP) and the Maryland Transportation Authority (MDTA). The program uses its five functional areas: 1) Traffic and Roadway Monitoring, 2) Traffic Management, 3) Incident Management, 4) Traveler Information, and 5) Emergency and Weather Operations to achieve its mission, which is to: "*Improve mobility and safety for the users of Maryland's highways through the application of ITS technology and inter-agency teamwork*."

  CHART is currently involved in public-private partnerships with organizations such as Traffic.com and INRIX, through the I-95 Corridor Coalition (I-95 CC). These organizations are allowed to install ITS equipment on the state's right-of-way with the understanding that CHART will have access to the information/data gained from the installations.

- When two or more organizations work together towards meeting certain policy objectives, how is this governed and how is accountability established for each organization? Do you have examples of agreements or MOU's that govern the collaboration?

  Response: When two or more organizations work together towards meeting certain policy objectives, governance and accountability are established for each organization through each organization's governing body and agreements or MOU between the organizations. Examples of such agreements and MOU's include:

  The National Capital Region's *Metropolitan Area Transportation Operations Coordination (MATOC)* agreement between the Maryland Department of Transportation (MDOT), Virginia Department of Transportation (VDOT), District Department of Transportation (DDOT) and the Washington Metropolitan Area Transit Authority (WMATA).

The MOU between the Maryland State Highway Administration (MDSHA) and MDTA for the construction, traffic management, operation and maintenance of the I-95 Express Toll Lanes (Section 100) Project.

The Cooperative Agreement between the National Park Services and the MDSHA to document the roles and responsibilities of the both agencies in improving traffic safety and operations of the Baltimore-Washington Parkway and the Suitland Parkway.

Area-wide traffic management:

- What is typically the range (area) of application of traffic management (TM) measures:
  - local, without coordination, or
  - coordinated in a corridor, or
  - integrated, network wide?

  Response: The CHART program has an independent performance evaluation prepared by the University of Maryland (UMD) on an annual basis. This evaluation assesses the benefits of CHART Operations to the state of Maryland in terms of a reduction in delay, secondary incidents, emissions reductions, and calculated user cost savings. The UMD has worked with CHART for the past eleven (11) years to produce this performance evaluation, which is available via the following link: http://chartinput.umd.edu/. The effectiveness of CHART's activities is also tracked by its local business plan (BP).

  On a corridor basis, the MDSHA is a member of the I-95 CC, which is a partnership of the major public and private transportation agencies, which serve the northeast corridor of the United States. Included in the Coalition is each of the 12 state departments of transportation in the Corridor stretching from Maine to Virginia, 12 toll authorities that operate major facilities within the Corridor, the transportation departments of Washington D.C. and New York City as well as the Federal Highway Administration (FHWA). In addition, the Federal Railroad Administration, Federal Transit Administration (FTA), the U.S. DOT Office of Intermodalism, Amtrak, and the American Trucking Association (ATA) Foundation, among others, are represented.

- Do you have examples of network-wide coordination of measures in practice, i.e. implemented traffic management programs where strategies change depending on traffic conditions and the deployment of other measures elsewhere in the network?

  Response: The CHART program, on occasion, will change its measures and strategies based on changes in measures elsewhere in the network. Measures may be modified to suit transportation network changes based on traffic conditions, special events and deployments, and natural or man-made disasters. The CHART traffic management system is event-based and monitors and facilitates events within the region using a hierarchy of prioritized events. The highway operations technicians (HOTs) in CHART's Statewide Operations Center (SOC) will, based on standard operating procedures (SOPs), determine what event supersedes another (ex. Natural or man-made event vs. vehicle incident).

- Is research carried out into how measures can be coordinated? Is there a common approach?

  Response: CHART does have SOPs that are developed and followed based on a best practices approach. However, we have not done any coordinated research with external agencies. As far as a regional-based coordination of transportation performance measures is concerned, we defer to and await an approach based on a national direction.

- What is generally optimized? Throughput? Do safety and environmental aspects play a role? How are those aspects included? How do you determine what will be optimized? What is the driver for the optimization?

  Response: CHART Operations uses reductions in response time and incident duration to produce a reduction in delay, which optimizes throughput. This reduction in delay results in fewer vehicle-hours spent on the roadway and is the driver of the optimization. Safety and environmental aspects certainly play a role as a reduction in delay leads to fewer secondary incident and ultimately safer driving condition. Emission reductions demonstrate the environmental benefits of TM measures and evaluation.

- How do different organizations involved exchange or combine data from different sources?

  Response: Transportation management agencies use the Regional Integrated Transportation Information System (RITIS), which is our region's ITS Data Clearinghouse. MDSHA, VDOT, and DDOT are all connected to and share data with, and through, RITIS. Transportation agencies also benefit from the I-95 CC's Information Exchange Network (IEN). The IEN serves to facilitate communications between the Coalition members for exchanging information and for coordinating their respective activities and resources. The I-95 CC's website also provides us an Incident Management Clearinghouse, which is another useful tool for information exchange.

- What added benefits do you expect from coordination of measures in a network? Has this been quantified? If so, how? (Using models?)

  Response: Apart from the benefits received from coordinated TM used to tackle the non-recurring portion of the congestion problem, coordinated measures help to address special event, emergency, and evacuation planning and procedures within the region. In the National Capitol Region (NCR), transportation agencies, with support from agencies such as FHWA and the U.S. Department of Homeland Security, have been involved in emergency management and evacuation modeling along with other ITS deployment projects.

Impact assessment / cost-benefit analysis:

- FHWA/RITA has an extensive on-line database on costs and benefits. Also, there are websites on evaluation (when to do it, how to do it). Does making this type of information available to everyone help to get TM measures implemented?

  Response: Making this sort of information available does help to promote the idea of TM measures. Whether or not transportation agencies implement these measures depends on if they are required to do so, and how it will benefit their organization.

- How much effort goes into maintaining the website or adding new info to it?

  Response: CHART is unaware of the effort or cost involved in maintaining the FHWA website. However, the CHART Annual Performance Evaluation's website (http://chartinput.umd.edu/) is maintained and updated by UMD through a CHART funded Task Order Agreement with the university, and requires extensive research and coordination efforts.

- What are issues in the evaluation of ITS / traffic management in the US? Is it considered more difficult than evaluation the effects of new infrastructure or mobility management? What measures of effectiveness are typically used to explain the need for more TM measures?

  Response: Issues such as a lack of funding and coordination affect the evaluation of ITS/traffic management. However, the greatest issue, from our perspective, is the lack of available real-time data. To effectively evaluate the progress and benefits of TM measures, traffic management agencies need to have sufficient ITS device coverage or have access to, through data exchange, information from other agencies (public or private). The lack of before and after studies is also an issue.

  The lifecycle and timeframe of ITS vs. new infrastructure are very different and are not compared by our organization. As far as measures used to explain the need for more TM measures are concerned, CHART is more concerned with addressing the non-recurring portion of the congestion problem and the need for TM measures is determined by the information obtained from the performance evaluation, and the demonstrated reduction in delay, incident response time, and an increase in the user cost-savings.

- Given the difficulties in evaluating TM/ITS, how comparable are evaluations of different measures? (→ see table measures of effectiveness: some of these are hard to determine).

  Response: See the 3rd column's comments – Highlighted in **BOLD.**

Table 1. Measures of Effectiveness within Each Goal Area (from RITA website on evaluation)

Goal Area	Measure	Difficulty
Safety	Reduction in the overall Rate of Crashes Reduction in the Rate of Crashes Resulting in Fatalities Reduction in the Rate of Crashes Resulting in	**Easy** **Easy** **Easy**

Goal Area	Measure	Difficulty
	Injuries	
Mobility	Reduction in Delay Reduction in Transit Time Variability Improvement in Customer Satisfaction	**Moderate** **N/A** **Difficult**
Efficiency	Increases in Freeway and Arterial Throughput or Effective Capacity*	**Difficult**
Productivity	Cost Savings	**Moderate**
Energy and Environment	Decrease in Emissions Levels Decrease in Energy Consumption	**Moderate** **Moderate**

Source: http://www.its.dot.gov/evaluation/eguide_eval.htm

- Are estimates made of the combined effect of several ITS/TM measures?

  Response: At the state level, the combined effect of several ITS/TM measures is the calculated reduction in delay, incident response time, and user cost savings, which are used to generate a benefit-cost ratio.

- Is a cost-benefit analysis (with a positive BCR) enough to convince policy makers to implement ITS / TM measures? If not, what else is needed?

  Response: Generally speaking, a positive BCR is not enough to convince policy makers to implement ITS measures. They are more concerned with the possibility of diminishing returns on an investment. The anticipated and projected costs of transportation system operations and management (O&M) is a key consideration. Political pressure, unfortunately, also plays a significant role.

- What data sources are used in evaluation studies? Do they provide sufficient data? Or is more needed for the evaluation of TM/ITS measures?

  Response: The data for CHART's evaluation are obtained from the CHART II Database, Maryland Accident Analysis Reporting System (MAARS) data, and speed/volume detection sources statewide. The CHART II database contains information related to incidents and events, which are created by SOC HOTs. The MAARS data provides statewide accident information on an annual basis. This data, as mentioned before, is used to calculate information such as the reduction in delay, which demonstrates the benefits of the CHART program. The effectiveness of our TM measures is also tracked by the Local BP.

  As is expected, CHART constantly strives to improve and increase the data used for evaluation and has been involved in studies, device deployment, and traffic management analyses/modeling to address this issue.

Design of an application architecture:

- Can you describe the general procedure in the realization of traffic management measures (from policy target to deployment?)

  Response: CHART TM measures revolve around non-recurring congestion (vehicle incidents, road construction, special events, etc.). The performance of CHART, as previously mentioned, is demonstrated through the annual performance evaluation, which influences the measures included in our organization's business plans at the state and local levels. Policy targets are developed using a best practices approach and are developed based on key performance areas (KPAs) and managing for results (MFRs). These tracked measures also help to influence current and future project deployments.

- It appears that the US architecture is mostly for technical aspects. In the Netherlands we also use a functional architecture. Is this lacking in the US? In relation to this: Which organizations are involved in setting targets and developing strategies for TM? How do the responsible organizations set targets?

  Response: The National ITS Architecture supports both the functional and technical aspects of the nation's architecture. This is done via the development and update of both the logical and physical ITS architectures at the state, regional and national levels. As far as developing strategies are concerned, agencies such as RITA and the FHWA, along with input from state and local transportation agencies, work together to set targets using a best practices approach from lessons learned.

- Does the existing architecture ensure interoperability (in theory AND in practice)?

  Response: The National as well as the Maryland ITS Architectures encourages interoperability both in theory and in practice. Before the update of each version of the architecture, the state hosts workshops with stakeholders to validate the architecture. ITS standards (NTCIP, IEEE, AASHTO, NEMA, etc.) also play an important interoperability role. To further encourage interoperability, federal (and sometimes state) funding eligibility is tied to the National ITS Architecture compliance process.

- In what areas would you like to expand the existing architecture? Does it cover all modes of transport or (predominantly) road transport? Does it apply for both regular and exceptional traffic conditions (e.g. incidents, events, road repair works)?

  Response: The existing ITS architecture covers all modes of transportation and involves agencies and stakeholders that are involved in both regular and exceptional traffic and transportation conditions. As far as the expansion of the architecture is concerned, we would like to develop the transit and aviation sections of the Maryland Statewide ITS Architecture.

- How is it ensured that architectures are used / complied with?

  Response: To ensure that the architecture is used and conformed to, the federal government requires that all federally funded ITS projects conform to the regional ITS architecture. In Maryland, the ITS Architecture Conformity Form is used for this approval process. The completed conformity form is reviewed by the ITS Architecture Advisory Panel (IAAP), which includes representatives and officials from federal, state, and local government transportation organizations.

Traffic management vs. road construction projects and/or pricing measures:

- Is the added value of traffic management widely recognized or is special effort put into making the added value more transparent to policy makers?

  Response: The awareness of TM measures is not as widespread as we would like to be. It is sometimes difficult to convince decision makers that road construction to increase capacity is a temporary fix to the overall congestion problem. Many policy makers are not aware of the benefits of TM measures vs. highway construction projects. However, issues associated with homeland security and emergency management, in general, have increased awareness among our policy makers. As a result, TM agencies often get more recognition for measures associated with large-scale incidents and events.

- Are there any documents from studies on the added value of TM / ITS? With quantitative estimates?

  Response: Documents of this nature do exist. An example is provided below.
  Intelligent Transportation Systems Benefits, Costs, Deployment, and Lessons Learned: 2008 Update. Link: www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/14412.htm

- Are decisions to invest in TM (rather than in road construction) based on measures of effectiveness and cost-benefit analyses or (local) politics? How are budgets (for TM vs. road construction) allocated?

  Response: The decision to invest in TM vs. road construction is based on the anticipated measure of effectiveness and a cost-benefit analysis. However, local politics does play a significant role, which increases the difficulty in convincing decision makers to invest in TM measures.

  In terms of a budget, the CHART program is supported by federal funds. MDSHA's ITS projects and initiatives are supported by the CHART Capital Budget, which is developed based on MDOT's Consolidated Transportation Program (CTP) and the associated 6-Year CHART Deployment Plan. The Office of CHART does not take on road construction projects, but competes for funding (required for expansion) with other MDSHA system preservation projects (roads, bridges, etc.).

- Are Smart growth ideas being implemented and are they popular (with policy makers and the public)? Does that mean that traffic management and pricing measures are given priority over construction of new roads or widening of roads?

  Response: Smart-growth ideas are being developed in this region and are popular with policy makers and especially the public. This idea, now termed "*Livable and Sustainable Communities*," is aimed at tying the quality and location of transportation facilities to broader opportunities such as access to good jobs, affordable housing, quality schools, safer streets, etc. This, however, does not mean that traffic management and pricing measures are given priority over road construction. These measures are more often than not factored into roadway construction projects (ex. Inter-County Connector (ICC)) as part of smart-growth, and/or other initiatives.

- Are (local) governments willing to implement pricing measures? Do communities compete (for businesses) which may make it harder to implement such measures?

  Response: Local governments in our region tend to be supportive of pricing measures. In fact, there are a number of projects being implemented that include pricing measures. These include:
  - The ICC
  - John F. Kennedy Memorial Highway Section 100 project – Variable pricing along I-95 (from I-895 to north of MD 43).

<u>Translation of pilot projects into regular, wide-area applications:</u>

- Pilot projects: How are they initiated, funded, evaluated, barriers that need to be removed, etc?

  Response: CHART does not have vast experience in this area. However, we have initiated, developed and deployed a number of pilot projects such as Travel Times on Dynamic Message Signs (DMS), Speed/volume Detectors on the Eastern Shore, and the MD 295 Contra-flow. We have applied for funding and support for potential projects such as the I-270 Integrated Corridor Management (ICM) and the CHART Model Deployment projects, which, unfortunately, were turned down for funding by the federal government. Pilot projects are often evaluated based on accuracy and effectiveness as well as the public's reaction to the initiative, which was the case in terms of the travel times on DMS project. The CHART program's activities are largely funded by federal allocations and require justification in terms of funding, ITS conformity and environmental approval.

- Large scale implementations: How are they initiated, funded, evaluated, barriers that need to be removed, etc?

  Response: As mentioned above, CHART's activities are largely supported by federal funding and have to satisfy a number of federal requirements prior to implementation. Major barriers to large-scale project deployments include intra/interagency coordination, the availability of funding, and system integration requirements. Deployments are also affected by the willingness of the target area to receive the proposed ITS project.

- What are the key success factors in bringing new TM measures to the market?

  Response: Driving home the anticipated benefits of the TM measure to decision makers and the general public (users of the system) is a key success factor and good starting point when implementing/proposing new measures. Public education well in advance of deployment is also important.

- What are important barriers? E.g. organizational, financial, legal, institutional, technical?

  Response: Some requirements/barriers involved in implementing large-scale ITS/TM initiatives are as follows:
  - Financial - Is there a funding source available?
  - Organizational - Are all the agencies involved aware of, able, and willing to take on the responsibility of being involved?
  - Institutional - Are the necessary resources available (equipment, man-power, etc.)?
  - Legal/Environmental – Have the legal and environmental requirements been met?

- What determines whether a pilot project is successful? In theory/in practice?

  Response: The success of a pilot project is determined by whether or not it meets the stated functional, federal, legal, or environmental requirements and is received well by decision makers and the general public.

- When pilot projects are successful, does that mean that implementation on a large scale is a logical consequence? Or do most pilot projects end and then nothing further happens?

  Response: As mentioned earlier, CHART does not have a lot of experience in this area. Based on our experience thus far, if the pilot project is successfully deployed, then it is usually implemented. If the pilot project is not approved for deployment, then the project is discontinued.

- What stakeholders are involved in large scale implementation? How are new TM innovations initiated? How are new initiatives funded?

  Response: When a large-scale implementation is considered, stakeholders are selected based on the jurisdictions they manage/operate, the services they provide, and how their activities, or ours, will be affected by the initiative. New innovations are initiated and influenced by the need, industry, and advances in ITS technology and are more often than not federally funded. Large-scale implementations are also, on occasion, set in motion by political forces.

Appendix C – Dutch CV's

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Aad Wilmink is the head of the Traffic Management division of the Center for Transport and Navigation, a department of Rijkswaterstaat. Apart from a few years in the consultancy business, he works for Rijkswaterstaat since 1975. He started his career as a researcher in the fields of traffic engineering, traffic safety and traffic behavior. Then he turned to management and became head of a division responsible for traffic research. In 1986 he started working for the Head Office of Rijkswaterstaat and was responsible for the scientific and technological research policy of Rijkswaterstaat. After a few years in facility management, he became the director of a regional department dealing with water management, an important task of Rijkswaterstaat.

In 1998 he was working for a consultancy firm and was responsible for a division of 260 employees. After that he worked in the field of strategic business development for another consultant. In 2004 he returned to Rijkswaterstaat as the head of department of operations. Finally, another core business of Rijkswaterstaat, namely traffic management, got his attention and he is working now as the head of the Traffic Management division of the Centre for Transport and Navigation. In that position he is involved and responsible for the further development and application of traffic management in The Netherlands.

Ir. Wilmink has a Master of Science degree in Civil Engineering from Delft University of Technology.

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Ben Immers graduated as Civil Engineer at Delft University of Technology. He started his professional career as research fellow at the Netherlands Institute for Transport Research. In 1976 he accepted a post as lecturer in Transportation Planning and Transportation Modeling at the Technical University of Delft. In 1985 he became associate professor at the same department. In 1992 he was appointed as secretary-director of the Delft research school for Transport, Infrastructure and Logistics (TRAIL). From 1993 to 2009 Ben Immers worked as senior research fellow at the Netherlands Organization for Applied Scientific Research (TNO).

In 1996 Ben Immers accepted a position as part-time university professor in transportation planning and highway engineering at the Catholic University of Leuven (Belgium). In 2009 he joined the Centre for Expertise on Traffic Management, a joint venture between the Dutch Ministry of Transport, TNO and Delft university of Technology. Since 2010 he combines these jobs with a professorship in Traffic, Infrastructure and Logistics at Delft University of Technology. In the same year he is also appointed as scientific director of TRAIL Research School.

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Henk Taale is a senior consultant employed by the Center for Transport and Navigation, a department of Rijkswaterstaat. He has more than 19 years of experience in the fields of traffic management, traffic models and evaluation and was project manager for numerous projects in those fields. To name a few: the assessment of tools for dynamic traffic management, such as ramp-metering; the assessment of the UTC-system SCOOT in the city of Nijmegen; the further development, validation and maintenance of the microscopic simulation tool FLEXSYT-II-; several assessment studies, including road maintenance on the ring road of Amsterdam, cross-border management, a pilot on the use of floating car data and measures taken by the traffic police; the development of guidelines for assessment studies and model validation studies.

Currently, he is responsible for the further development and application of a tool for sustainable traffic management (called the Regional Traffic Management Explorer), for the design and application of a national monitoring and evaluation plan and for ITS Edulab, a cooperation project for master students between Rijkswaterstaat and the Delft University of Technology. Furthermore, he is the coordinator of the Centre for Expertise on Traffic Management, a cooperation between Rijkswaterstaat, TNO en Delft University of Technology. He is also a member of the management committee of the International Benefits, Evaluation and Costs (IBEC) Working Group and a member of several conference committees.

Dr. Taale has a Master of Science degree in Applied Mathematics from Delft University of Technology and finished his PhD in December 2008 on the subject of anticipatory control of road networks. Anticipatory control deals with the interaction between road users and road managers and with the question how to find an integrated control plan for networks taking into account the route choice behavior of road users.

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Isabel Wilmink obtained her Master's degree in Civil Engineering in 1995. Since then, she has worked as a traffic and transportation researcher at TNO. In 2009 she joined TrafficQuest, the Center for Expertise on Traffic Management, a jointly initiated center of Rijkswaterstaat, Delft University of Technology and TNO.

Isabel has experience with national and international projects in the areas of traffic modeling, scenario and evaluation studies, and the assessment of environmental effects of transport policies. Isabel currently works on several projects focusing on the evaluation of the effects of Intelligent Vehicle Safety Systems (e.g. the EU project euroFOT), cooperative systems (e.g. eCoMove, an EU project in which cooperative systems are developed that aim to reduce fuel consumption) and traffic management (e.g. the evaluation of the Dynamax field trials with dynamic speed limits in the Netherlands). She also worked on the EU projects eIMPACT, PReVAL, IMAGINE, ASSESS, PROSPER, PRIME and IN-RESPONSE. Other recent projects include TNO's SUMMITS program, in which co-operative systems were developed, evaluated and demonstrated, and the development and evaluation of speed management schemes for air quality, noise and traffic safety purposes.

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In the past five years, my research has involved theory, modeling, and simulation of traffic and transportation networks. I focused on innovative approaches to collect detailed, microscopic traffic data and the use of these data to underpin the models and theories that I have developed, using new techniques for model identification. In the VIDI project 'Tracing Congestion Dynamics – With Innovative Traffic Data to a Better Theory', microscopic traffic data are collected from an airborne platform using advanced video techniques. These data have resulted in a new generic theory of driving behavior, with as key elements driver adaptation, inter-driver heterogeneity, and multi-vehicle anticipation. The data collection method has been applied to a multitude of situations in which driving behavior could not be studied until now (e.g. adverse weather conditions, narrow lanes, work zones, incident sites). Analyses of these data have resulted in new insights into the large differences in driving behavior (in terms of car-following, and lane changing) in case of normal and non-recurrent conditions. In the Full Traffic project, performed on behalf of the Ministry of Transportation, twenty instrumented vehicles were used to investigate driving behavior and long-term changes therein due to advanced driver support systems (intelligent cruise control and lane departure warning systems). Research on such driver support system was also performed in the ROTAS project (NWO/Connekt), in which an overtaking assistance was developed and tested in our driving simulator. Currently, I am involved in the European project Smart-Vei, aiming to study driver adaptability to driver support systems.

Under my supervision, the pedestrian flow research was also furthered. The NOMAD pedestrian simulation model developed during the project 'Collective Walking Behavior in Public Spaces', for which I received a PPS grant from NWO, has been completed. The model has been applied in several commercial projects in order to solve design problems. The model functionality (evacuation modeling, revolving doors, train access and egress) was extended based on new walking experiments performed at our laboratory

I have furthermore initiated and supervised the NWO-AMICI ('Advanced Multi-agent Information and Control of multiclass Integrated traffic networks') program, which was aimed at developing new models and control strategies for regional traffic networks. Within the program, the multi-class traffic flow theory I have developed during my dissertation research was extended, and is now applied in Dutch Regional Traffic Management Centers to assess the impacts of traffic control scenarios. Recent work involves the operationalization of developed control algorithms and paradigms into practice (DYNAMAX and Praktijkproef Amsterdam projects on behalf of the Dutch Ministry of Transport, Public Works and Water Management). Furthermore, research on travel behavior in uncertain situations and the impact of traffic information thereon has lead to the development of the Travel Simulator Laboratory (TSL), which is an interactive laboratory to study the travel behavior dynamics.

Finally, I have initiated, performed and supervised research on evacuation modeling for buildings and for regional networks. Together with the Fluid Dynamics department, the evacuation of Walcheren was simulated using a newly developed travel behavior model. I am involved in the upcoming evacuation training (TMO project) pertaining to the evacuation of the Rijnmond area (area around Rotterdam).

I acquired a so-called VICI grant for a large research program (budget 1.4 million Euro) focusing on transport and traffic management in case of exceptional events. Within this program, a research group of four PhD's and one Postdoc will be working on different aspects relevant for prediction and management of network traffic flows in case of an exceptional situation (large incident, hazards or disasters, etc.).

Finally, I have organized the ICEM'09 (first International Conference on Evacuation Modeling and Management; September 2009).

Hans van Saan

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Hans van Saan is Senior Advisor at the Rijkswaterstaat Center for Transport and Navigation. Since September 2008 he is posted in Washington DC. Hans is detailed at TRB and functions as a liaison for Rijkswaterstaat in the USA. Hans' assignment in the US is to link relevant transportation research and innovations in the US with similar developments in the Netherlands. Hans is with Rijkswaterstaat since 1986. Prior to his posting in Washington Hans was project manager for the prevention and enforcement of overloading by trucks on the highway network of Rijkswaterstaat. He also has been involved in several of innovative ITS projects initiated by Rijkswaterstaat. He holds a bachelor's degree in Traffic Studies from the NHTV Breda University of Applied Sciences.

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Henk Schuurman graduated as Civil Engineer at the Technical University of Delft. From 1991 to 1996 he worked as a researcher and assistant lecturer at the Transportation Planning and Transportation Modeling department at the Technical University of Delft. His main research topics were Traffic Flow Theory and Simulation. In 1997 Henk joined the Center for Transport and Navigation at Rijkswaterstaat. He is a senior consultant on the field of Dynamic Traffic Management and ITS. Since 2009 he is Technical Program Manager for the Dutch Rijkswaterstaat Program on Dynamic Traffic Management, an innovation Program for Traffic Management which contains 41 projects and a program budget of 125 million euro. In 2009 he joined TrafficQuest. TrafficQuest is a joint venture between the Dutch Ministry of Transport, TNO and Delft university of Technology.

Ronald van Katwijk

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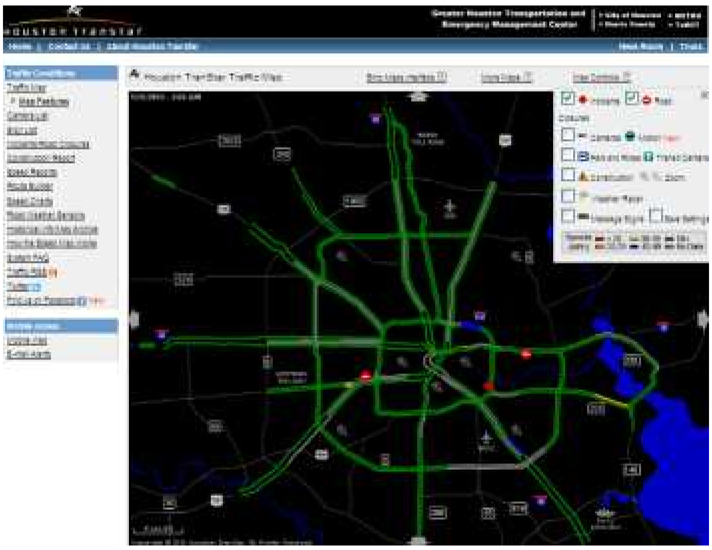
Ronald van Katwijk (1973) obtained his MSc in Computer Science at the Delft University of Technology, faculty of Computer Science, The Netherlands. As part of his specialization in Knowledge Based Systems his Master's Thesis involved the creation of an Expert System for the classification of anomalies as found in the infrared reflections of the Dutch Railway's overhead wires. After his graduation he has been working as a researcher at TNO, the Netherlands Organization for Applied Scientific Research, since 1997. At TNO he has been responsible for the development of both microscopic and macroscopic traffic and transport models, real-time data analysis and processing algorithms (e.g. for forecasting travel time based on detector loop and floating car data), and various decision support systems. He furthermore contributed to the creation of various architectures amongst which the European RIS (River Information System) architecture and the Dutch Architecture for Traffic Management.

The Dutch Architecture for Traffic Management defines a structured approach through which the cooperating road operators can formulate their joint objectives and ultimately determine the operational traffic management instruments needed to attain these objectives. His research has since focused on how to further operationalize the Dutch Architecture of Traffic Management (i.e., how to bridge the gap between traffic management and traffic control). It was during his work on TNO and the projects that he was involved in that he developed the basic ideas and notions that inspired him to pursue a PhD on the subject of multi-agent traffic control. This ultimately led in 2003 to a part-time position at the Delft Center for Systems of Control of the Delft University of Technology, where he has been working on traffic control, multi-agent systems, and optimization. In 2008 he obtained his PhD on the subject of Multi-Agent Look-Ahead Traffic-Adaptive Control.

Appendix D – Website TranStar

Visit the TranStar Home Page at www.houstontranstar.org

For traffic conditions and Incident management Information, visit:
http://traffic.houstontranstar.org/layers/



Traffic Conditions

Traffic conditions are being displayed via the following headings:

- Traffic Map (Map Features)
- Camera List
- Sign List
- Incidents/Road Closures
- Construction Report
- Speed Reports
- Route Builder
- Speed Charts
- Road Weather Sensors
- Historical Info/Map Archive
- How the Speed Map Works
- System FAQ
- Traffic RSS
- Twitter
- Find us on Facebook

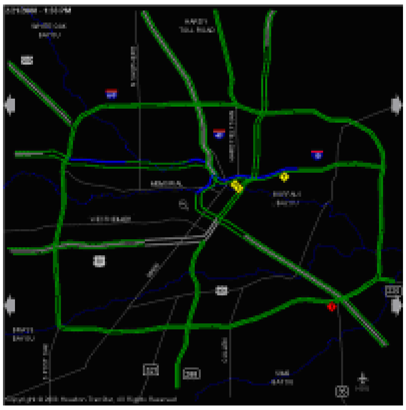
Mobile Access is also made possible via:

- Mobile Web: Access an enhanced version of the Houston TranStar mobile website on your iPhone, Android, or other touch screen device at http://traffic.houstontranstar.org/mobile/idefault.aspx.
- E-mail Alerts: Houston TranStar offers free, personalized E-mail alerts that notify users of **incidents and travel times** on Houston area freeways.

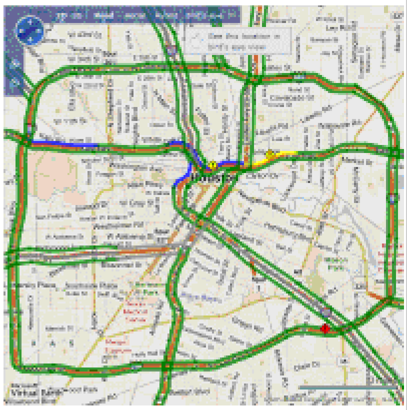
Houston TranStar Traffic Map Features

The Houston TranStar Traffic Mapping System allows users to toggle traveler information map features on and off, view detailed maps of the Houston region, zoom in and out of specific map areas, and click on hot links to various traveler information directly from the maps. The map is available in the traditional TranStar map format or as a Microsoft Bing Maps mashup.

TranStar Map Format



Bing Maps Format



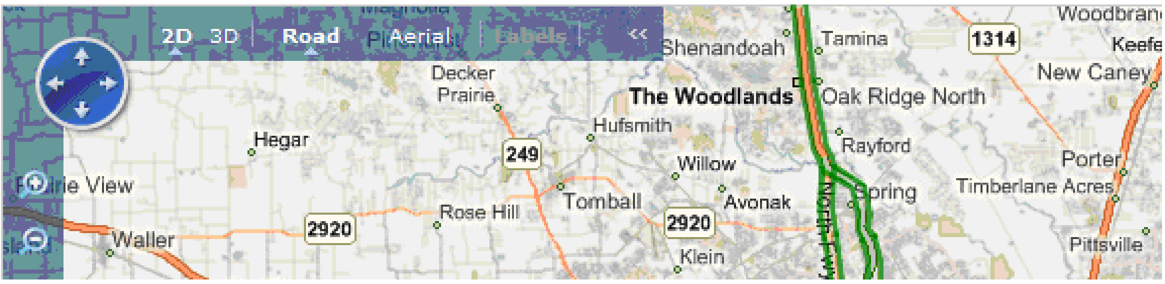
Toggling Map Features

Users have the ability to customize their view of the various events and devices that are mapped by the TranStar system. Real-time speeds and travel times, incidents, emergency road closures, scheduled lane closures, cameras, freeway message signs, park and ride lot locations, and weather radar can all be viewed on a single map. The "Map Controls" menu available on the navigation bar at the top of the map allows users to quickly toggle map items on and off. To add or remove a feature from the map, click the checkbox next to an item. Any event or item shown on the map can be clicked to obtain additional details.

Additional Maps and Zooming

The system allows users to zoom in or out of specific areas in the Houston region. On the TranStar map, simply click the magnifying glasses to zoom in or out, click the arrows to visit a geo-graphically adjacent map, or click the "More Maps" menu to easily navigate between area maps. The area maps provide greater detail and contain expanded coverage of the Houston region.

Bing Maps Navigation Controls



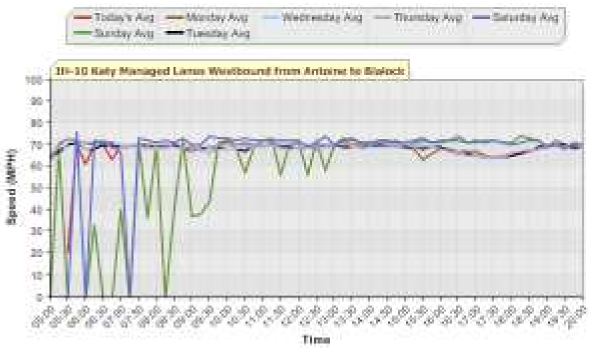
For an even more detailed view of TranStar information, use the Bing Maps Interface which is accessible via a link on the navigation bar. To navigate the Bing Maps Interface, use the built in controls on the top-left portion of the map. You can also drag the map with your mouse to pan and double-click the map to zoom. In addition, satellite imagery is available by selecting the "Aerial" option on the navigation controls.

Map Hot Links

Embedded into the maps are "hot links" which give users direct access to other web-based traveler information. Click on the airport icons to visit each respective airport's website or the boat icon to get current Galveston-Bolivar ferry wait times. The “Statewide” map offers links to other Texas Traffic Management Center web sites.

Live speed charts

Live speed charts are used to monitor the evolution of speed on a road section during one or more days



Statistics

- 420,000 visitors per month
- User survey indicates that:
- 25% change travel pattern
- 50% had left earlier or later
- 70% saves up to 30 minutes
- > 90% say information is reliable and accurate
- > 95% say information is useful
- TranStar map format is black with roads indicated in red, yellow and green (not Google maps as operating on other platform and therefore not reliable)
- Since RITA TranStar has unlimited bandwidth accommodating millions of hits
- In the past TranStar has invested much in fiber optic cable (700 miles); however maybe this is not a sustainable development as wireless communication is also becoming successful.
- One of the advantages of fiber optic is bandwidth thus allowing for robust communication.