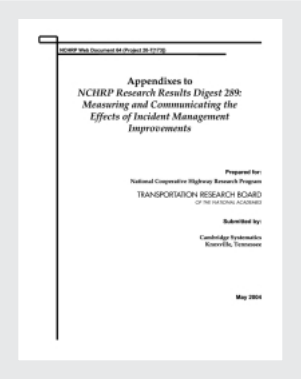
Appendixes to
NCHRP Research Results Digest 289:
Measuring and Communicating the
Effects of Incident Management
Improvements

TRANSPORTATION RESEARCH BOARD

Appendixes to Measuring and Communicating the Effects of Traffic Incident Management Improvements

DETAILS

0 pages | | PAPERBACK
ISBN 978-0-309-43137-8 | DOI 10.17226/21964

AUTHORS

NCHRP Web Document 64 (Project 20-7[173])

Appendixes to
NCHRP Research Results Digest 289: Measuring and Communicating the Effects of Incident Management Improvements

Prepared for:

National Cooperative Highway Research Program

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

Submitted by:

Cambridge Systematics
Knoxville, Tennessee

May 2004

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Advisers to the Nation on Science, Engineering, and Medicine

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www.TRB.org

www.national-academies.org

CONTENTS

Appendix A:

Workshop Presentations

Beyond Talk:
A Strawman Framework for Focusing and Applying the National Dialogue on Transportation Operations
(DRAFT – May 24, 2004)

The 3-year old National Dialogue on Transportation Operations has generated broad interest in the topic, and has revealed a diverse set of related issues and challenges. However, there remains a transcending need to translate the Dialogue into a limited and focused action plan. This action plan needs to simultaneously engage and energize key stakeholders that have responsibilities and economic stakes in the safe, secure, and reliable operation and management of the national highway system.

Clarifying the basic questions that must be answered can help focus the Dialogue towards action. These "**Essential Questions**" can establish a foundation for "**Essential Actions**" that, in turn, could serve as building blocks for a sustained and effective national highway operations and traffic incident management program.

Three Essential Questions

1. Subjecting to Economic Interests – Understanding the fundamental "issue drivers"
- Who makes money and how?
- What are the primary economic and political motivators and sources of power?

2. Scanning & Structuring – Understanding current activities and initiatives
- What is this "stuff"?
- Who is doing what, and why are they doing it?

3. Bottom-Lining – Understanding the desired end state
- What do you want, and what will it accomplish?

Building Blocks Towards a Focus – Three Essential Actions

1. Develop a "National Highway System Operational Vision Statement and Performance Goal Set".
Recognize the operation of the highway system as the 10 percent of the "Dialogue" that is likely to address 80 percent of the prospective economic and political benefits. In effect, re-establish the Interstate Highway System and the National Highway System as a backbone infrastructure resource for national security and international economic dominance. For example,

Vision:
No unexpected delay on the National Highway System.
- Delay is minimized and optimized
- All shippers and travelers are instantaneously warned of unavoidable delay and hazards

<u>NHS Operational Performance Goal Set:</u>

COMPLETE, RELIABLE WARNING
- All congestion is detected within 60 seconds.
- All travelers are warned of congestion or hazards within 120 seconds.

SAFE, QUICK CLEARANCE
- 80% of lane blockages are cleared within 20 minutes
- All minor traffic incidents are cleared within 30 minutes.
- All major traffic incidents are cleared within 90 minutes.

<u>Organizational and Functional Objectives:</u>
A Network for Highway Operations & Security with layers that are both institutional (e.g. interstate corridor operational coalitions or multi-state transportation operations programs) and functional (e.g. linked statewide highway operations data hubs).

2. Develop and document a "10-year *Unified* National Action Plan for Safe, Secure, and Reliable Highway Operations". (Tie the strategic threads together at the top.)

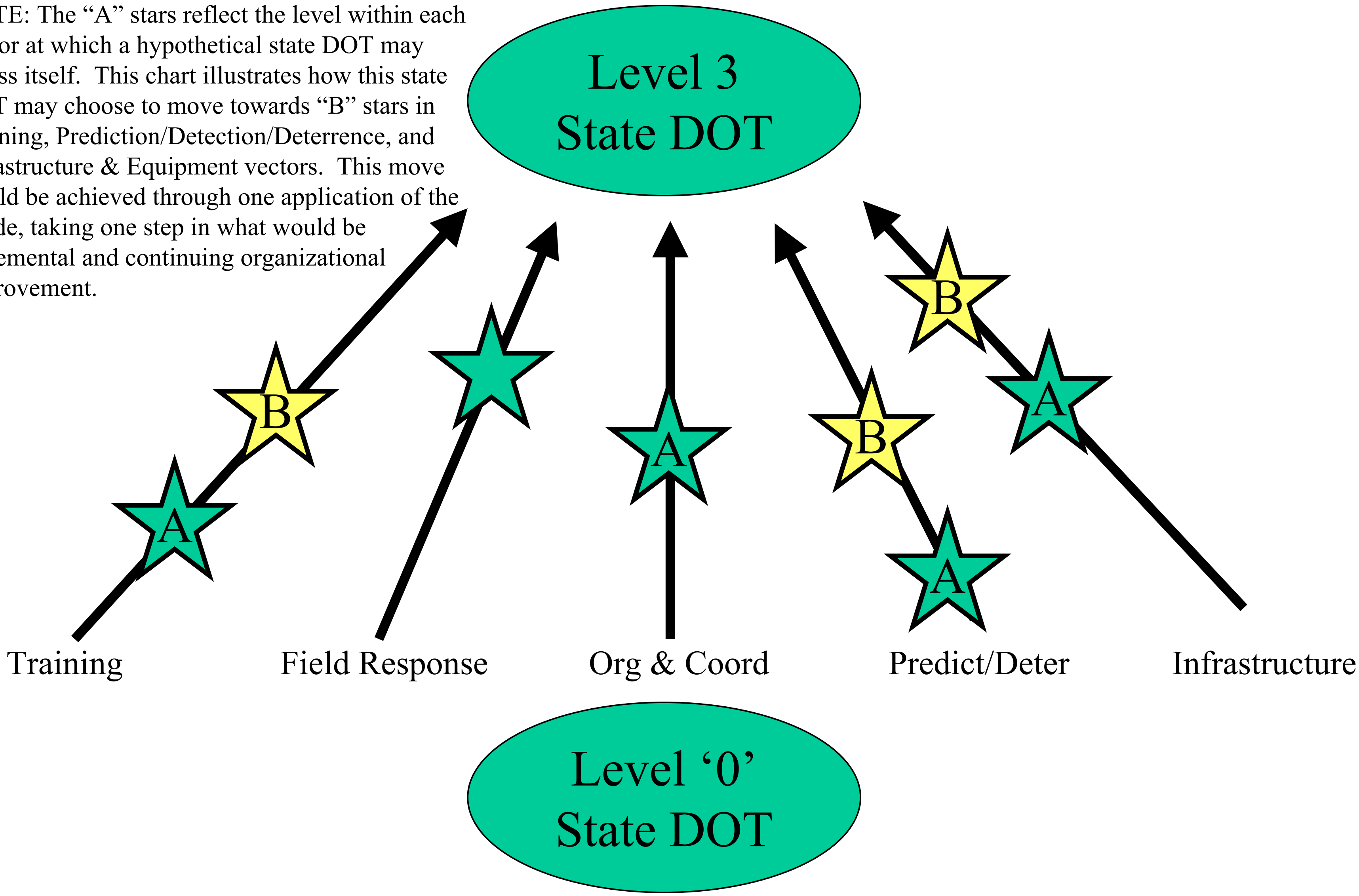
- Include AASHTO, ITE, TRB, ITS America, ASCE, APWA, PTI, and the USDOT Public Safety Advisory Group (PSAG).
- Incorporate recommendations of the pending National Traffic Incident Management Coalition.
- In the context of developing the Unified Action Plan, introduce a geographically distributed National Highway Operations Program Support Team. Specifically,
    - Integrate permanent contract staff alongside FHWA staff in the Resource Centers to accelerate knowledge management as well as regional, state, and federal highway operations program development.
    - Precipitate multi-state regional program support partnership teams between the enhanced FHWA Resource Centers, local University Transportation Centers, local ITE Districts & Sections, and local ITS America State Chapters.
    - Accelerate the development of Multi-State Transportation Operations Programs (MSTOPS) such as the I-95 Coalition, the Gary-Chicago-Milwaukee Corridor, the High Plains Coalition and others.

3. Initiate a "National Highway Operations Communications and Awareness Plan and Program".

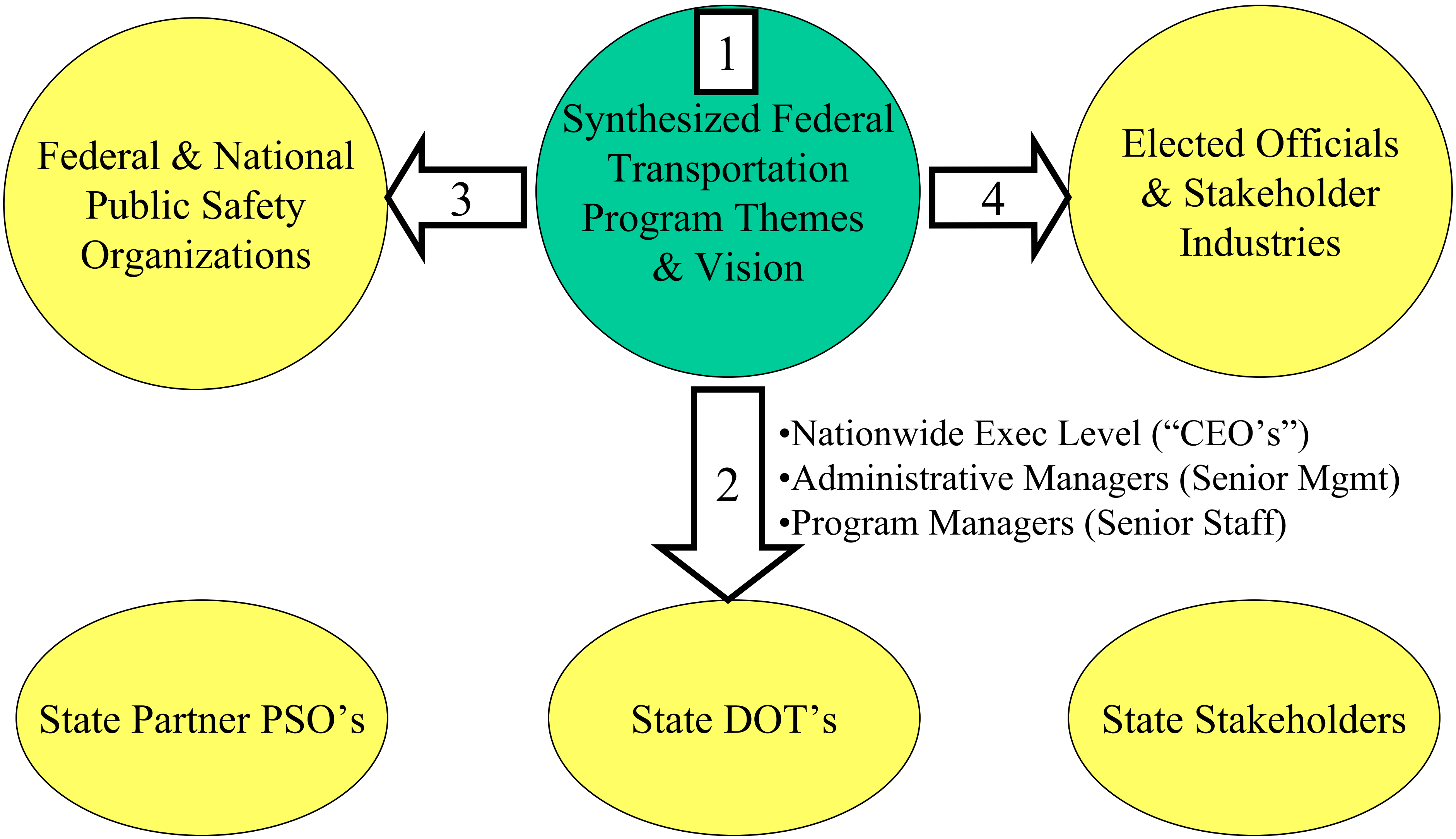
- Engage professional communications program management expertise to develop and administer a communications and awareness plan that distributes communications responsibilities and activities between AASHTO, ITE, ITS America, and others.
- Target **<u>State DOT CEO's, Administrators, District Directors, and State Police Commanders</u>** with a "Traffic Incident Management Principles and Benefits" Campaign
- Adapt the AASHTO Strategic Highway Safety Plan approach (Guides, Lead-State Roles, etc.) to encourage state **<u>DOT professional staff</u>** in the development and administration of ongoing traffic incident management programs at state and regional levels.
- Create a National Highway Operations (or Traffic Incident Management) Task Force of national organizations that represent **<u>elected officials (e.g. NGA, NCSL, NCA, etc.) and private industry</u>** (e.g. ATSSA, ATA, TRAA, U.S. Chamber of Commerce, etc.) to produce a joint policy statement on the importance of safe, secure, and reliable operation of the National Highway System.
- Design a series of national and coordinated regional workshops. Coordinate efforts with regional workshops for the TMC Pooled-Fund Study. Leverage a Chicago-area regional Traffic Incident Management Conference in July 2004.

State DOT TIM Programs: Applying the Vectors for Convergent Evolution

NOTE: The “A” stars reflect the level within each vector at which a hypothetical state DOT may assess itself. This chart illustrates how this state DOT may choose to move towards “B” stars in Training, Prediction/Detection/Deterrence, and Infrastructure & Equipment vectors. This move would be achieved through one application of the Guide, taking one step in what would be incremental and continuing organizational improvement.



Highway Emergency Preparedness and Traffic Incident Management: National Communications & Awareness Plan & Pilot Program



Measuring and Communicating the Effects of Incident Management Improvements

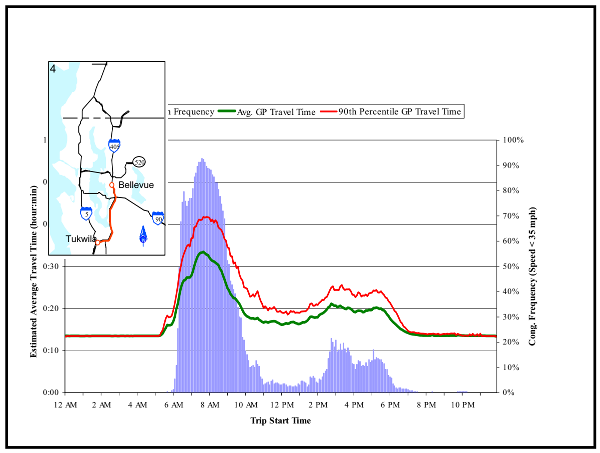
Washington State DOT

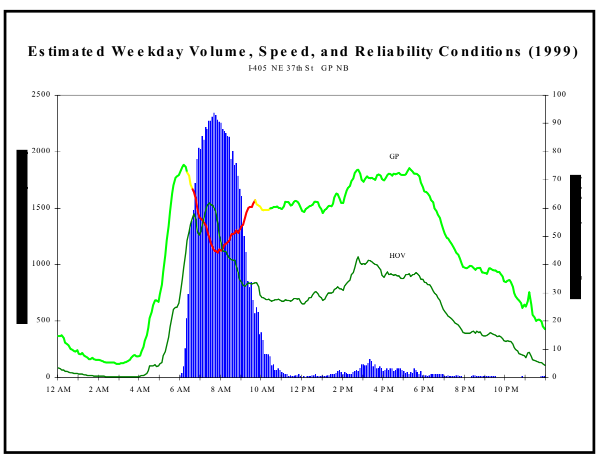
Performance Measurement

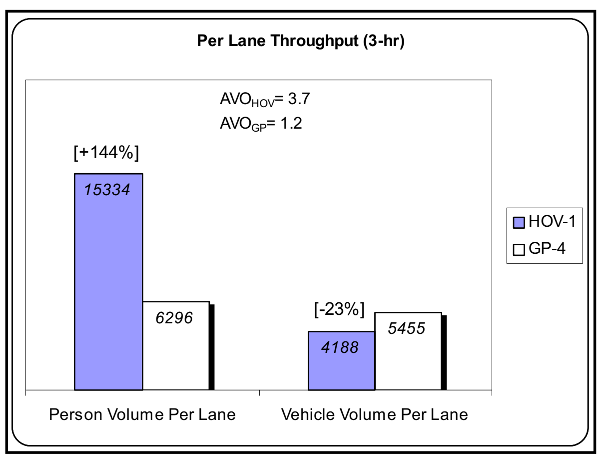
- WSDOT has been actively computing, reporting, and using freeway performance measures since 1999
- The performance measures have undergone a variety of improvements since that time

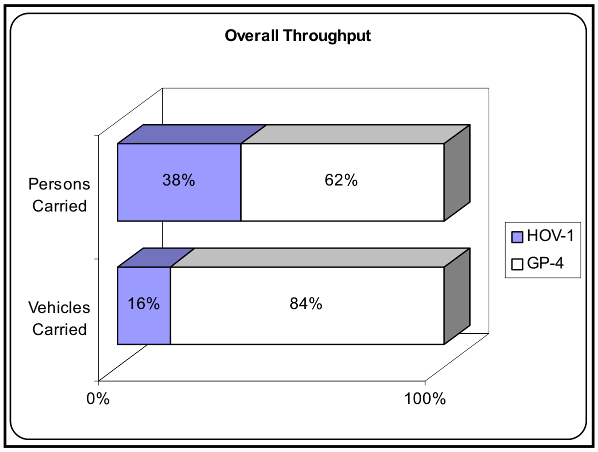
Performance Measures

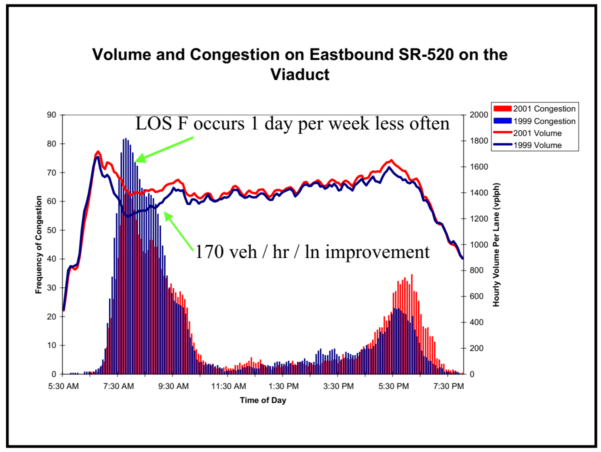
- The basic measures used are:
  - Travel time
    - Mean
    - 95th percentile
  - Volume
    - Person
    - Vehicle
  - Frequency of congestion









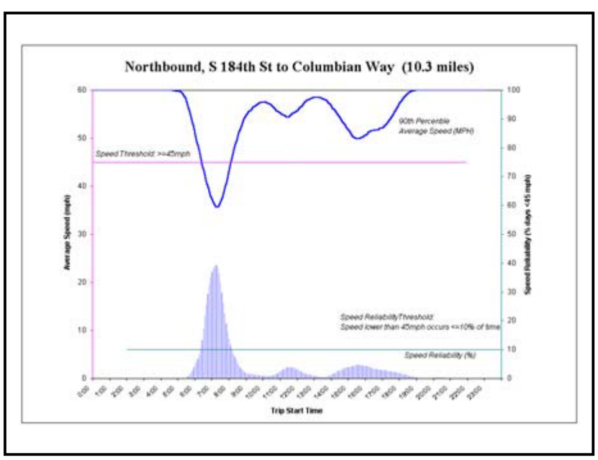


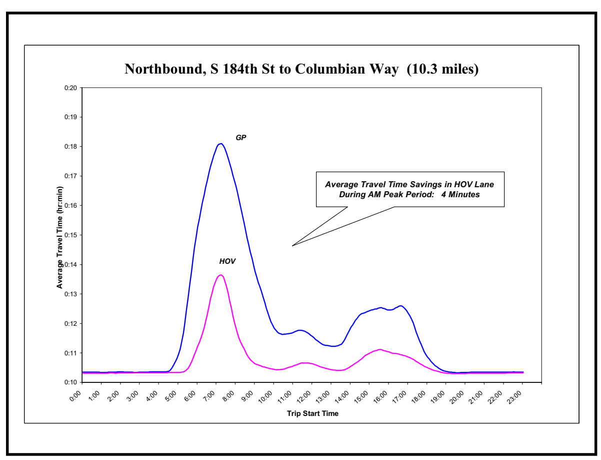
HOV Lane Standards

- We apply the same basic process to the review of freeway HOV lane performance
- However, HOV lanes also have a stated performance standard against which they are judged
  - "HOV lanes should travel at 45 mph or faster, 90 percent of the time"

HOV Lane Standards

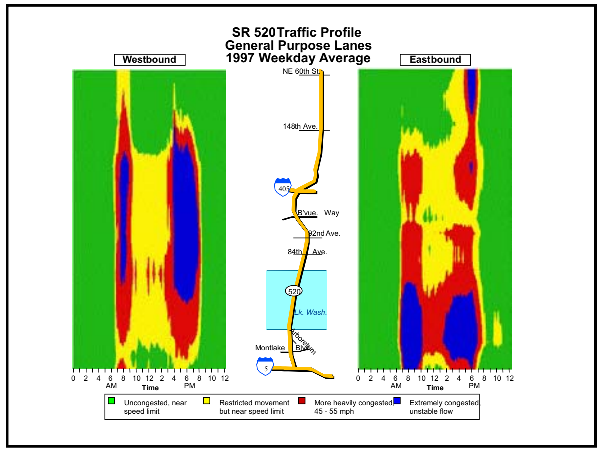
- HOV lanes have additional performance graphics
- These indicate when:
  - HOV lane corridors are not in compliance with performance objectives, and
  - How HOV lane travel times compare to GP lane travel times

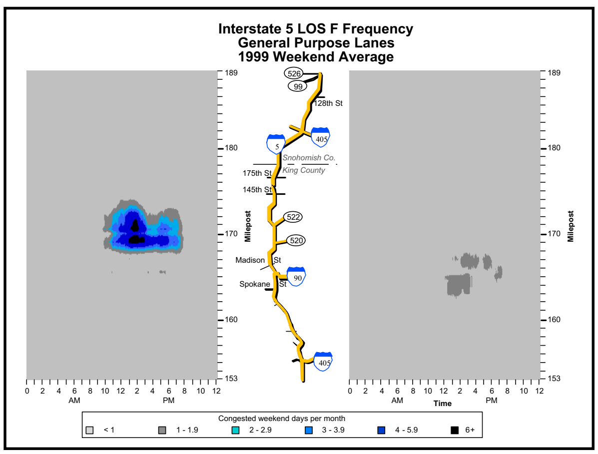


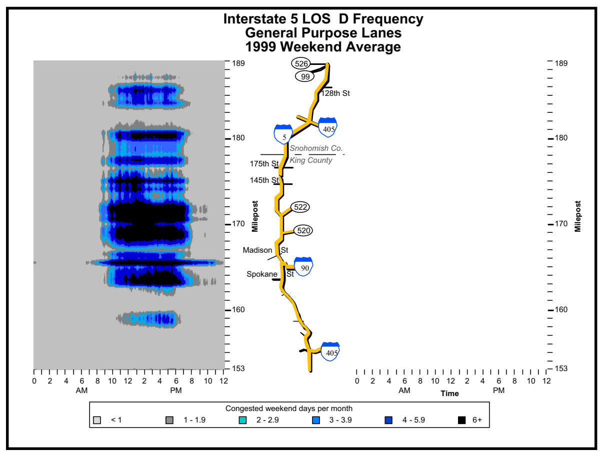


Routine Performance Measures

- We also look at congestion geographically
  - The "mean" performance (lane occupancy)
  - The frequency of congestion by time and location







Routine Performance Measures

- Allow WSDOT to examine and report on trends in facility use and performance
- Directly measure changes in performance that occur after operational or geometric changes are made

Routine Performance Measures

- Measures can be computed for one day, or for many days

Limitations For Use Measuring The Effects of Incident Response

- The system as currently designed
  - Measures effects, but not causes
    - (WSDOT actively working on collecting data on causation)
  - Difficult to account for exogenous variables
    - How much congestion is caused by the incident, versus some other cause (a volume fluctuation, bad weather, some distraction)

Recurring-Nonrecurring Congestion Study

- An attempt to measure the relative size of incident caused congestion in the Seattle metro area
- If possible, make the system so that it could be routinely performed

Recurring – Nonrecurring Congestion Study

- Approach:
  - Start with travel conditions (vol., spd., occ.) for all instrumented roads by time and location for study period (2 months)
  - Remove days when incidents occurred
  - Select the median condition from the remaining days (by time of day and location)
    - Add a confidence interval around median condition
    - This is considered the "routine" or "recurring" condition
    - Use median lane occupancy +/- 5%

Recurring-Nonrecurring Study

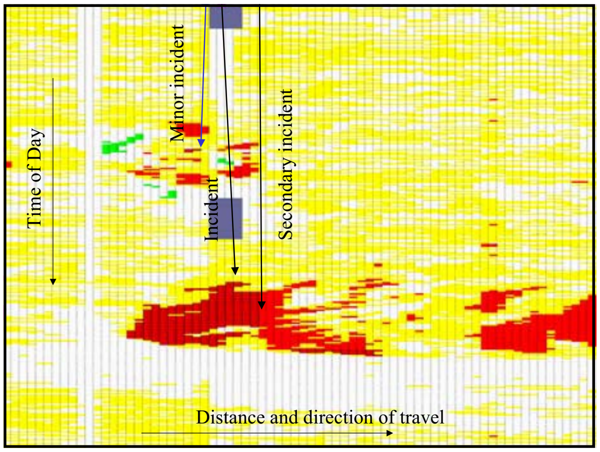
- Approach (cont.)
  - Non-recurring conditions are defined as those outside of "recurring" conditions.
  - Take each day's performance and subtract "recurring" condition
  - The difference is the "non-recurring" condition
    - Better (must be outside confidence interval), or
    - Worse

Recurring-Nonrecurring Study

- Approach (cont.)
  - Identify when "events" take place in time and space
    - For this study, lane blocking incidents
  - Associate non-recurring delay with event
    - Difficulty: how much congestion is allocated to an incident?
    - Two basic approaches: all adjacent (time & space) non-recurring congestion or just that prior to when other events cause an increase in delay

Recurring-Nonrecurring Study

- Approach (cont.)
  - Sum total delay
    - volume * delay in segment
    - Segment = a 5 minute interval for ½ mile
    - Delay is either
      - Difference in speed below 60 mph, or
      - Difference in speed below "optimum" flow speed
      - Where "optimum" is the speed at maximum rate of flow for the facility (~50 mph)



Recurring – Nonrecurring Study

- Different definitions of delay
  - From free flow conditions?
  - From conditions at which maximum flow occurs? (optimal flow)
  - From some adopted standard?
- Performance measure = vehicle hours of delay

Recurring – Nonrecurring Studyh

- Is a good technical performance measure
- but does not mean much to the average person

Recurring-Nonrecurring Study

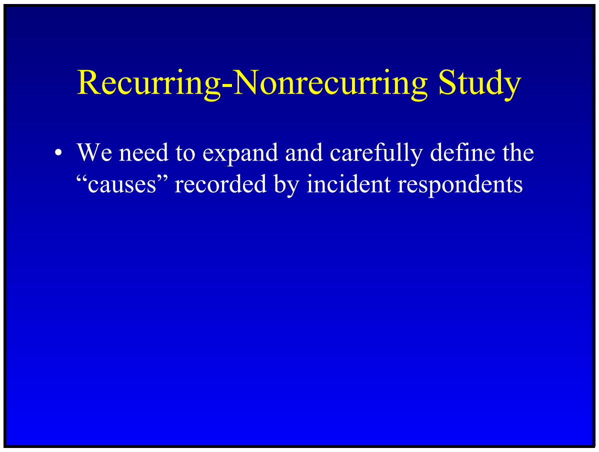
- Results
  - Lane blocking incidents cause 2 to 20 percent of total delay
  - Non-recurring delay ranges between 30 to 50 percent of all peak period, peak direction delay, but is between 30 and 70 percent of total daily delay
  - A large fraction of delay is non-recurring, but is not related to lane blocking incidents

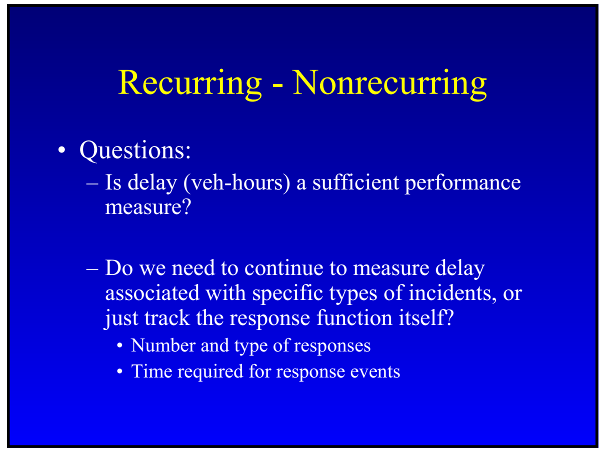
Recurring – Nonrecurring Study

- But…
  - One 3-minute long lane blocking incident,
  - at 9 AM,
  - on the I-90 Floating bridge,
  - caused 35 vehicle-hours of delay (700 veh-min of delay / min of incident)

Recurring – Nonrecurring Study

- Good incident data is hard to obtain/maintain
  - Databases describing events and response are required
  - Minor errors in these databases make analysis difficult to automate
- Good incident data is necessary for adequate management of the response process


Recurring-Nonrecurring Study
• We need to expand and carefully define the "causes" recorded by incident respondents


Recurring - Nonrecurring
• Questions:
– Is delay (veh-hours) a sufficient performance measure?
– Do we need to continue to measure delay associated with specific types of incidents, or just track the response function itself?
• Number and type of responses
• Time required for response events

Selling Mobility

Experiences of Other States & National Monitoring Programs

(Who is Buying What We're Selling and How Can We Sell it Better?

Incident Management Workshop
Seattle, December 2003

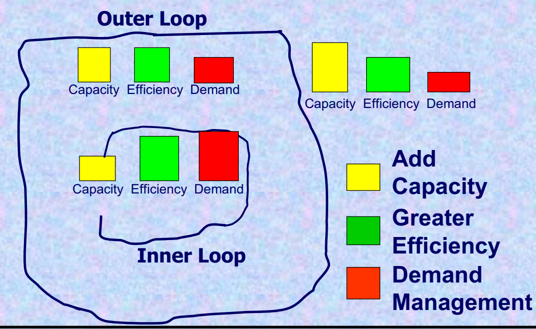
Tim Lomax
Texas Transportation Institute

Experiences

- ✓FHWA
  - ➢Mobility Monitoring Program
  - ➢Performance Plan
- ✓TTI's Annual Mobility Report
- ✓Texas Governors Business Council
- ✓Florida, Oregon, Minnesota
- ✓Focus on Data and Communication

Variety of Solution Types

Strategy Mix Will Be Different



Urban Mobility Measures

Delay/Person – Hours per year
% of Daily Urban Travel in Congestion

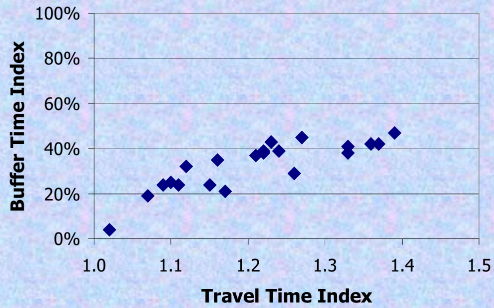
Travel Time Index $= \dfrac{\text{Peak Period Travel Time}}{\text{Free Flow Travel Time}}$

Buffer Time Index $= \dfrac{\text{95th \% Travel Time} - \text{Average Travel Time}}{\text{Average Travel Time}}$

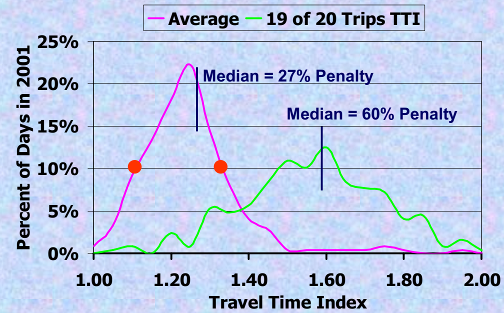
Mobility Monitoring Program

- ✓ Cambridge Systematics and TTI – sponsored by FHWA
- ✓ Parts of 26 cities for 2002 data year
- ✓ Archived data quality and reporting
- ✓ Findings
  - ➢ Data quality varies – maintenance, use and budgets
  - ➢ Average congestion and reliability are related
  - ➢ Need to save the "Whys" to make this data really pay off

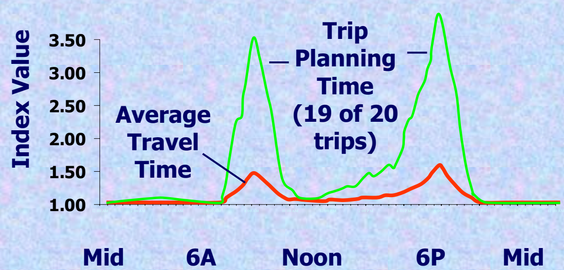
2001 Monitored System Average Conditions – 21 Cities



Daily Variation in Peak Period "Frustration" Levels



Planning a Trip What do you consider?



Mobility Studies Website (http://mobility.tamu.edu)

- ✓ **Urban Performance Measures Study – Pooled Fund**
  - ➢ Refining and Applying Performance Measures
  - ➢ Estimating Methods
- ✓ **Mobility Monitoring Program - FHWA**
  - ➢ Teamed with Cambridge Systematics
  - ➢ Analysis of archived freeway data in 26 cities
- ✓ **Resources**
  - ➢ Annual Mobility Report – 75 Areas
  - ➢ Performance measures
  - ➢ Corridor & Multimodal analysis
  - ➢ Data archiving

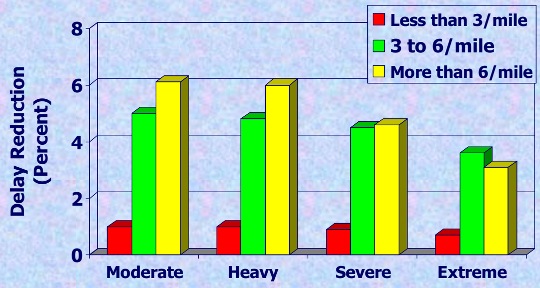
2003 Urban Mobility Report Operational Benefits for 2001 Data

Technique & Func Class	# of Cities	% of FC in Cities	Delay Reduction	
			(mill hrs)	(% of FC)
Freeways				
Ramp Metering	26	23%	73	3.1%
Incident Management	53	54%	117	5.0%
Streets				
Signal Coordination	75	54%	16	1.4%
Total			206	

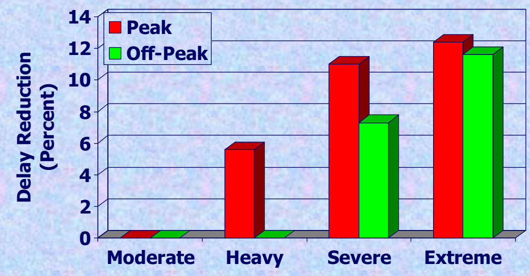
Operational Treatment Delay Savings

- ✓ Key elements of transportation spending
- ✓ Basic Mobility Study methods did not include operations
- ✓ Subtract delay reduction estimates from basic estimates
- ✓ Key Factors
  - ➢ Area Covered – How much is treated?
  - ➢ Density – How well is it treated?
  - ➢ Congestion – What is treated?
  - ➢ Effect – What is the delay reduction effect?

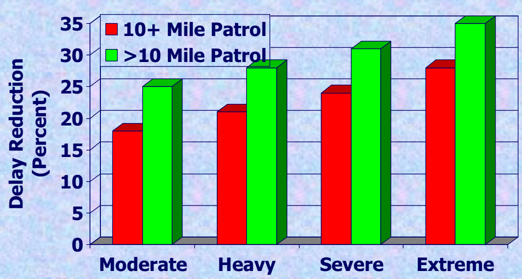
Signal Coordination Benefits (progressive)



Ramp Metering Delay Reduction



Benefits of Freeway Service Patrols



2003 Urban Mobility Report

Scenario: Added Roadways (2001 Data) (for all 75 Urban Areas—Frwys and Streets)

% Added Roadways	Total Delay (million hours)	Delay Reduction (million hours)
Base Condition	3,600	--
+ 1%	3,460	140
+ 2%	3,320	280
+ 3%	3,190	410
+ 5%	2,950	650

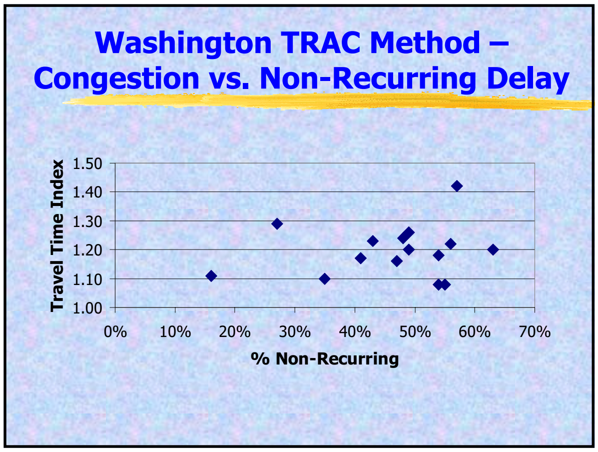
>To get 200 M hours of delay reduction would require 1,200 Freeway LM and 1,230 Principal Arterial LM.

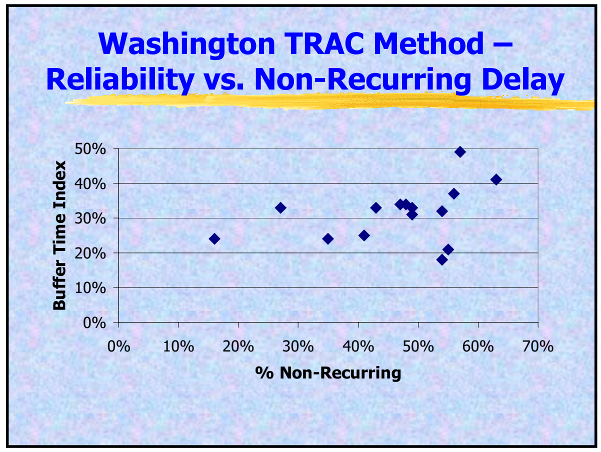
Solutions? Need for Expanded Management

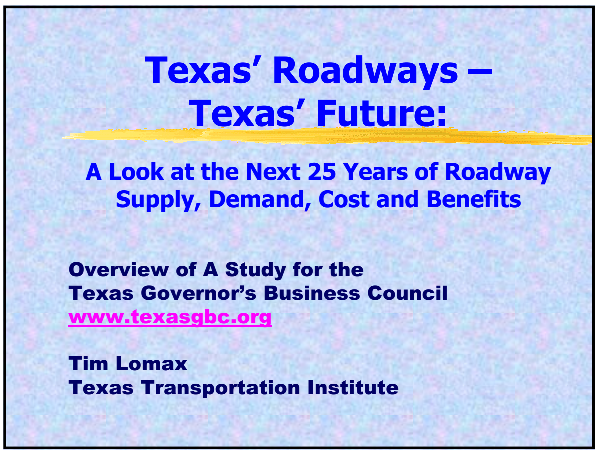
- ✓In the past we managed:
  - ➢Construction Projects
  - ➢Supply & Capacity
  - ➢Operations
  - ➢Demand
- ✓Should we add?
  - ➢Pricing?
  - ➢Expectations?

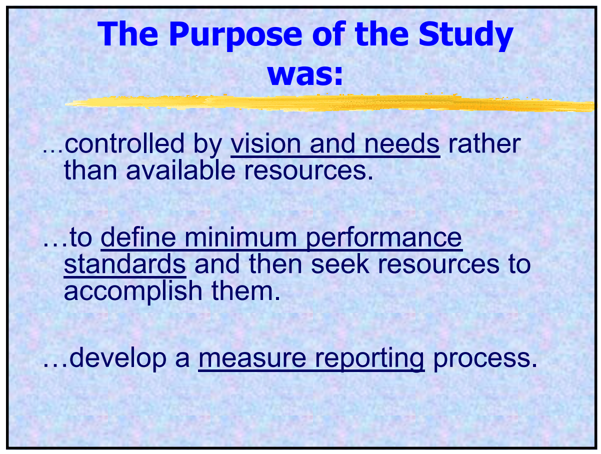
Need for Expanded Measurement, Also

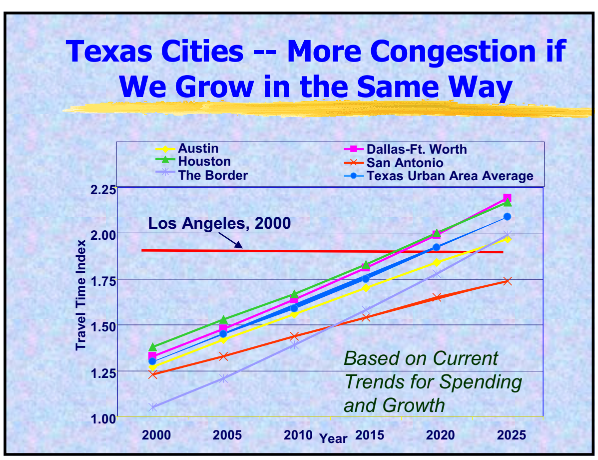
- ✓ Use real-time data
- ✓ Incorporate benefits of operational improvements & public transportation
- ✓ Improve communication to many audiences
- ✓ *Incidents – what are we measuring when an incident occurs?*
- ✓ *Can we prevent incidents? (Gas, Rubberneck)*

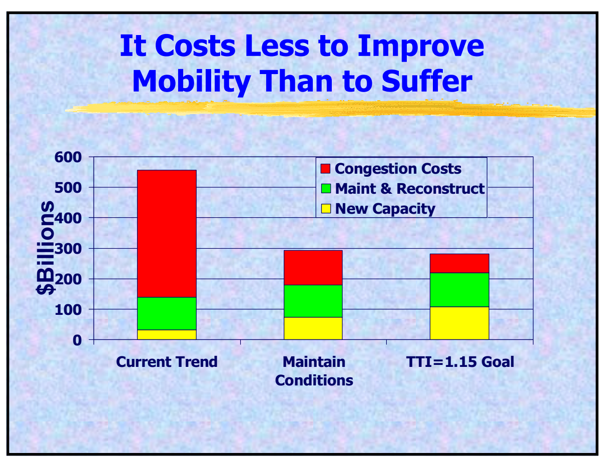

Washington TRAC Method –
Congestion vs. Non-Recurring Delay
Travel Time Index
1.50
1.40
1.30
1.20
1.10
1.00
0% 10% 20% 30% 40% 50% 60% 70%
% Non-Recurring


Washington TRAC Method –
Reliability vs. Non-Recurring Delay
Buffer Time Index
50%
40%
30%
20%
10%
0%
0% 10% 20% 30% 40% 50% 60% 70%
% Non-Recurring

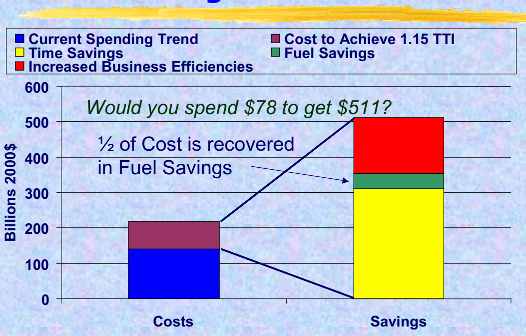

Texas' Roadways –
Texas' Future:
A Look at the Next 25 Years of Roadway Supply, Demand, Cost and Benefits
Overview of A Study for the
Texas Governor's Business Council
www.texasgbc.org
Tim Lomax
Texas Transportation Institute


The Purpose of the Study was:
…controlled by vision and needs rather than available resources.
…to define minimum performance standards and then seek resources to accomplish them.
…develop a measure reporting process.

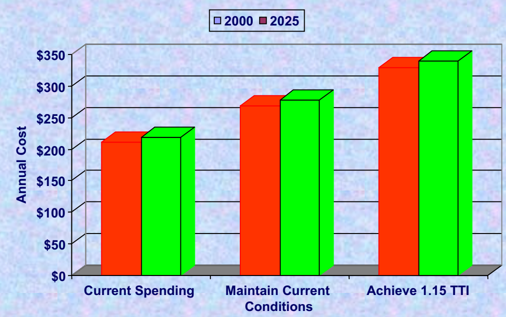

Texas Cities -- More Congestion if We Grow in the Same Way
Austin
Houston
The Border
Dallas-Ft. Worth
San Antonio
Texas Urban Area Average
Los Angeles, 2000
Travel Time Index
2.25
2.00
1.75
1.50
1.25
1.00
2000 2005 2010 2015 2020 2025
Year
Based on Current Trends for Spending and Growth


It Costs Less to Improve Mobility Than to Suffer
Congestion Costs
Maint & Reconstruct
New Capacity
$Billions
600
500
400
300
200
100
0
Current Trend
Maintain Conditions
TTI=1.15 Goal

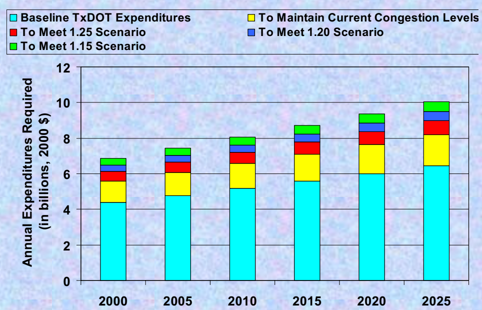
25-Year Costs and Savings - Achieving the 1.15 Goal -



Annual Cost per Texan to Achieve Mobility Goals



Spending to Reach Goals, Not Preside Over Decline



Recommendations

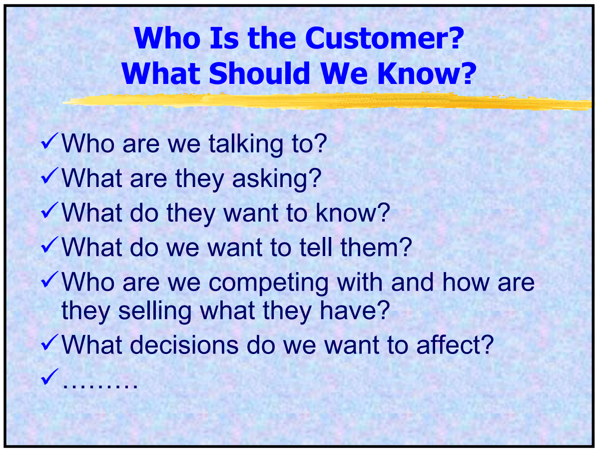
- ✓ TxDOT and MPOs should create goal-oriented plans not constrained by spending.
- ✓ Reward, not penalize, local funding efforts in TxDOT funding allocation program.
- ✓ Publish an Annual Report Card to measure progress.
- ✓ **Doing nothing costs $511 billion.**
- ✓ **Solving the problem costs $78 billion more than current trend.**

TMMP Process is Under Development

- ✓ Needs-based plan – a return to the vision-oriented approach
  - ➢ Local and State mobility goals & funding requirements
  - ➢ Peak periods
  - ➢ Multi-modal corridor solutions
  - ➢ People and Freight
  - ➢ Show the effect of all Projects, Programs, Policies, Plans, & Partnerships
- ✓ Extension of current financially constrained planning process
- ✓ Planning models & other benefit estimates

Other States

- ✓ Florida & Minnesota – Reliability measure being developed – driven by IM activities and reporting/accountability needs
- ✓ Oregon – Operational Perf Measures – “we need a measure like the pavement & bridge people have”
- ✓ Key element - Predicting reliability measures where no archived data


Who Is the Customer?
What Should We Know?
✓Who are we talking to?
✓What are they asking?
✓What do they want to know?
✓What do we want to tell them?
✓Who are we competing with and how are they selling what they have?
✓What decisions do we want to affect?
✓………

Appendix B:

Marketing Examples

SUNGUIDE
Florida's Intelligent Transportation System

Summer 1999 *Volume 1, Issue 2*

Traffic Management Centers on drawing board

In the world of Intelligent Transportation Systems (ITS), Traffic Management Centers (TMC) are to traffic engineers what NASA's Mission Control is to astronauts — the nerve center.

As ITS moves from the conceptual phase to implementation in South Florida, a number of transportation agencies have TMCs on the drawing board.

FDOT's District Four in Fort Lauderdale is planning a two-story TMC on Commercial Boulevard in Fort Lauderdale where FDOT and Broward County Traffic Engineering will be co-located. The project will be funded with federal, state and county dollars and is targeted to be operational in 2005. FDOT is considering building an interim TMC at the District Four headquarters if necessary.

Florida's Turnpike District plans to build a TMC at its Pompano Beach Turnpike Operations Center with Florida Highway Patrol and the Office of Toll Operations planning to be onsite. The Turnpike TMC is scheduled to be partially operational this November.

FDOT District Six in Miami recently moved into an interim TMC housed at the District Six headquarters with plans for the permanent TMC to go to construction in FY 2001-02. Florida Highway Patrol will be co-located with FDOT at the Miami TMC.

Once built, the TMCs will give South Florida traffic managers a physical location to monitor traffic conditions, respond to incidents and coordinate ITS programs.

"The TMC will be a command center of sorts," said Rory Santana, District Six Traffic Operations Engineer. "We will have real-time

TMCs continued on back page

District Four's TMC will house Broward County Traffic Engineering as well as FDOT staff.

SunGuide Service Patrol expands coverage areas

Florida DOT's regional SunGuide service patrol program, started in 1995, is expanding.

Service patrols are operating on Interstate 95 and the Dolphin Expressway (State Road 836) in Miami and will be added to the Palmetto Expressway (State Road 826) this summer.

The Miami-Dade Expressway Authority (MDX) plans to add service patrols on the Don Shula Expressway (State Road 874), Snapper Creek Expressway (State Road 878), Airport Expressway (State Road 112) and Gratigny Parkway (State Road 924) later this year.

FDOT and MDX, partners in the SunGuide service patrol program in Miami-Dade, are operating eight trucks with plans to expand to 21 trucks by the end of 1999.

FDOT's Fort Lauderdale office is running service patrols on Interstate 95, Interstate 595 and Interstate 75 in Broward and Palm Beach counties with plans to expand the service to Interstate 95 in Martin, St. Lucie and Indian River counties.

"We are running 15 service patrol trucks now and plan to increase our coverage to weekends in the future," said Rick Mitinger of FDOT's Traffic Operations Office in Fort Lauderdale.

Service patrols operate weekdays from 6:30 a.m. to 7:30 p.m. in Miami-Dade County and from 6 a.m. to 7 p.m. in Broward and Palm Beach counties.

Service patrols were first used on FDOT construction projects. A strong and positive response from motorists resulted in the department looking at service patrols as a permanent service.

In Broward and Palm Beach counties, FDOT is installing automated vehicle location (AVL) devices to track the service patrol trucks. Trucks in Miami-Dade have the AVL devices.

"With AVL we can know where the trucks are at any given time," said Mitinger.

"Service patrols are useful tools in freeway incident management," said Giovanni Cestari of FDOT's Miami office. "Having patrol trucks on the freeways helps us to clear an incident and reduce congestion delays by as much as 45 percent. That allows traffic to get back to a normal flow and lessens delays to motorists," he said.

The 3,500 motorists assisted each month by the service patrols in South Florida are the program's biggest fans. Having a service patrol driver stop and offer gasoline, water, booster cables, cellular phones and flat tire service at no cost has cast the agency in a hero's role.

"People stranded on the expressways are often in a dangerous situation. Our drivers come to the rescue and we get some strong testimonials. The main reason for having the service patrols may be to keep traffic moving, but people who get helped will tell you the service patrols make the highways safer as well," said Cestari.

What they carry

- Cell phones
- Fire extinguishers
- Air compressor
- Auto fluids
- Flashlight
- Booster cables
- First aid kits
- Drinking water
- Flashing arrow board
- Flares
- Broom and shovel
- Tire repair kit
- 2-ton jack
- 5 gallons sand
- Wood blocks
- Radiator water
- Public address system
- Reflective cones

South Florida gets electronic tolls

Florida DOT kicked off its much-awaited SunPass electronic toll collection system in April at six plazas in Broward and Palm Beach counties. In June, SunPass moved into Miami-Dade County at toll plazas on Gratigny Parkway (S.R. 924), Dolphin Expressway (S.R. 836), Airport Expressway (S.R. 112), Don Shula (S.R. 874) and the Florida's Turnpike Extension.

By the end of the year, all toll plazas on South Florida's expressways will be using SunPass, becoming part of 117 toll plazas statewide that will have SunPass by the end of 2000.

The system will enable motorists to save time and money while creating more efficient, less congested roadways. SunPass allows motorists to pass through toll plaza lanes without having to stop while tolls are electronically deducted from customers' prepaid accounts. A single dedicated lane processes up to 1,800 vehicles per hour — 300 percent more than a conventional toll lane.

Tampa toll roads, including the Veterans and Sunshine Skyway Bridge Expressways, are planned for conversion beginning in November and continuing throughout 2000. Orlando area toll roads are scheduled to be operational by the end of summer 2000.

Frequent users of SunPass will receive a 10 percent rebate after 40 or more transactions are made each month on Florida's Turnpike. Less than two trips per day on average are required to receive the discount. Similar discounts will be available on select toll roads throughout Florida.

"This is a $38.6 million project designed to benefit everyone by making toll road driving easier and more convenient," said Deborah Stemle, FDOT director of toll operations. "By the year 2000, SunPass will be operational on more than 450 toll lanes throughout Florida."

SunPass combines 90 dedicated and 365 mixed-use lanes. The 90 dedicated lanes are clearly marked for SunPass users only, allowing motorists to pass through toll plazas at speeds up to 25 miles per hour without being required to stop to pay a toll.

The new high-tech system is comprised of small, pocket-sized "transponders" which attach to the inside of car windshields, transmitting and receiving signals between each toll facility. As a motorist approaches a toll plaza, the SunPass transponder processes the toll transaction as the motorist continues through the SunPass toll lanes.

SunPass transponders cost $25 and require a minimum opening balance of $25. Transponders are warrantied against manufacturing problems or defects for 90 days after the date of purchase. To get into the fast lane and save time and money with SunPass call 1-888-TOLL-FLA or visit www.SunPass.com.

Signs of the Times — FDOT's Dynamic Message Signs (DMS) at the Golden Glades Interchange (GGI) in Miami-Dade County are operational, providing motorists with traffic updates on conditions in and around the interchange. Four major highways, Interstate 95, Florida's Turnpike, Palmetto Expressway and U.S. 441, converge at GGI. ITS Administrator Arvind Kumbhojkar said the GGI signs are one of the first elements of a comprehensive SunGuide Intelligent Transportation System (ITS) that will deliver traffic information to motorists in South Florida.

FDOT kicks off Radio Advisory Program

The Florida Department of Transportation (FDOT) and the Traveler Information Radio Network (TIRN) kick off a first-in-the-nation statewide radio advisory program for Florida's highway travelers this summer.

Radio station WTIR 1680 AM in Central Florida is scheduled to be the first TIRN network station to start operations. WTIR reaches listeners in Orange, Osceola, Seminole and Brevard counties, an area dominated by six theme parks, including Disney World.

"Our talk-radio format is designed to share with travelers all the great places to eat, sleep, and have fun in our great state. It will enhance the travel experience for millions of our residents and visitors while making their travel safer and easier," said TIRN's Joe Gettys.

Stations in Gainesville, Lake City, Daytona, St. Augustine and Jacksonville will follow.

Eventually, the TIRN format will be broadcast over a network of 18 commercial radio stations throughout Florida informing travelers about the state while at the same time alerting them to adverse traffic or weather conditions.

"Under the unique partnership between FDOT and TIRN, the department will administer the program while TIRN will pay for it entirely with private sector funds," said FDOT spokesman Dick Kane. The costs include more than $9 million for staffing, equipment and the placement of "Traveler Info" signs on the state's highways so motorists can tune to a TIRN affiliate as they travel through Florida.

During routine operations, FDOT will have one minute of each ten minute broadcast segment to air highway safety public service announcements.

The SunGuide newsletter is a publication of the Florida Department of Transportation. For more information about SunGuide call 305-470-5830.

TMCs

Continued from front page

information coming in from pavement sensors and cameras and will distribute that information to motorists in real-time. Law enforcement and emergency services will be at the table and will allow coordinated responses to freeway incidents and rush hour congestion," said Santana. "The TMC is another piece in the puzzle. We want to evolve to managing traffic rather than traffic managing us," he added.

Patterned after TMCs in Atlanta, Los Angeles and a number of other cities, the South Florida TMCs will feature video walls and computer stations connected by high-speed communications links.

"The key to success in ITS is accessing real-time information and delivering it to motorists via an assortment of methods. The TMC becomes our Mission Control for that process," said Santana.

SunGuide Glossary

The world of Intelligent Transportation Systems (ITS) is filled with acronyms and technical terms. We list a few definitions to help our readers expand their ITS vocabulary.

ATIS — Advanced Traveler Information System. A high-tech system that delivers real-time traffic information to motorists and travelers uses pavement sensors and cameras to inform motorists and travelers via dynamic message signs, internet websites,e-mail, pagers, onboard computers, traffic kiosks and conventional news media outlets. *ATIS will provide the smart information for the smart highways of the near future.*

ETC — Electronic Toll Collection. This term refers to a variety of methods used to collect tolls via car-mounted transponders that communicate with tollbooths, deducting tolls from established accounts. *Eliminates stopping at tollbooths and digging for coins.*

NAVIGATOR

Highway
Emergency
Response
Operator

Monthly Statistics

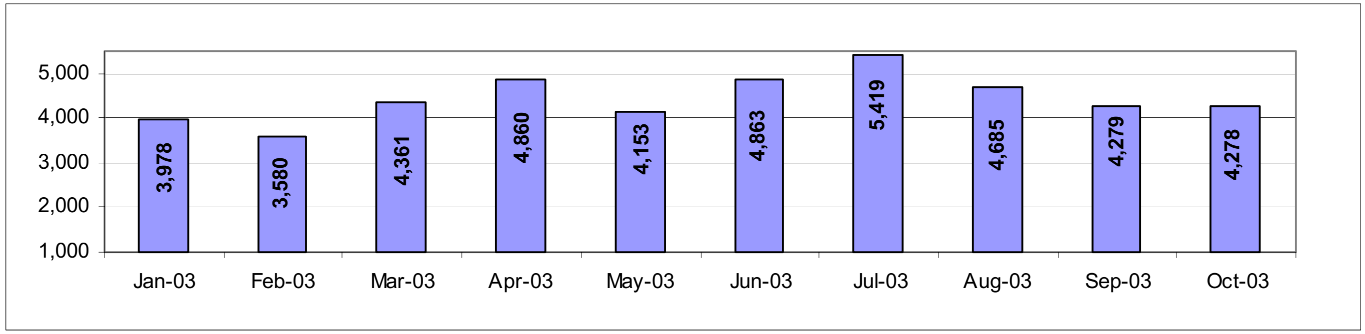
Carla W. Holmes, P.E.
State Traffic Operations Engineer

Gary Milsaps
Incident Response Manager

Transportation Management Center
Wayne Shackelford Building
935 E. Confederate Ave., Bldg. 24
Atlanta, Georgia 30316

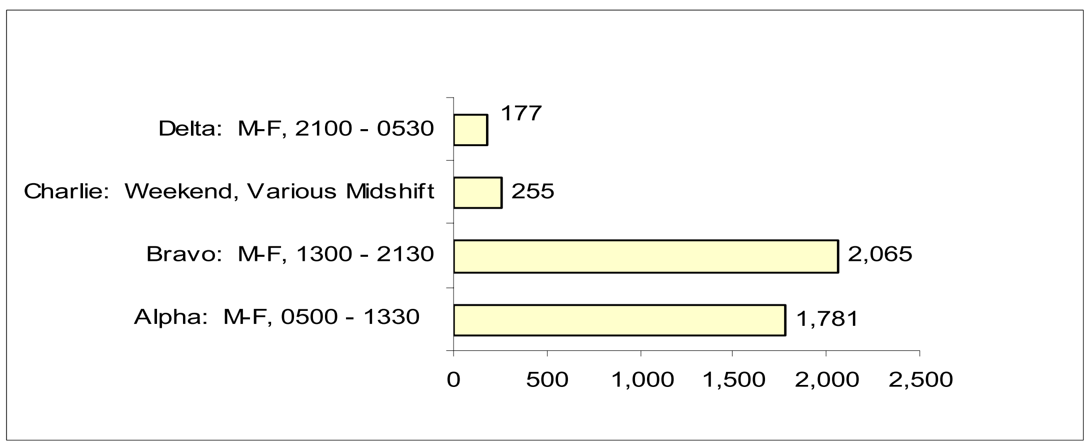
October 2003

Total HERO Assists By Month*



* Includes all incident categories: accidents, stalls, debris, property damage, abandoned vehicles & other

Total HERO Assists By Shift



URS

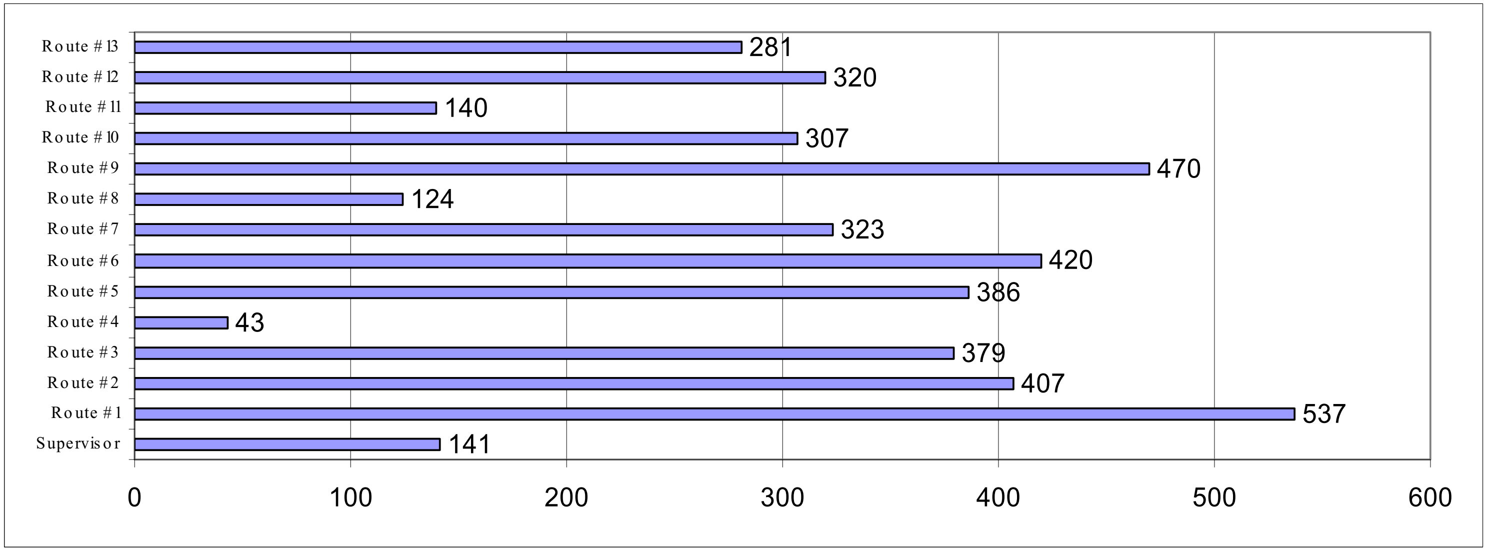
NAVIGATOR

Highway
Emergency
Response
Operator

Monthly Statistics

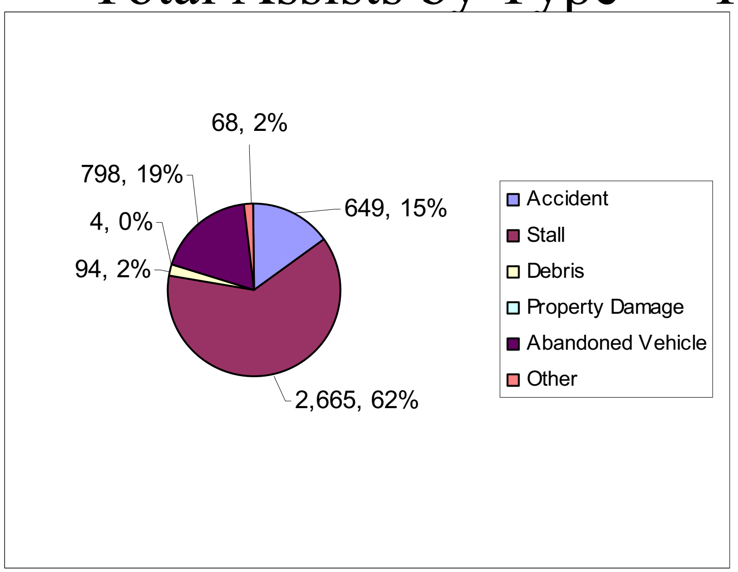
October 2003

Total Assists By Route Number*

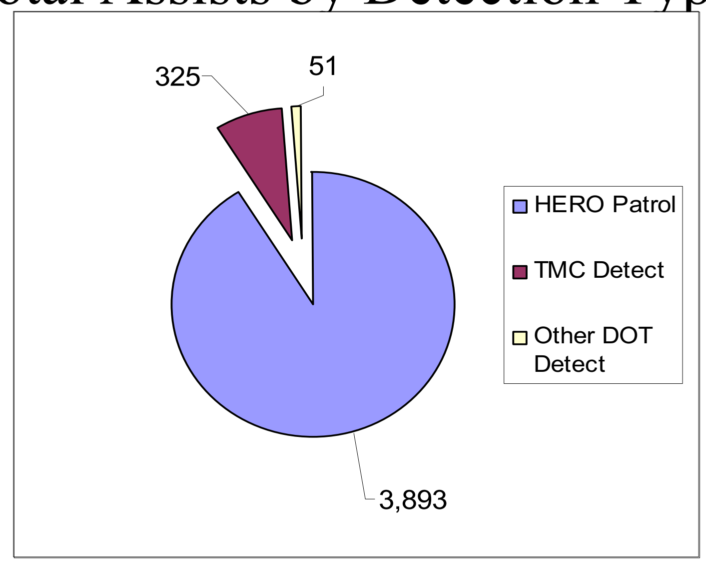


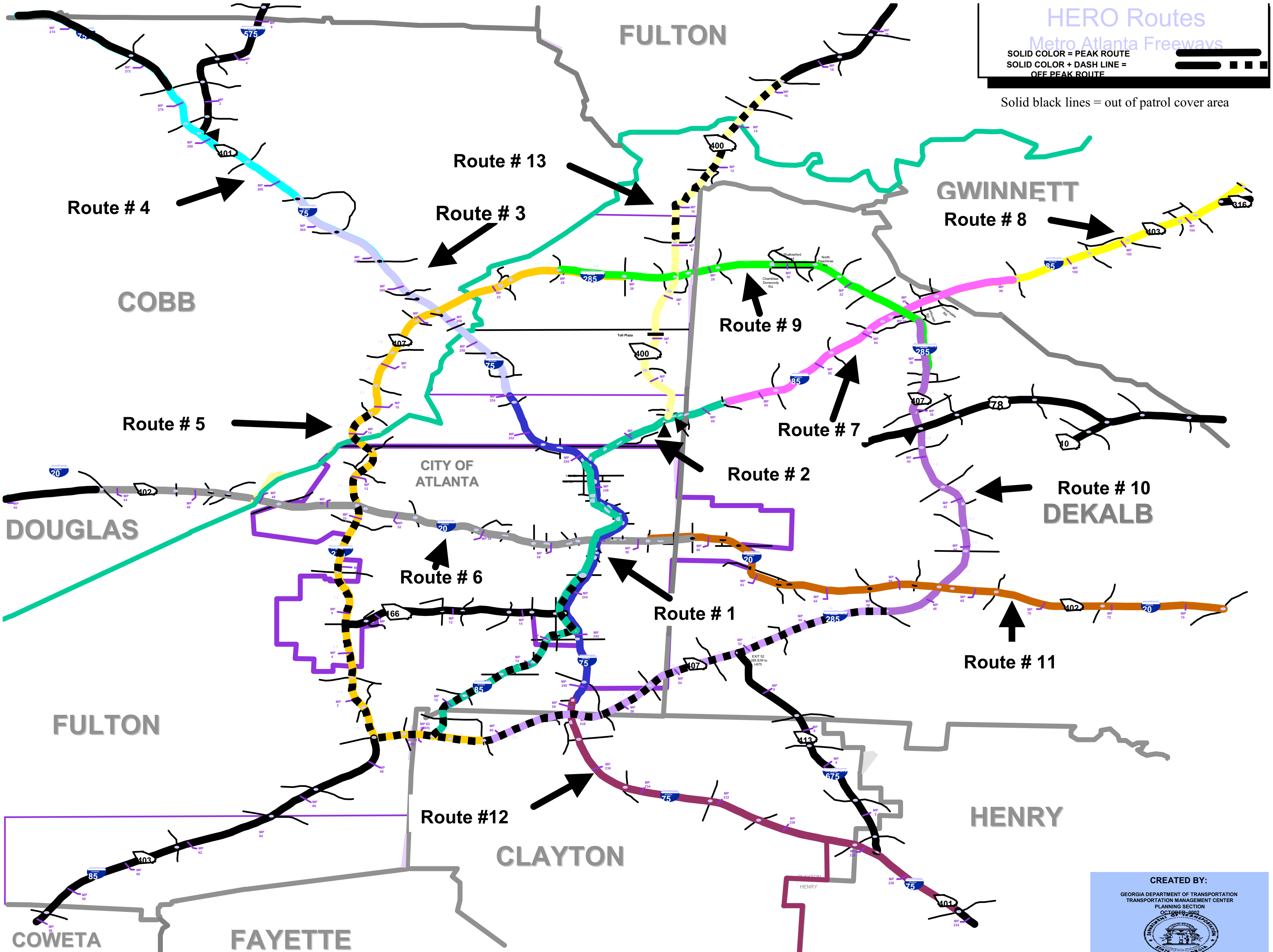
* See HERO route map on Page 3 for a location reference

Total Assists by Type



Total Assists by Detection Type




HERO Routes
Metro Atlanta Freeways
SOLID COLOR = PEAK ROUTE
SOLID COLOR + DASH LINE = OFF PEAK ROUTE
Solid black lines = out of patrol cover area
FULTON
GWINNETT
COBB
DOUGLAS
DEKALB
CITY OF ATLANTA
FULTON
CLAYTON
HENRY
COWETA
FAYETTE
Route # 1
Route # 2
Route # 3
Route # 4
Route # 5
Route # 6
Route # 7
Route # 8
Route # 9
Route # 10
Route # 11
Route #12
Route # 13
CREATED BY:
GEORGIA DEPARTMENT OF TRANSPORTATION
TRANSPORTATION MANAGEMENT CENTER
PLANNING SECTION
OCTOBER, 2002

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Highway
Emergency
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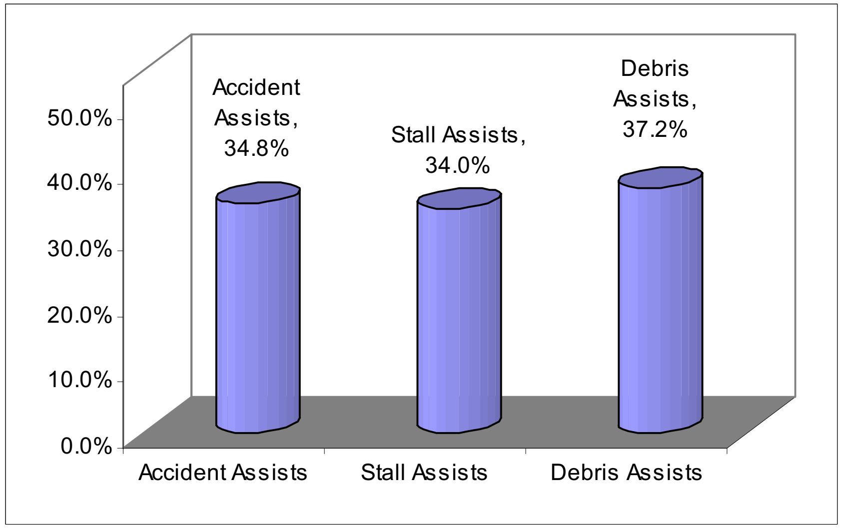
Monthly Statistics

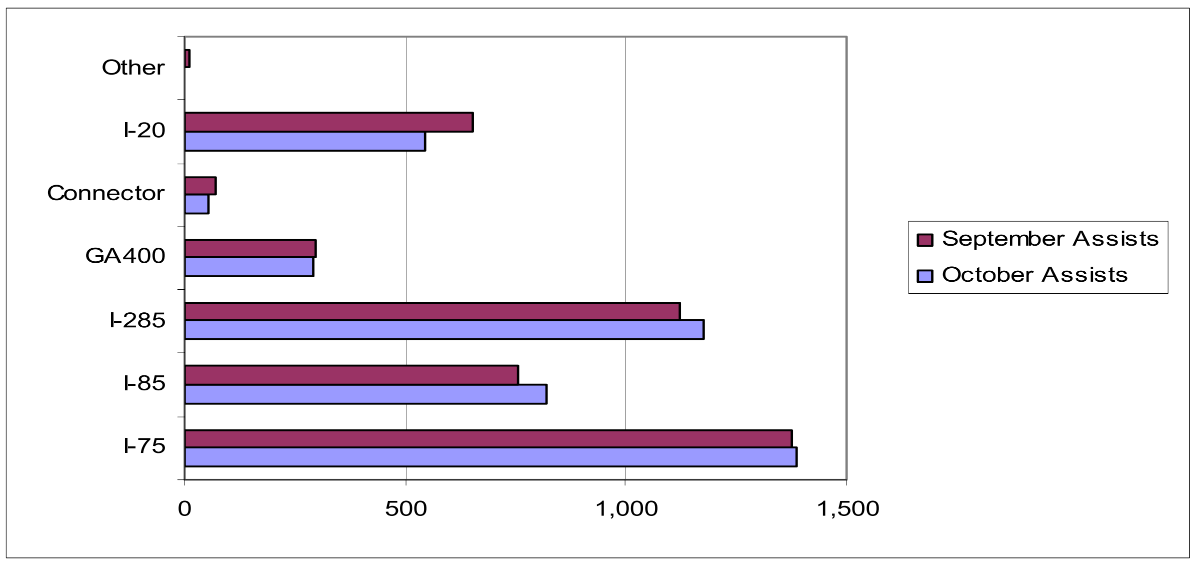
October 2003

Most Active Routes by Assist Types



Routes with most:					
Accident Assists		Stall Assists		Debris Assists	
Route #1	113	Route #1	345	Route #12	13
Route #2	92	Route #9	305	Route #9	11
Route #7	21	Route #3	256	Route #6	11
Total # of Assists	226		906		35
% Total of All Routes:	34.8%		34.0%		37.2%

HERO Assists by Roadway



NAVIGATOR

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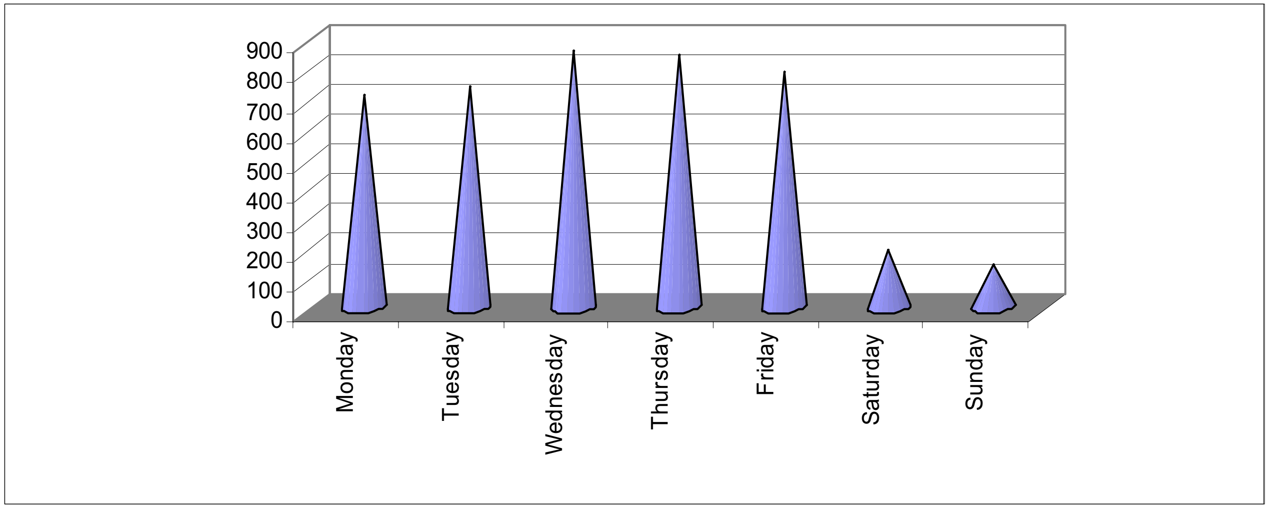
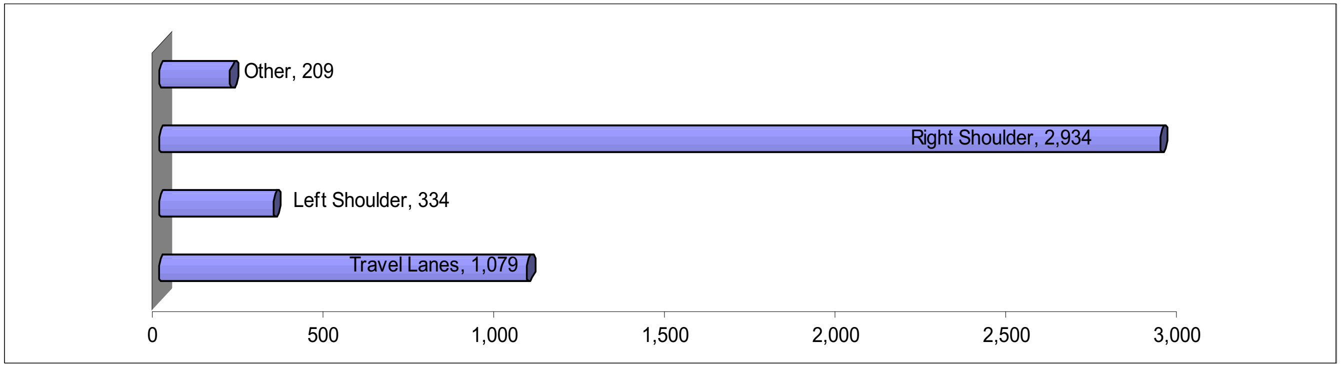
October 2003

HERO Assists Worked by Day of Week



Lanes Blocked During Assists

Number of times the following lanes have been blocked upon a HERO unit's arrival



* Other Includes: Auxiliary Lanes, Coll./Dist., Entrance Ramps, Exit Ramps and HOV

NAVIGATOR

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Monthly Statistics

October 2003

Data Key

Total HERO Assists By Month – This chart reflects the total number of assists that the HERO's have made stops for over the past months. Assists include: accidents, stalls, debris, property damages, abandoned vehicles and 'other'.

Total HERO Assists By Shift – This chart reflects the four scheduled HERO shifts (Alpha – Bravo), their hours of duty (note – Charlie shift works weekends and 2 shifts during the week), and their total assists they have been on the scene of over the past month.

Total Assists By Route Number – The HERO's are assigned routes one through thirteen and patrol only their route over the course of their shift (unless pulled 'off-route' by either a Supervisor or HERO Dispatcher). This chart reflects the total number of HERO assists that have been worked over the past month, by route number. Note – the next page reflects the coverage of each route on a map of the metro-Atlanta area.

Total Assists by Type – This chart breaks down by assist type the stops made by the HERO's. Assist types include: accidents, stalls, debris removal, property damage, abandoned vehicle, and other (i.e. construction support)

Total Assist by Detection Type – HERO's list on their log sheets after each incident how they came across the incident. They either ran across the incident while on patrol and stopped (referred to as HERO Patrol), they are notified via SouthernLinc radio of the incident and its location by HERO Dispatchers (referred to as TMC detect) or another agency / DOT department identifies the problem and requests HERO assistance (referred to as Other DOT Detect).

HERO Routes – This page will remain static each month. Its purpose is to visually show the routes that are associated with each route number (1 – 13). Solid color lines reflect a HERO route at its peak (during rush hours), a dashed black and color line show the same route during its off peak hours (after rush hour periods), and a solid black line reflects a segment of roadway not yet routinely patrolled by HERO's.

Most Active Routes by Assist Types – This chart and table show the 3 most active routes for each of the categories of: accidents, stalls, and debris assists. Frequently a majority of these three assist types will fall on three extremely active routes. This chart shows what the three most active routes are in each of these assist categories in comparison to the entire number of assists offered over all routes for that category. Month over month, you will notice that just under half of the total assists occur on the top 3 routes under each category.

HERO Assists by Roadway – This chart reflects the total number of HERO assists there have been on each of Atlanta's major roadways. 'Others' would include: SR166, I-575, I-675, etc.

HERO Assists Worked by Day of Week – This chart reflects the number of HERO assists there have been by the day of week. Along with the previously descried charts showing assists by time of day (shift) and route number, a good decision can be made as to when and where HERO's should be scheduled.

Lanes Blocked – This chart describes which lane segment was blocked when the HERO first arrives on the scene. While a vast majority of assists are come across on the right shoulder, many are also discovered on the left should, travel lanes and 'other' (other can be defined as the auxiliary lane, exit-ramp, on-ramp, HOV, and coll. dist.)

INCIDENT MANAGEMENT PROGRAM BACKGROUND

"Incident Management just makes sense. We, as professionals, are responsible for providing the public with an efficiently operated and safe transportation system. The impact of not doing so is significant – personal injuries, time loss, fuel consumption, delays in critical goods reaching their destination and other economic impacts". – Thomas Brahms, Executive Director, Institute of Transportation Engineers.

WHAT ARE INCIDENTS?

Incidents are any non-recurring events, which result in either a reduction in roadway capacity or an increase in traffic demand. Incidents include predictable events such as Chiefs games, Kansas Speedway events, parades, concerts, and unpredictable events such as accidents, stalled vehicles, bad weather, cargo spills and structural failures (such as a collapsed bridge or a washed-out or high water on road). Each of these incidents can result in considerable congestion, delay, wasted fuel and even secondary accidents.

Common types of incidents include:

? Stalled vehicle on shoulder with driver present.
? Stalled car blocking one lane of pavement.
? Abandoned vehicle blocking a lane.
? Pedestrians.
? Minor accidents.
? Motor vehicle crashes involving serious personal injury.
? Motor vehicles on fire.
? Major truck accidents.
? Accidents with hazardous materials.
? Accidents when a load of cargo is spilled.
? Fatal accidents.
? Overturned car or trucks.
? Downed power lines or high water across highways.

WHAT ARE THE IMPACTS OF INCIDENTS?

The primary considerations related to incidents include vehicle delay to motorists and the safety of motorists and emergency response crews. In summary, the vast majority of incidents are vehicle disablements and minor accidents. During off-peak periods when traffic volumes are low, these incidents have little or no impact on freeway traffic. But when traffic volumes are high, their cumulative effect is substantial. Police and tow trucks can clear these incidents rapidly and efficiently if all agencies give this work high priority. Incident congestion can be reduced considerably by assigning a high priority to the detection and clearance of minor incidents.

Traffic Congestion and Vehicle Delay

Although urban freeways make up less than 2.4% of the total urban highway mileage, they carry approximately 20% of the traffic nationwide. Congestion on this roadway system can occur under recurring conditions (i.e., due to capacity or operations problems) or can be caused by accidents or breakdowns known as non-recurring congestion. By some estimates, as much as 60% of all freeway congestion is considered non-recurring. Thus, a key strategy for reducing congestion in major urban areas is to handle accidents and incidents as quickly as possible to keep traffic flowing. Limiting the impact on traffic of non-recurring events such as crashes, traffic stops, fire or disabled vehicles through effective incident management should be the top priority of the Incident Management Program.

It is estimated that annual delay due to congestion is more than 2 billion hours at a cost exceeding $16 billion per year. The FHWA has estimated that nearly 60% of this delay is due to accidents. The Incident Management Manual is not a tool to eliminate congestion totally but rather to reduce the effects that incidents in traffic have on road capacity and travel conditions.

The impacts of time of day: To demonstrate the impact of the time of day on the amount of delay, consider a study conducted in California. This study found that every minute of delay during the off-peak period results in five minutes of congestion.

The impacts of lane closures: Closing even one lane has a significant impact on roadway capacity and vehicle delay. While lane closures are sometimes inevitable at the incident site, it is important to recognize the impacts of lane closure. A study by the Federal Highway Administration (FHWA) demonstrates the effect of lane closure on the capacity of a divided multi-lane roadway. Consider an incident on a freeway with three lanes in each direction and shoulders (similar of I-35, I-70 and I-435).

- An incident on the shoulder reduces the capacity of the roadway to 82% of its typical capacity even though no lanes are blocked.
- An incident blocking one lane of traffic reduces the capacity of the roadway to 87% of its typical capacity.
- An incident blocking two of the three lanes of traffic reduces the capacity of the highway to just 15% of typical capacity.

These findings indicate that closing lanes has a greater impact on traffic flow than might be expected. Closing one lane of a three-lane cross section does not merely reduce the capacity to 2/3 (or 66%) of its typical capacity, as might be expected, but rather it reduces the capacity to 87%. Similarly, an incident on the shoulder reduces capacity - - even though the travel path is not directly affected. The results of this study show the dramatic impact of lane blockage on capacity and vehicle delay, and demonstrate the importance of clearing the roadway as quickly as possible.

How major are the impacts of incidents related congestion? It is important not only to consider the factors that contribute to incident delay, but also to recognize the magnitude of incident delay. Many studies have been conducted to examine the relationship between the frequency of incidents, the resulting delays and the associated cost. United States Secretary of Transportation Fredrico Pena noted in his January 1996 speech to the Transportation Research Board nationally, “50 to 60 percent of rush hour congestion is caused by accidents, stalled cars or some other incident”. This has been confirmed by other studies. Furthermore, the proportion of delay caused by incidents is even greater here in Kansas City, where recurring delay caused by peak hour congestion is not as much of a problem as in bigger cities like Los Angles, but it is still very significant.

It is estimated that 70% of all highway incidents are recorded by police and highway agencies, usually as brief annotations in communication logs. The other 30% go unreported and, as such, are assumed to be minor incidents having little or no effect on traffic. Of the incidents that are recorded by police and highway departments, the vast majorities, some 80%, are vehicle disablement - - cars and trucks that have run out of gas, flat tires or have been abandoned by their driver. Of these, 80% wind up on the shoulder for an average of 15 to 30 minutes. During off-peak hours when traffic volumes are low these disabled vehicles have little or no impact on traffic flow. But when traffic volumes are high the presence of a stalled car or driver changing a flat tire on the shoulder can slow traffic in the adjacent travel lane, causing 100 – 200 vehicle-hours of delay to other motorist.

Metropolitan areas are growing rapidly and their congestion is creating sticky rides on the national highway system. Over 75% of the United States population now live in urban areas. Since 1970, most of the growth in population and jobs has been in metropolitan areas. More people are working. Almost 67% of the adult population are working and women make up almost half the nation's work forces. In the 1970's employment grew about twice as fast as population, the highest rate of expansion in any decade since the 1900's.

Today more people have cars. The majority of the households now have 2 or more cars. As a nation we have more vehicles than licensed driver. Most all people are commuting by car. Automobiles now account for over 80% of all work trips. The growth in travel has outpaced our investment in highways.

Demographic projects suggest that congestion will now be appreciable in the foreseeable future:

- Population growth is slowing but is still expected to grow by 30 million people over the next 20 years. This is the equivalent to 70% of the population growth experienced over the last 30 years.

- For the next 20 years the baby-boom generation will be middle aged providing a source of economic growth and travel demand.

Incidents cause more than 60% of the metro-area freeway congestion. The Federal Highway Administration reports incidents account for approximately 60% of all urban freeways delay in the United States. Mtigation of such delays through rapid and reliable incident detection is a vital traffic management object.

According to the Federal Highway Administration estimates for as far back as 1987, incident congestion cost the nation 1.3 billion vehicle hours of delay or a loss of nearly $10 million. In most metropolitan areas incident related delay accounts for between 50% and 55% of the total congestion delay. In small urban areas, it can amount for an even larger portion, according to traffic studies conducted by the American Trucking Association in cooperation with Cambridge Systematic Inc.

It is estimated that major incidents make up 5% - 15% of all accidents and cause 2,500 – 5,000 vehicle-hours of delay per incident. A very few of these major incidents, typically those involving hazardous materials, last 10-12 hours and cause 30,000-40,000 vehicle-hours of delay. These types of incidents are handled but their impacts can be catastrophic and trigger gridlock on the freeways.

The urban areas of the United State have experienced tremendous population growth over the past 10 years. With this growth has come rapidly worsening traffic, as both passenger vehicles and freight carriers stretch the capacity of our road system. The increased number of one – or two – occupant vehicles has overburdened our highway system to the point that peak periods of highway use ("rush hours") frequently extend 2 to 6 hours. Traffic slows to 30-35 MPH on roadways designed to move vehicles at 55 MPH or more. The result is more pollution, more frustrated commuters, and a higher cost of commuting due to increased fuel consumption. The additional fuel consumption annually in the 10 most congested urban areas; because of incidents range from 56 to 383 more gallons of fuel. This translates to an annual cost for each eligible driver of $140 to $291 per year.

Unlike recurring congestion, (congestion during the morning and evening rush hours) which occurs regularly at the same location and time of day, the location and time of congestion created by incidents is generally unpredictable. Once an incident occurs, the effectiveness of the response depends not only on coordination at the incident scene, but also on pre-planning and an appreciation for the activities and goals of other agencies at the scene.

The Institute of Transportation Engineer(s) (ITE) has estimated 10-45% decrease in travel time during congested times when using an incident management program.

For the purpose of this guide, incident management is defined as: An operational strategy for a transportation network that involves a coordinated and planned inter-jurisdictional, cross-functional, multi-disciplinary, and ongoing approach to restore traffic to normal conditions after an incident occurs, and to minimize the delay caused by resulting disruption to the traffic flow. Organized traffic incident management is the primary tool in mitigating the impact.

GOAL OF INCIDENT MANAGEMENT PROGRAM

The goal of this Incident Management Program is to facilitate efficient clearance of incident sites on major roadway facilities in the Kansas City metro area. This goal can be accomplished by pre-planning and by a commitment to communication, cooperation and coordination among all agencies at the incident scene. Attainment of this goal will result in faster and safer incident removal, and will enhance the safety and mobility of the Kansas City transportation system.

Incident management involves the systematic use of human and mechanical processes. The primary goals of the Kansas City Incident Management Program, in addition to saving lives and property, is to minimize the effects of such incidents on traffic congestion and reduce the possibility of secondary incidents. This can be accomplished by the following:

- Reducing the time spent for incident detection and verification.
- Reducing response time by the appropriate agency.
- Reducing the time spent to clear the incident from the roadway.
- Improve accessibility for emergency response vehicle.
- Providing accurate and timely information to the public in order to divert traffic from the incident.
- Provide incident impact information to motorists in a timely manner so that they can change their trip plans and avoid delays.
- Reduce the probability of secondary incidents.
- Improve travel time reliability.
- Maintain peak period capacity of strategic transportation corridors.
- Reduce motorist delay

No single agency can be effective and able to respond and clear a major traffic incident.

Often an incident is followed by a sudden, temporary decrease in road capacity, which results in traffic queues, reducing speeds and increased travel times, which potentially result in additional secondary accidents. The queue and the vehicle-hours of delay will continue to build until the incident is cleared and traffic flow is restored.

It has been estimated that 57% of the nations traffic congestion is due to crashes and other incidents, amounting to 24.5 billion vehicle-hours of delay in the year 1997 in the 68 areas studied by the Texas Transportation Institute for their 1999 Urban Nobility Report. Between 10% and 20% of all incidents are caused by pre-existing conditions. In 1995, 10,200 police cars, 1,800 fire vehicles, and 2,900 ambulances were, themselves, involved in motor vehicle crashes. With this type of impact on the health and well being of the nation and it citizens; a mandate exists in many areas to mitigate, to the extent possible, the impacts on American roads. In 1997, nearly 40% of all police who died in the line of duty died in traffic incidents. In the year 1998, there were 143 fatalities in the United States involving emergency vehicles, 77 of which occurred when the vehicle was responding to an emergency.

As urban and suburban development continues to increase, the resulting travel demand will place an increased strain on an already congested freeway.

An incident that causes delay on a freeway can be as simple as a disabled vehicle in the traffic lane or on the shoulder. It can be a lost piece of lumber from a truck that causes motorists to change lanes suddenly. Such minor incidents, if detected promptly, can be cleared rapidly with little residual effect on peak use traffic. Incidents are particularly disruptive when a roadway is operating to near capacity. The focus on improving traffic has changed from increasing the size of the freeway to improving its efficiency.

The Federal Highway Administration (FHWA) has translated the average 20-minute blocking into a monetary figure to show how freeway incidents directly affect the national economy. If one lane of a three-lane freeway is blocked for 20 minutes – assuming the freeway is running at capacity – the delay caused to motorist will exceed 1,210 vehicle-hours. At the FHWA assigned value of $4.00 per hour for each vehicle hour of delay, the cost of the incident due to delay is approximately $5,000. A delivery truck, delayed because of a stalled vehicle or flat tire up ahead can cost an employer an estimated $60 per hour. Multiply this by millions of times per year and the staggering cost of roadway incidents becomes clear.

FACTS AND FIGURES ON INCIDENT MANAGEMENT

Listed below are some facts and figures on incident management programs from other locations in the United States; they show bss in vehicle hours of delay, economic and other interesting issues pertaining to incident management:

ATLANTA, GA (GDOT Navigation System):

- Average time to verify incidents was reduced from 4.2 minutes to 1.1 minutes during the first 3 weeks of operation.
- Average time to generate an automated incident response after incident verification reduced from 40.5 minutes to 4.7 minutes during first 3 weeks of operation.
- Mean time between incident verification and clearance of travel lanes reduced from 6.25 hours to 1.5 hours during first 3 weeks of operation.

BROOKLYN, NY (Gowanus Expressway/Prospect Expressway Rehabilitation) (Incident Detection System):

- BEFORE – average time to clear any type of incident – 90 minutes.
- AFTER – average time to clear any time of incident – 31 minutes (68% decrease).

CONNECTICUT:

- A 1990 report indicated that an incident management system involving 80 miles of roadways in the Fairfield region would produce an annual savings of 2.38 billion vehicle hours of delay and reduce fuel consumption by 1.43 million gallons in fuel savings.

CALIFORNIA DOT (Caltrans):

- Each minute of blockage results in 5 minutes congestion.

HOUSTON, TX (TransStar System):

- Annual delay savings of 572,095 vehicle-hours with an economic value of $8.4 million.

MINNESOTA (Minnesota Highway Helper Program):

- Duration of stalled vehicles reduced by 8 minutes.
- Annual delay savings due to reduced delay assessed $1.4 billion per year (Program costs $600,000 per year to operate).
- 13% of all peak period incidents were a direct result of a previous incident.

PHILADELPHIA'S TRAFFIC & INCIDENT MANAGEMENT SYSTEM (TIM):

- Decreased freeway incidents by 409%.
- Reduced freeway closure time by 55%.

SAN ANTONIO, TX (TransGuide Traffic Management Program):

- Total accidents reduced by 30%
- Total accidents reduced by 40% during inclement weather.
- Overall accident rates reduced 41%.
- Significant improvements in drivers confidence.

- Average response time reduced by 20%.
- Average delay savings per incident – 700 vehicle hours.
- Average reduction in fuel consumption per incident – 2,600 gallons.
- Benefit translates to annual savings of $1.65 million.

SAN FRANCISCO, CA (CA Freeway Service Patrol):

- Assisted more than 90,000 drivers as of January, 1997.
- Hydrocarbon emissions reduced by 32 kg/day.
- Carbon Monoxide (CO) emissions reduced by 322 kg/day.
- Nitrous Oxides (Nox) emissions reduced by 798 kg/day.

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION:

- Over a 7-year period, 2,165 shoulder collisions had occurred on the freeway system. These collisions caused 40 deaths and 1,774 injuries. Injury rates for shoulder collisions were substantially higher than the rates for all other accident categories. It showed that 40% of all other shoulder collisions involved injuries.
- 80% of incidents were reported by cell phone calls from motorist, - - police, DOT's, Motor Assist, detected an additional 18%. The Traffic Operations Center staff detected a scant 2%. Multiple cell phone calls for the same incident were normal, with operators reporting up to 80 multiple calls per major incident. The multiple calls do, however, serve a purpose since dispatchers need to speak to several callers to accurately report the location, direction of travel, and other aspects of the incidents.

These statistics highlight the need for effective incident management, which is a pre-planned and coordinated program to detect and remove incidents and restore freeway traffic as soon as possible.

But the greatest benefits of an effective incident management program are achieved through the reduction of the incident duration. Reducing the duration of an incident is fostered by:

- Reducing the time to detect incident. Enhanced technologies for incident detection on freeways have reduced response times and brought opportunities for reducing the duration and intensity of the impact on traffic. The potential for disruption of traffic can be measured by times and delays from the time the incident occurs until it is cleared.

- Initiation of an expedient and appropriate response. The speed and effectiveness of clearance activities may depend on the appropriateness of resources dispatched; were the right equipment and personnel dispatched in a timely manner or were extraneous resources sent to further congest the scene and perhaps delay response to other incidents. Creating and maintaining effective, trust-based working relationships among a multitude of individuals and organizations involved in traffic management change will be challenging. The typical objective of multi-agency incident management includes emphasis on the importance of incident response from each agency. Key to high success is a higher level of inter-agency coordination, particularly among state and local law enforcement agencies, fire department, tow trucks, city, state and local DOT's and public works departments as well as HazMat clean up companies.

- Although the priorities of emergency response must focus on protection of life and property, failure to maintain safe and efficient traffic operations not only can increase delay costs associated with incidents, but also can generate additional incidents, multiplying the individual and social costs of such events.

Once the incident is cleared, traffic will flood through the incident site until the queue is dissipated, but the getaway flow is limited by the maximum capacity of the highway. On a congested urban highway, an incident can dam up a high reservoir of vehicles and it may take an hour or more to dissipate the accumulated traffic. Traveling in or around urban areas during a peak-use period is irritating at best, but it can be down right miserable when an incident further impedes the traffic flow.

As far back as the 1950's the disruptive potential of incidents on freeways was recognized and steps were taken to detect incidents and provide information to motorists. In the top ten most congested urban areas in 1998, the amount of incident-related congestion delay ranged from 218,000 to 1,295,000- person hours. Freeway congestion due to the occurrence of incidents is a major cause of traffic delays in the United States and around the world. Traffic congestion continues to increase in the United States, particularly in metropolitan areas. It is no longer feasible to build new roads or to increase the capacity of existing roads in an attempt to significantly improve the situation. This congestion was once a downtown issue; congestion is now a metropolitan concern. Congestion is a symptom of travel boom that has occurred in cities and metropolitan areas and reflects underlying structural change in population, employment and automobile use. Congestion is no longer limited to highways near downtown; it has spread over the roads that were once the bypass routes for the congested routes. It is no longer a short peak-period, it has become a problem spreading over 4, 6 or even 8 hours per day. Metropolitan congestion is creating sticky rides on the nations highway system, and is impeding the flow of regional and interstate freight as well as local freight. Congestion is a symptom of travel boom that has occurred in cities and metropolitan areas and reflects underlying structural change in population, employment, and automobile use.

Incident Management systems include an array of strategies to improve incident detection/verification, response time and motorist information. Accidents themselves account for only 10% of reported incidents. In 10% to 60% of all accidents, drivers are able to move their vehicles to the shoulder. Each such incident costs an average of 45-60 minutes. In congested traffic they can trigger 500-1,000 vehicle-hours of delay per incident. The congestion impact of these minor incidents is substantial because the presence of a police car, tow truck, ambulance or fire truck will cause passing motorists to slow down and gawk, even if the vehicles involved in the incident are well off the highway. Emergency maintenance work, debris on the road, wandering pedestrians, stray animals and other events account for the remaining incidents.

Updated information on impacts of freeway incidents on roadway capacity as reported in the 1996 Traffic Control Systems Handbook shows the freeway is actually reduced by an amount far greater than the physical reduction in roadway space caused by the incident.

The primary considerations related to incidents include vehicle delay to motorists and the safety of motorists and emergency response crews. In summary, the vast majority of incidents are vehicle disablements and minor accidents. During off-peak periods when traffic volumes are low, these incidents have little or no impact on freeway traffic. But when traffic volumes are high, their cumulative effect is substantial. Police and tow trucks can clear these incidents rapidly and efficiently if all agencies give this work high priority. Incident congestion can be reduced considerably by assigning a high priority to the detection and clearance of minor incidents.

The severity of the impact of an incident varies, depending on the nature of the incident, where it takes place, and when it occurs. A major incident may result in total blockage of a freeway, while a minor incident, such as a flat tire, may be merely a momentary distraction. An incident can have widespread effects. An incident may impact both directions of travel, even on a divided facility such as a freeway, because motorists often slow down to look at an accident in the opposite direction. An incident may also affect other facilities, as congestion spills over onto adjacent arterial streets.

Safety

Incidents not only result in delay, they also compromise the safety of both emergency responders and motorists. In addition to hazards at the incident scene, emergency responders traveling to other emergencies or EMS vehicles transporting sick or injured to medical facilities are also at risk of incidents. A successful incident management program addresses these issues.

Alerting motorists of incident conditions can enhance the safety of emergency responders. Providing motorists with current, accurate information accomplishes a number of things: it reduces driver frustration, warns drivers to exercise greater caution when driving by the incident scene, and encourages motorists to divert to alternate routes. Motorist's information can be provided using commercial traffic reports, the Missouri Department of Transportation's highway advisory radio and variable message signs.

Reducing the time required to clear the incident also enhances the safety of emergency responders. **Cooperation, coordination and pre-planning** can speed incident removal and increase safety by limiting the amount of time that personnel are exposed to the traffic and other dangers at the site.

Faster incident response and removal also enhances safety for motorists. The secondary accident rate (the likelihood of a second accident when the roadway is congested following the initial incident) is much higher than typical accident rates. Some studies have found secondary accident rates to be as high as six times normal accident rates. **Quickly clearing an incident not only saves time, but it also increases safety by reducing motorists' exposure to secondary accidents.**

INCIDENT RESPONSE

One of the main issues that had to be resolved in an incident management program was the line of responsibility for managing an incident. **Since one agency cannot take the lead and direct other**

agencies, it was decided that all parties would have to work together. With this in mind, the Kansas City Incident Management Plan has worked toward these goals:

- to develop better coordination among organizations.
- to be come familiar with each organization's resources and personnel.
- over a period to develop standard operating procedures that would ensure that the groups work together to make suggestions for additional training that would augment the current incident management capabilities.
- create and maintain effective, trust-based relationships among a multitude of individuals and organizations involved in incident management.

The time required to respond to an incident is measured from the moment of detection until assistance arrived at the site. This time can vary significantly depending on such factors as:

- the nature of the incident relative to the resource necessary for clearance (location, type and severity).
- The location and availability of the assistance resources.
- The traffic conditions encountered enroute to the incidents.
- The handling of traffic relative to available capacity ramp control, detours, motorist information.

The time taken to restore the road to full capacity is the clearance time. This time starts when the response unit reaches the incident and ends on departure. Activities that occur during the clearance time include:

- First aid and removal of injured.
- Accident investigation.
- Fire control.
- Vehicle removal and debris clean up.
- Placement and removal of traffic control.

Once an incident has been detected, response depends on recognizing the factors that affect response and removal of the incident and knowing the steps and resources that are needed to return the facility to normal conditions. These steps may include requesting assistance or services from other agencies, requesting special equipment and/or personnel, and implementing traffic control plans.

The accurate identification of equipment and personnel needed at an incident site significantly decreases the time required to clear the incident. Proper identification of needs at an incident site is more of a function of training and knowledge of the available resources than a function of technology. One goal of the Incident Management Program is to provide a reference for available resources and to lay a foundation for the knowledge and training required.

Because incidents can be cleared using many different techniques and pieces of equipment, persons whom initially respond to (or investigate) an incident must have adequate training to select the most appropriate response. They must be able to judge the magnitude and scope of the problem and know the resources that are available for responding to that type of incident, at that time, at that location.

Although this manual and this program are an important part of an incident management system, successful incident management is not limited to a single action or program. Instead, successful incident management is a combination of actions that allow the responding agencies to tailor the response to the conditions and the resources available. The most successful management systems provide a range of response actions that offer both quick response and strong clearance capabilities.

The notification of an incident on a freeway is often generated by numerous phone calls, typically mobile cellular telephones calls. The dispatchers will then contact the appropriate emergency response facilities (e.g., police, fire, EMS, etc.). If emergency response vehicles are not present at the facility the dispatcher will directly contact the vehicle.

Effective incident response begins as soon as an incident has occurred. Decreasing the time required detecting the incident and notifying the first responder is the first step. Decreasing the time required for personnel and equipment to reach the site is the second step. Decreasing the detection and response time decreases the total time required to clear an incident, which in turn decreases both the personnel cost associated with incident management, as well as the cost to motorists due to incident related delay. Incidents critically hurt the operational efficiency of the transportation network and put all users of the network at risk. The severity of secondary crashes is also often greater than the original incident.

INDIVIDUAL ROLES IN INCIDENT MANAGEMENT

The object of any search and rescue response always has been to locate victims, reduce pain and suffering, and prevent recurrence to the greatest extent possible. This must be accomplished efficiently, effectively, and economically. Efficiently is doing things right - - using well-trained resources.

Effectiveness is doing the right things right - - combining well-trained rescues with good strategy and tactics. But, what pulls all this together and makes it run smoothly and therefore economically is good management. Management through a well-planned stature and organization.

Incident responders must be prepared for a variety of emergency situations. Because there are a lot of activities at the incident scene, it is very important that all participants have an understanding and appreciation for responsibilities and priorities of other agencies at the scene. For example, many responders already have fundamental emergency medical skills such as basic First Aid and CPR; similarly, many responders have learned the importance of moving disabled vehicles. It is also valuable if the majority of responders are knowledgeable in rudimentary traffic control strategies, because traffic control is a major responsibility.

In order to provide an appreciation for the activities and responsibilities of other agencies at the incident scene, the following explanation of agency priorities and activities is provided.

?? **THE TOP PRIORITY OF HIGHWAY AGENCIES IS TO CLEAR THE INCIDENT AND OPEN THE HIGHWAY TO NORMAL TRAFFIC FLOW AS SOON AS POSSIBLE.**

Highway agencies tend to stress restoring the facility to maximum capacity as quickly as possible while ensuring the safety of personnel. Restoring traffic flow and cleaning up the incident site is their responsibility and other agencies need to recognize the importance of this job. To accomplish this quickly and safely, cooperation between all agencies at the incident site is needed.

LAW ENFORCMENT: Law enforcement services often are provided by a number of organizations, including Highway Patrol, County Sheriff, and local police. Typical incident management roles and responsibilities assumed by law enforcement include:

- As peace officers, they bring the ability to control the scene activities and to arrest and remove violators who hamper emergency operations.
- Assist in incident detection.
- Secure incident scene, bystander and crowd control, perimeter establishments and enforcement.
- Accident investigation, and crime scene management.
- Provide emergency medical aid until EMS arrives.

- Traffic control – In order for traffic to move smoothly and safely past the incident; traffic control needs to be established at the scene. If lanes or roadway will be closed, traffic needs to be channelized to merge into lanes or shoulder that will remain open.
- Conduct accident investigation.
- Safeguard personal property.
- Clearance of scene.
- Meet with media.

FIRE AND RESCUE: Fire & rescue services are provided by local fire department, and by surrounding fire departments through mutual aid agreements. Incident management roles and responsibilities typically assigned by fire departments are:

- Protect incident scene.
- Provide traffic control until police or DOT arrives.
- Provide emergency medical care until EMS arrives.
- Provide HazMat response and containment.
- Fire suppression.
- Crash victim rescue from wrecked vehicle.
- Assist in incident clearance.

EMERGENCY MEDICAL SERVICE: EMS primary responsibilities are:

- Triage
- Provide advanced emergency medical care.
- Determine destination and transportation.
- Coordinate evacuation with fire, police, ambulance or airlift.
- EMS personnel are almost never utilized for other than medical activities.

MOTORIST ASSIST: Motorist assist patrols assist in the following ways:

- Accident clearance.
- Determine roadway repair needs.
- Assist disabled motorists.
- Coordinate response efforts with other agencies.
- They may also provide traffic control.

DEPARTMENT OF TRANSPORTATION (DOT's): They are typically responsible for:

- Assisting in incident detection and verification.
- Protect accident scene.
- Provide traffic Control.
- Determine incident clearance and roadway repairs needed.
- Implement (when necessary) detour routes.

TOWING SERVICE: Professional tow services are often the experts:

- On how to unstack wrecked or overturned vehicles.
- They also provide recovery services for large truck accidents.

MEDIA: The broadcast media typically:

- Report traffic accidents.
- Broadcast delays in traffic.
- Provide alternate route information.
- If the incident is particularly severe, update incident status frequently.
- The appropriate authority handles news-making events, warnings, rumor control items and alerts.

When agencies with a wide range of priorities are all present at one location and trying to conduct activities to meet their responsibilities, it may lead to tension and conflict unless all participating groups understand and appreciate the needs of the other agencies. It is very important that people responding to an incident understand the needs of other agencies and those actions are coordinated to meet as many goals as possible.

Safety of personnel at an incident site is the foremost responsibility of each responding agency.

HAVING PROVIDED FOR THE SAFETY OF THE VICTIMS AND RESPONDENTS, IT IS IMPORTANT TO CLEAR THE ROADWAY AND RESTORE TRAFFIC TO NORMAL AS QUICKLY AS POSSIBLE.

No consistent standard has been identified that can be uniformly applied to evaluate the quantifiable benefits of an effective incident management program.

In any case quantifiable benefits generally associated with an effective incident management program include:

- Increased survival rate of crash victims.
- Reduced delays.
- Improved response time.
- Improved air quality.
- Reduced occurrence of secondary accidents.
- Improve safety of responders, crash victims and other motorists.

Just as with quantifiable benefits, no consistent standard has been identified that can be uniformly applied to evaluate qualitative benefits of an effective incident management program. Qualitative benefits generally associated with an effective incident management program include:

- Improved public perception of agency operations.
- Reduced driver frustration.
- Improved quality of life.
- Improved coordination and cooperation of response agencies.

Metroplan Incident Management Study

Study Purpose

The purpose of this study was to investigate and evaluate current practice in response to vehicular incidents within the Central Arkansas Regional Transportation Study (CARTS) area on interstate freeways as well as the priority corridors of the Regional Arterial Network [(1)]. The study also examined ways to enhance interagency cooperation and coordination, with respect to vehicular incidents. Work involved the examination of relevant accident and traffic data for incidents over a three-year period, review of related operations and management issues, and review of existing or planned institutional agreements for procedures dealing with incidents. The study concludes with a recommended incident management program suitable for the CARTS area.

1.0 OVERVIEW OF INCIDENT MANAGEMENT

Incident Management is the process of managing multiple agencies and jurisdictions that coordinate responses to non-recurring disruptions in traffic, including vehicle accidents, construction zone activities, weather related incidents, and major events. Efficient and well-coordinated incident management practices can reduce vehicle accidents, improve public safety, reduce congestion and driver frustration, and generally improve the operations of an existing transportation system. Additional benefits include reduced vehicle emissions, improved coordination among public works and public safety agencies, as well as better public understanding and support for transportation services and providers.

The basic features of an incident management program include consideration of the following elements:

1. **Incident Management Planning** — Quick response and implementation of traffic control strategies requires advance planning of detour routes, control strategies, alternative signal timing plans and other pre-planned measures. This is in addition to the normal advance planning and training measures that each component in the Incident Management Team must employ to execute their responsibilities.
2. **Incident Detection** — receipt of information by monitoring and response mechanisms at an incident management agency to suggest that an incident has occurred. Many forms of detection can be used, including: roaming service patrols, personal cell phone call-ins, closed circuit television reviewed by operators or detection software, and aerial surveillance by agency and traffic reporting services. Less labor-intensive detection measures include automated remote traffic speed and density detection coupled with abnormality detection software.
3. **Incident Verification** — confirmation and refinement of information on location and nature of incident sufficient to form and execute a first response plan. With the more advanced detection measures, verification and detection are accomplished almost simultaneously. If automated detection measures are used, then some type of visual confirmation, of the types listed above, is needed to be able to mobilize the correct incident response crews. Citizen call-ins may require verification from a second source before full

response deployment. In simpler systems, a highway patrol or police unit is diverted to access the scene and initiate response.

4. **Incident Response** — activation of initial emergency response to the scene and dispatch of ensuing support response. Communication links and chain of command are established in response to the type of incident and the agencies involved. Information is generated for conveyance to motorists and the media.

5. **Motorist Information** — getting information to motorists regarding the location and impact of the incident, as well as possible alternative routes as soon as possible with follow-up as conditions change. Dissemination means include commercial radio and television special bulletins, highway advisory radio (HAR) stations, dynamic message signs (DMS), internet or on-line services such as a traffic web page or personal data assistant, and route guidance services such as Navistar or the new 511 Traveler Information Systems.

6. **Incident Site Management** — control and security of the incident scene, effectively coordinating and managing on-scene resources. The safety of response personnel as well as the incident victims and/or workers and the control of debris and effluent are the predominant concerns. Very often, the quality of traffic flow is the least of the concerns of response personnel as priorities are established on the scene. Most areas that are served by a 911 system have established a hierarchy of incident site control and some standard procedures for interagency communications. The effectiveness of the interagency communications and the incident handling on site can have a significant impact on the duration of traffic impacts.

7. **Traffic Management** — measures for emergency access and general traffic control. These efforts include: closing lanes needed for safety and staging of response vehicles, local or remote special operations of traffic control signals and other devices, and designating and operating alternative routes. Much of the effectiveness of traffic control is pre-destined in the advance planning stages, as described above.

8. **Incident Clearance** — removal of the incident and residue out of the flow of traffic to bring the return to workable traffic flows and eventually normal traffic conditions. At times, this may include temporary or permanent repair to roadway infrastructure.

Reduction in the time to accomplish most of these elements can contribute to ability to save lives and can contribute to reduction in delay time and frustration for many of the thousands of vehicles that experience delay due to accidents each year. The nature of traffic incidents in the region and how agencies currently respond to such incidents will govern the magnitude of improvements that are possible.

1.1 Definition of Traffic Incident

Vehicle accidents (more accurately called vehicle crashes) are the most commonly envisioned traffic incident causing major traffic delay. However, there are many other types of traffic incidents , generally defined as unexpected happenings or objects on or near the roadway that impact motorists travel. Roadway construction and maintenance activities can contribute to incidents, especially when lanes are constrained or reduced. Special events, which generate unusually large amounts of vehicle and/or pedestrian traffic, can also lead to roadway incidents due to temporary over-capacity of the roadway system. For its potential to delay traffic, a vehicle stopped on the side of the road also can contribute to traffic incidents. In addition, adverse weather conditions lead to incidents, which may or may not always involve vehicle crashes. Road debris, especially when in the travel lanes, also can impact traffic flow and may cause additional incidents. Nationwide it is estimated that traffic incidents account for over 50% of travel delay on the highway system. This percentage is expected to rise to 70% by the year 2005. [(2)] [(3)] A well-planned incident management program can address the wide variety of incidents that are contributing to rapid increases in traffic congestion. These actions can, in turn, increase the safety of the traveling public.

1.2 Travel Delay Due to Congestion

As part of its Congestion Management System, Metroplan has developed a methodology of categorizing levels of congestion on major arterials and highways using the delay rate (minutes per mile). The delay rate is defined as: the difference in time to travel the length at the posted speed limit without stopping and the actual travel time, divided by the length of the roadway segment. The delay rate is based on time, not volume, thus the factors which effect capacity are included in the delay rate. Thus, because these adjustments are included, the delay rates of two facilities, regardless of geometric design or functional classification, can be compared. A facility can also be compared with itself as a measure of effectiveness of congestion mitigation strategies. Metroplan has determined that the delay rate will be the quantitative value on which CARTS roadway congestion will be measured.

For roadway facilities in the CARTS area, a roadway shall be considered to be congested if the delay rate is equal to or greater than 0.41 minutes per mile (min/mi). This delay threshold is derived from the difference in travel times for 55 mph and 40 mph, which is the congestion threshold for an urban freeway. The 40 mph travel speed has been determined to be this threshold for three reasons. First, it is the boundary between levels-of-service E and F (with F being associated with a congested facility) for 2-lane roads in rolling terrain, which comprises the majority of lane miles of pavement within the CARTS area; second, it is the boundary between levels-of-service E and F for ramp-freeway junctions, the primary location of congestion on freeways; third, it is the speed at which many motorists perceive congestion, as it is the speed at which a 5-speed transmission must be downshifted from fifth to fourth gear. Table 1 lists the congested delay rates and equivalent average operating speeds for posted (ideal) speeds.

Table 1. Delay Rate and Average Speed Thresholds for Congestion

"Ideal" Speed (mph)	"Ideal" travel time (min/mi)	"Congested" travel time (min/mi)	"Congested" speed (mph)
(A)	(B=60/A)	(C=B+0.41)	(D=60/C)
70	0.86	1.27	47
65	0.92	1.33	45
60	1.00	1.41	43
55	1.09	1.50	40
50	1.20	1.61	37
45	1.33	1.74	34
40	1.50	1.91	31
35	1.71	2.12	28
30	2.00	2.41	25

Source: Adapted from Congestion Management Study, Metroplan, 1996.

It is important to note that facilities that have a high volume to capacity ratio may not necessarily surpass the congestion threshold, and vice versa. Low volume facilities may be congested due to excessive turning movements, a proliferation of access points, excessive signal cycle lengths, poor signal coordination, and/or poor signal phasing. The field speed observations are not valid if there is an incident causing congestion during observations, so the congestion levels recorded represent the degradation of traffic flow primarily due to traffic volumes and lane changing activity. The levels of congestion are defined approximately as follows:

- None — operating speed at or in excess of posted speed limit
- Acceptable — delay rates between 0 and 0.24 minutes per mile
- Borderline — delay rate between 0.24 and 0.41minutes per mile
- Mild — delay rate between 0.41 and 0.62 minutes per mile
- Moderate - delay rate between 0.62 and 0.91minutes per mile
- Serious - delay rate between 0.91 and 1.91 minutes per mile
- Severe - delay rate between 1.91 and 4.91 minutes per mile
- Extreme — delay rate over 4.91 minutes per mile

The 2000 congestion levels for the CARTS area are incorporated as a background layer in Figure 2 that displays the high accident frequency locations in the study area. The normal congestion levels were compared to high accident frequency locations to examine the relationship between congestion and accident levels. Obviously, segments of roadway with serious to extreme delay when no incidents are present could produce significant vehicular delay when an incident occurs. These roadway segments should receive priority for implementation of incident management treatments.

1.3 Traffic Incident Impact on Travel Delay

As the volume of traffic on a roadway segment approaches the capacity of the roadway to move the traffic, traffic speeds and related Level of Service of the facility gradually decrease. According to the Highway Capacity Manual [4], the flow at capacity of an uninterrupted multilane highway is between 1,900 and 2,200 passenger cars per hour per lane (pcphpl). For interrupted flow (signalized roadways), the flow rate would be per hour of green time for each through movement. Typical of a multilane highway, at a level of traffic density greater than the volume to capacity ratio (v/c) of about 0.4, speeds are reduced by about 5 percent for every 0.1 increase in v/c. As the level of traffic density approaches a v/c of about 0.85, speeds drop dramatically and delays become significant.

The significance of the v/c ratio and delay relationship for incident management lies in the relative impact of capacity losses due to an incident. The amount of delay time incurred by motorists when traffic incidents occur depends on the number of lanes (capacity) lost to the incident and the volumes of traffic on that section of roadway containing the incident. For roadways that normally operate at or near capacity during peak travel periods and experience moderate or worse congestion, reductions in capacity typically result in immediate over-capacity conditions resulting in significant delay to vehicles and their occupants.

For example, if the capacity of a six-lane freeway was 6,000 passenger cars per hour (pcph) in each direction and there were 4,000 cars going in one direction, then the volume-to-capacity ratio (v/c) for that direction of travel would be 0.67, and cars normally going 60 MPH would be expected to average between 50 and 55 MPH. If an incident occurred which took up one travel lane in that direction, then the capacity would be reduced to between 3,000 and 3,500 pcph, and the v/c would increase to between 1.14 and 1.33. Under those conditions, average travel speeds would be expected to reduce to about 10 MPH or less due to overcapacity conditions and rubbernecking .

Thus, the prompt clearing of a travel lane can significantly reduce travel delay. Additionally, the presence of an accident and the abrupt slowing of vehicles upstream can also contribute to secondary traffic crashes due to inattentive or impatient drivers, and other potential incidents such as mechanical breakdowns and overheating that can further delay traffic.

1.4 Benefits of Incident Management

Incident management programs can yield significant benefits to motorists. The Freeway Service Patrol instituted in San Francisco is credited with reducing nitrogen oxide emissions by 798 kg/day in addition to assisting more than 90,000 drivers (as of January 1997). In San Antonio, Texas, the incident management program contributed to a nearly 35% reduction in vehicle crashes and a significant (20%) reduction in response time to accidents. The average time between incident verification and clearance of traffic lanes in Atlanta was reduced from 6.25 hours to 1.5 hours with their incident management program. In Maryland, the CHART program is estimated to have produced a non-recurrent delay savings in excess of 2 million vehicle hours per year. These are but a few of the positive results recorded around the country as incident management programs have been developed and implemented.

Incident management programs were initially developed in the largest metropolitan areas with the most serious traffic congestion problems. However, the benefits to medium and small cities, as well as rural areas are now uniformly recognized. State Departments of Transportation are now expanding incident management programs and policies on a statewide basis. Most Transportation Management Areas (TMAs) (populations over 200,000) have developed or are considering developing incident management improvements. While some highly sophisticated Intelligent Transportation Systems (ITS) may be either inappropriate or not practical for all locations, there are a wide variety of economical incident management tools and strategies that can be implemented in most areas.

1.5 Costs of Congestion Caused by Incidents

There are obvious personal and economic values in preventing accidents. There are also costs associated with the traffic congestion caused by crashes and other roadway incidents. These costs include: the personal value of time lost, and the potential of traffic congestion to cause additional crashes. Thus, there is economic value in doing a better job to clear the crash scene, maintain optimal event traffic flow, and then reestablish normal traffic flow.

Lost Time (Delay) — Estimates of the personal value of lost time (delay) to the traveling public used in value analyses range from about $4.00 per hour to over $10.00 per hour [(5)]. For the purposes of this study, a value of $7.50 per hour is used as the personal value of time lost due to traffic delay. Thus, every minute of delay incurred is worth about 12.5¢ per person. As a typical value of the cost of delay time, if one vehicle is reduced in speed from 60 MPH to 3 MPH (stop and go) for a distance of one mile, then that one vehicle has incurred about 19 minutes of delay. Assuming an average occupancy rate of 1.1 persons per vehicle, the 19 minutes of delay to one vehicle results in $2.61 worth of personal time lost per vehicle. If this incident occurs during a busy travel time and some 4,000 vehicles per hour incur that 19 minutes of delay over the course of two hours, then the incident has cost the traveling public a total of $20,900 in personal delay. With over 2,000 reported motor vehicle crashes each year on the freeways and on the RAN in the CARTS area, and if only half of these crashes result in one mile backups for 2 hours, the value of the lost time due to incidents in the CARTS area could be well over $20 Million. This value does not include crashes on non-RAN streets nor non-crash incidents, such as spilled cargo and disabled vehicles. If the incidents could have been detected, responded to and cleared quicker, significant personal time-loss savings could have occurred.

Induced Crashes — The presence of slowed traffic ahead of traffic traveling at normal roadway speeds presents the probability of additional roadway incidents. The relative probability of such an occurrence upstream of any crash scene is dependent upon visibility and the relative speeds. The costs of such induced crashes include not only the additional traffic delay time, but also the additional incident response costs. Advance notification by the use of dynamic message signs (DMS) to tell motorists to slow down and watch for the incident could significantly reduce the occurrence of induced crashes.

1.6 Multiple Agency Involvement and Coordination

A central theme of all effective incident management programs is the close coordination of the myriad of agencies that provide services in the event of a traffic incident. These include state and local transportation agencies, metropolitan planning organization (MPO), state and local law enforcement agencies, fire and rescue agencies, towing and recovery companies, as well as public and private traveler information providers. These agencies all have different missions and methods of operation. An effective incident management program will bring these agencies together to work cooperatively toward a range of common goals and objectives.

2.0 CURRENT INCIDENT MANAGEMENT ACTIVITIES IN THE CARTS AREA

As in most metropolitan areas, a number of state and local agencies are closely involved with incident management. The Arkansas State Highway and Transportation Department (AHTD) owns and operates the freeway system and many major arterial roadways. The Arkansas State Police have primary responsibility for enforcement and accident investigation on this system. They are assisted by local police agencies and fire and rescue agencies depending on location. The Arkansas Highway Police, a division of the AHTD, have primary responsibility for motor carrier enforcement, including truck size and weight, safety, and hazardous materials inspection. Local agencies include police departments from the Cities of Little Rock and North Little Rock, as well as the suburban communities of Conway, Cabot, Bryant, Benton, Sherwood, Jacksonville, and Maumelle. Also involved are the sheriff s departments of Pulaski, Faulkner, Saline, and Lonoke counties as well as local fire, and rescue organizations. Towing and recovery services are provided by local private companies. All of these organizations are members of the Intelligent Transportation Systems (ITS) Task Force for Metroplan, the metropolitan planning organization for the CARTS area.

2.1 Arkansas State Highway and Transportation Department

AHTD is currently in the process of developing a statewide strategic plan for ITS. The early focus of this project is concentrated on ITS strategies that can be deployed in construction zones and coincides with a massive reconstruction and rehabilitation program for the Interstate system. The strategic plan will also include an incident management component which has not yet been clearly defined.

AHTD has already implemented three ITS systems in conjunction with work zones with varied success. Vehicle queue detectors linked to DMS and highway advisory radios (HAR) were deployed as part of an interstate reconstruction project in the West Memphis area, in order to give real time delay information to the motorists and media. A slightly different system (ADAPTIR) was implemented on an I-40 reconstruction project in Carlisle. While both systems achieved less than perfect results, it was deemed that positive benefits could result with upgrading and refinement.

AHTD also began its first Motorist Assistance Patrol (MAP) in the West Memphis area on Interstates 40 and 55. After this program received a positive public response, the MAP was instituted in May 2001 in the CARTS area primarily in freeway work zones. The MAP is operated out of the AHTD District 6 office and is presently composed of three vehicles operating on I-30, I-40, I-630, I-430, and I-440 in the urbanized area. It is AHTD s intention to provide some coverage of both US 67/167 and I-530, from I-30 to Dixon Road. This expansion as well as the existing coverage will depend upon personnel and funding limitations. The original intent was to start in the areas with the most work zones, and expand beyond that as they can.

MAP drivers assist motorists with minor mechanical difficulties, fuel, notifying wreckers, and some vehicles are capable of pushing a vehicle to the side of the road. No towing services are provided. Between inception of the MAP in May 2001 and August 19, 2001, the patrol came to the aid of over 1300 motorists. The single largest category of assistance was for flat tires. As in West Memphis, the CARTS area MAP has proven to be very popular with the traveling public. A more detailed evaluation of the effectiveness of the program has not yet been undertaken.

2.2 Arkansas State Police

The Arkansas State Police have primary jurisdiction on the state highway system for traffic law enforcement, including managing the scene of accidents. State Police officers generally direct activities at the incident scene and determine if assistance is needed from other law enforcement agencies, emergency response providers or the AHTD. The State Police maintain a rotation list of qualified towing and wrecker services they utilize for clearance of accident scenes and removal of disabled vehicles. Firms secure a spot on the rotation list if they have adequate equipment available within a certain distance. However, the current procedures do not specify a minimum response time or schedule of fees. A more detailed proposed policy for use of towing and wrecker services is now under consideration by the State Police. State Police Public Information Officers handle contacts with the media to get information out to the traveling public regarding incidents.

2.3 Emergency Medical Services Centers

Emergency Medical Services (EMS) Centers in Little Rock and North Little Rock receive 911 calls and dispatch emergency services personnel appropriate to the type of incident reported and the location of the incident. The majority of roadway incidents are initially detected and reported to 911 by cellular phone callers. EMS dispatchers can presently locate cellular phone callers only to the nearest cellular tower utilized. However, communications upgrades are being planned that would automatically locate a cellular caller to a much more precise location. EMS dispatchers must now frequently question cellular phone callers to determine a more precise incident location.

2.4 Private Providers

In addition to the AHTD Motorist Assistance Patrol (MAP), the Landers car dealership sponsors a service patrol. Landers pays a driver to travel the freeway system in the area during week day peak hour traffic. The driver will offer assistance to disabled vehicles, but will not tow or push vehicles off the main travel lanes.

KLOVE Radio Station provides traffic reports between the hours or 7:00 a.m. and 8:40 a.m. as a service to listeners. Skywatch Traffic reports are provided by reporter Mike Willingham, who uses a small fixed wing aircraft, supplemented by vehicles on the ground, to observe traffic conditions, primarily on the freeway system. Mr. Willingham also frequently reports incidents to 911 centers. Skywatch traffic reports may also be carried by other radio stations in the area.

Towing and Wrecker services are provided by local firms. Some local agencies utilize the State Police rotation list of firms, while others may contract directly with single providers. No other specific policies were identified for utilizing towing services. Only anecdotal information was available to gage average response times and fees. Many local towing companies are represented by the Arkansas Towing Association.

2.5 Metroplan

Metroplan, as the MPO for the CARTS area, is the appropriate forum for discussion and coordination of incident management in this region. Metroplan has established an ITS Task Force representing the full range of incident management players and services, as well as local, state and federal governments. The ITS Task Force represents an ideal home for incident management coordination, with its emphasis on intelligent transportation technologies and broad stakeholder involvement.

Metroplan has embarked on an ambitious effort to plan for development of ITS projects in the region. The Task Force has reached preliminary agreement on ITS architecture and will focus on ITS components for incorporation into the region s long-range transportation plan. Incident management is a key component of this effort, and an area that appropriately deserves early attention.

2.6 Other Related Activities

Local governments have begun deploying ITS technologies on a very limited basis, primarily in Little Rock and North Little Rock. The City of Little Rock has a small traffic control center, which is responsible for traffic signal systems. Little Rock has begun to synchronize traffic signal systems and has signal preemption available in limited locations. The Traffic Control Center would like to use video surveillance cameras in selected locations, such as major river crossings, and at key intersections not only for incident detection, but also to assist with signal timing and coordination and to replace less reliable inductive loop sensors.

2.7 Traveler Information System

In July 2000, the Federal Communications Commission (FCC) designated 511 as the United States national traveler information telephone number. The FCC ruling leaves nearly all implementation issues and schedules to state and local agencies and communications carriers. In the CARTS area, state and local agencies are looking into statewide and regional development and support of the 511 traveler information system. The 511 system will deliver the information a traveler wants, at the time and location that he or she wants it. The systems will empower travelers to make better decisions, benefiting both the traveler and the transportation network and society at large. The vision of 511 is to serve as the principal audio interface for providing this information to travelers. In an environment of rapidly changing technology and consumer tastes and needs, precisely pinpointing what a mature 511 system is would be nearly impossible. However, key characteristics of successful mature systems will likely include construction/maintenance projects and road closures by location, direction of travel, days/hours of duration, general description of impact, detours and alternative routing advice. Other information may include weather and road surfaced conditions, availability of local public transportation, special events driving and parking directions, and tourist information.

3.0 ISSUES DISCERNED FROM STAKEHOLDER AGENCY INTERVIEWS

A combination of meetings and telephone calls were initiated to a broad range of incident management stakeholders including state and local police agencies, emergency medical and fire departments, and highway and transportation agencies. These interviews were valuable in understanding the current incident detection and response procedures, the relationships between involved agencies, as well as identifying new procedures and technologies planned in the near future. The individuals providing information for this study are listed in Appendix A.

The following paragraphs present key issues emerging from stakeholder interviews.

3.1 Coordination Issues

Nearly all stakeholders pointed to serious coordination and cooperation issues as key to the process of improving incident management in the CARTS area. Participants offered that Metroplan, as the metropolitan planning organization, would be in a uniquely appropriate position to serve as the forum to promote coordination among the agencies of local and state government. Within this context, several participants suggested that AHTD take a leadership role in promoting and funding ITS applications that would lead to better incident management, as well as helping to develop centralized traffic management for the area.

Stakeholders consistently supported the need for an on-going incident management team that would meet on a regular basis and serve as the coordinating committee for the various involved agencies. Additionally, commitment and support from local elected officials for this team would be necessary for its successful implementation.

3.2 Communications Issues

Police agencies consistently called for improvements in the communications systems they use in the field. Currently, there are a number of different radio systems in use by the various agencies, resulting in the inability of officers to contact each other directly at the scene of an incident. Some state police officers are now carrying cellular phones to alleviate this problem, but the practice is not uniform. Several agencies are in the process of upgrading or considering upgrading their radio systems. More coordination of these upgrades among the agencies would be productive. Participants also pointed to the lack of funding and manpower as a particular problem with radio maintenance.

3.3 Incident Traffic Control Procedures

Most participants acknowledged that traffic control procedures for incidents are not governed by uniform guidelines. While each incident may have different traffic control requirements, several stakeholders supported the idea of developing standard procedures that could be tailored to individual circumstances. In rare instances, officers at the scene have been injured or patrol vehicles damaged during the interruption of traffic flow. A more frequent occurrence has been additional vehicle incidents resulting from the initial accident. However, little documentation is currently available for this problem.

3.4 Funding

The vast majority of participants from all sectors called for additional funding and manpower for improved incident management. Many stakeholders realize that funds are not likely to be available for large scale capacity improvements to the existing highway system in the region. As a result, the importance of operational improvements in incident management can play a priority role in the reduction of congestion and reduction of vehicle accidents. Participants felt that more funding should be made available for ITS and incident management related technology for this reason.

3.5 Public Information and Education

Stakeholders called for education efforts to inform the public of the value of incident management improvements. Such efforts would be crucial in obtaining public and political support for both short and long term incident management projects. A public education program would not only focus on the new technology available, but on explaining how such technological improvements would benefit citizens of the region in every day life. A key focus would also be to educate the public on how better incident management practices can directly relate to their personal safety. The program could also bring about better understanding of the increasingly large role that highway incidents play in the aggravating roadway congestion that motorists frequently experience.

3.6 Technology

Stakeholders voiced support for a variety of technological improvements related to incident management, including video camera surveillance at selected locations, dynamic message signing (DMS), highway advisory radio (HAR) and sophisticated communications systems. The majority voiced support for more advanced traveler information systems that would provide real time information to allow motorists to avoid incidents. Several participants also pushed for expanded geographic information systems (GIS) and more widespread traffic signal synchronization. The participants especially supported video camera surveillance for several reasons:

- Assistance in incident detection and location,
- Aid in determining the type of equipment and personnel that should be sent to a accident scene, and
- Providing travel time and incident formation to the motoring public.

3.7 Existing Highway System

Several participants indicated that the existing highway infrastructure in the CARTS area was not built to accommodate today s traffic levels. They also advised that certain incident prone locations, such as the major river crossings, deserved special attention for incident management purposes.

3.8 Coordinated Traffic Management

A number of stakeholders identified a more regionally coordinated approach to traffic management as a desirable goal for the metropolitan area. Participants called for a range of options spanning the spectrum from more formalized coordination of existing resources to actual consolidation of traffic control, management, and EMS functions under a collective management structure either in one facility or in a number of interconnected and cooperating locations. Several comments were made urging that AHTD could or should take a leadership role in development of centrally coordinated traffic management. There was a general recognition that steps could be taken toward the ultimate goal of a centralized traffic management function by starting with improved coordination and cooperation. Lack of available funding was again mentioned as a major stumbling block in this area.

3.9 Towing/Wrecker Services

There was a general consensus among stakeholders that incident clearance could be improved with cooperation of the towing and wrecker industries. While no data was available on the average response and clearance times for towing services, State Police indicated that wreckers usually arrive at the incident scene in between 10 and 60 minutes. There is considerable variability in response times, as well as state and local agency policies with regard to calling for wrecker services. Most participants believed that continuing to rely on private towing and wrecker services would be most appropriate for the region, but that uniform standards or policies would be useful.

3.10 Truck Traffic

The CARTS area highways carry a large percentage of heavy truck traffic, particularly on I-40 and I-30, which are major east-west interstate thoroughfares. The large volume of truck in the traffic mix also contributes to peak hour congestion levels and the number of serious roadway incidents. Several participants recommended that motor carrier operations in the metropolitan area be scrutinized to determine if alternate truck routing should be considered.

3.11 Data Collection

A key issue that was discussed by most stakeholders was lack of data to support the decision making process for a better incident management program. In some cases, participants called for simply upgrading of existing data systems and in other cases, advised that additional data collection and development of new data bases would be useful. The need for better and more accurate vehicle crash data was mentioned most frequently. Another high priority data issue was the development of real time traffic information to be used not only by the agencies, but also to be disseminated to the public.

4.0 STRATEGIES FOR ENHANCING INCIDENT MANAGEMENT

Selection of appropriate strategies for incident management varies considerably around the country and is highly dependent on the characteristics of the area of implementation. It is important that each area carefully consider operation of transportation infrastructure on the ground, existing institutional structures, availability of funding for both capital and operating expenses, as well as the priority of objectives that the program seeks to address. A variety of available and soon to be available Intelligent Transportation Systems (ITS) strategies show great promise for improving incident management. These include strategies to provide more timely and accurate incident related information to the traveling public, sophisticated incident detection technologies, such as roadway sensors and video surveillance cameras and integrated communication systems for coordinating response agencies. On the other end of the technological spectrum, the addition or expansion of motorist assist patrols has also been shown to be a highly successful and publicly popular method of reducing incident related congestion and safety problems. However, coordination of key incident response agencies is the critical component of success, regardless of particular suite of technological improvements that are ultimately implemented.

4.1 Lessons from Other Medium Sized Metro Areas

Many other small and medium size metropolitan areas around the country have plans or are developing plans to implement incident management strategies. The Greenville Spartanburg area, as described in the following paragraphs, has implemented a number of strategies as part of an overall plan to address non-recurrent traffic incidents. However, many other areas are still in various stages of planning, similar to the CARTS area. While implementation may be lagging, nearly all areas are at least working toward implementation of incident management procedures. Contacts at other MPOs consistently cited the need to move ahead strongly in the direction of more coordinated incident detection, response and clearance.

4.1.1 Greenville-Spartanburg, SC

A detailed incident management study was completed for the Greenville-Spartanburg, South Carolina metropolitan area in 1995. This MSA has a population of approximately 830,000, which is expected to increase to 986,000 by the year 2010. Several Interstate highways pass through the area, including I-85, which can be particularly congested. At the time of the study, only 8 miles of the 44 mile I-85 corridor were 6 lane. (The remainder were scheduled to be widened to 6 lanes in the future.) Annual average daily traffic (AADT) in the I-85 corridor ranged from a low of 36,600 at the far edge of the study area to 71,700 on the most congested segments. Historic trends showed traffic to be increasing on I-85 nearly 10 percent annually.

The goals of the incident management program for Greenville-Spartanburg were:

- Mitigate congestion on interstates and principal arterials
- Create more effective response to incidents by cooperating agencies
- Improve safety and minimize environmental impacts
- Identify incremental program benefits at each stage of development
- Increase visibility to the public of safety and mobility concerns

Additionally, an overall goal was to develop a program consistent with advanced traffic management strategies identified for the region.

The Greenville-Spartanburg study included a detailed analysis and evaluation of a full range of options for improving the different aspects of incident management. These options were categorized as either short, medium or long range strategies. Short term recommendations focused on strategies to implement a Traffic Management Team, expand and improve motorist assistance patrols, enhancement of local control centers, and initial development of advanced traveler information systems (ATIS). The focus of medium range recommendations was the integration of local projects into a regional system, and further expansion of motorist assistance patrols and other ATIS services. The longer term focus was to provide a full range of advanced traveler information and traffic management and commercial vehicle operations services and to develop links to other regional systems.

Priority projects for early implementation in the Greenville-Spartanburg area include:

- A widespread public information and education program to help area motorists gain understanding and knowledge of new traveler information that is becoming available and to build support for the overall traffic management program;
- The expansion of the motorist assistance patrols, particularly in areas with construction projects; and
- The institution of the Traffic Management Team.

Also recommended for early deployment were limited freeway surveillance and ATIS in a few specific locations.

4.1.2 Nashville, Tennessee

The Nashville Area Metropolitan Planning Organization (NAMPO) is actively involved in developing incident management programs to address traffic problems in the metro area of approximately 1.2 million people. The MPO is working closely with the Tennessee DOT to coordinate these efforts. In 1999, freeway courtesy patrols were implemented in the Nashville area by TDOT personnel. The public response to these patrols has been overwhelmingly positive and NAMPO cites this service as a key piece of their strategy to deal with incident related congestion as well as improve public safety. In addition, TDOT is currently constructing a traffic management center (TMC) in the Nashville area and has begun installing video surveillance cameras at selected locations on I-65 north of the city. On the regional level, NAMPO is starting up a coordinating committee for ITS and incident management activities involving all affected agencies and has recently adopted a regional architecture for ITS.

Currently, only anecdotal information is available regarding the effectiveness of incident management activities undertaken in Nashville. However, the MPO and Vanderbilt University plan to do evaluation studies to document the benefits of incident management, as well as other ITS activities in the future.

4.1.3 Tulsa, Oklahoma

INCOG, the MPO for the Tulsa, Oklahoma area, is actively beginning to plan for incident management initiatives, but has yet to implement any strategies. This metropolitan area of approximately 800,000 people currently has radio and internet-based traffic reporting provided by the private sector. INCOG and OK DOT have contracted with consultants for a study of ITS architecture which will also include a recommended incident management component. This study is expected to be completed in one year. The MPO has also submitted an application for special federal funds which are to be made available to metro areas in need of ITS assistance. INCOG plans to implement a pilot courtesy patrol project when funds are made available. In addition, the MPO staff has received approval to organize an ITS Steering Committee to oversee and advise on ITS and incident management initiatives. The Steering Committee will consider the potential implementation of a variety of incident management strategies and make recommendations to the MPO Policy Committee.

4.2 Accident Analysis

Accident history gives an indication of priority areas of focus for development and implementation of a traffic monitoring system as part of the Incident Management program. The accident data for the CARTS area freeways and RAN are annually compiled by the Planning and Research Division of AHTD. Information on key data attributes for years 1997, 1998, and 1999 were provided by AHTD for use in this study. The data fields provided include the following:

- Atmospheric conditions;
- Road surface conditions;
- Whether crash was in a Construction Zone;
- Type of traffic control and whether it was functioning;
- Intersection type;

- Crash date, day of week and time of day;
- Route and log-mile of the accident; and
- Crash type and whether alcohol was involved.

The traffic accidents were analyzed for basic trend analysis to facilitate prioritization of treatments. The three years of data were compiled into an Access database, which is provided on disk accompanying this report. The three years of data were averaged, resulting in an annual average number of traffic accidents that are indicative of the sustained trends and less influenced by a few localized crashes in one year.

A graphic representation of the high accident locations for the freeways and RAN in the CARTS area is shown in **Figures 1 and 2**. A threshold of a minimum of 20 accidents per year in any one-half mile segment was chosen for representation in the two figures for the sake of representing areas of high-accident trends, as there appeared to be a natural break in frequency of occurrence after approximately 15 to 18 accidents per year. A level of 20 accidents per year represents nearly two accidents per month on average.

Summaries of accidents by other statistical traits provided further insight into causal factors that indicate higher needs and potential benefits of incident management applications. A summary of the observations from this accident analysis and the possible Incident Management tools that can be applied to address these issues are listed in **Table 2**.

Table 2. Traffic Accident Evaluation and Indications

Observation	Incident Management Tool
The locations with an average of over 20 accidents per year are graphically represented in **Figures 1 and 2**. The heaviest concentration of accidents in adjacent _ mile segments occurs on I-30 between the I-30/I-440 interchange and the I-30/I-40 interchange, indicating the highest priority area for incident management application. This section of highway also experiences significant levels of congestion during non-incident conditions.	• Install video surveillance cameras • 24 hour service patrol on I-30 segment • Alternative peak period routes advertised for all traffic • Alternative truck routes during peak • Preplanned detours by segment • 24 hour crash investigation site(s) • DMS for critical segments
Figure 3 is a graphical representation of the variation in accident occurrence by time of day and day of week. Not surprisingly, the occurrence of accidents roughly tracks the volume of vehicles on the roadway. There is a peak of accidents between 6:00 and 9:00 am, then a gradual rising around the lunch hour up to about the morning peak level, then to a significant peak in the afternoon between 4:00 and 7:00 pm. Friday afternoons see the greatest occurrence of accidents.	• Install video surveillance cameras and sensors to track congestion and incidents • More service patrols during peak periods and midday • Dynamic message signs advising of congestion and alternative routes • Key positioning of tow trucks and incident response teams during peaks • HAR and 511

Approximately 20 percent of the accidents, injuries and fatalities occur during rainy conditions or on wet pavements. Approximately 75% of accidents, injuries and fatalities occur during clear conditions or on dry pavements.	• Reduce speed limit in rainy conditions • Install pavement condition monitors • Broadcast weather precaution advisories • Message signs indicating conditions of the roads
Less than five percent of accidents, injuries and fatalities occur in construction zones.	• Require high quality construction detours and traffic control plans • Police enforcement of zone activities • Require proper maintenance of installed roadway construction zone signs
Single vehicle crashes account for about 15 percent of the accidents and injuries but over 45 percent of fatalities.	• Public notification and education regarding driving safety • Increase number of rest areas and facilities • Install video surveillance cameras and sensors to track errant behavior
Rear end collisions account for over 40 percent of accidents and injuries, but less than 10 percent of fatalities.	• Public notification and education regarding defensive driving
About 50 percent of accidents and injuries are not related to intersections, but account for over 70 percent of fatalities.	• Consider reduced speed limits • Message signs and indicators • Public notification and education regarding driving safety
A fire is involved in about two percent of accidents and injuries and in about seven percent of fatalities.	• Special training for police officers for accidents involving fire response team
Alcohol is a factor in less than 10 percent of accidents and injuries but in over 30 percent of fatalities.	• Increase public awareness of traffic deaths due to impaired drivers • Increase the breath alcohol testing especially on Fridays and weekends • Increase fines and consequences of DWI

More detailed accident analyses could be conducted to correlate many of these and more factors to develop an accident prevention and deterrence program for the region.

There are some limitations in the use of the AHTD accident database. The freeway data is relatively accurate and descriptive, but there were many blank fields in the data. There are also some fields that use the value of 0 and 1 to indicate yes or no while another field used 1 and 2 for yes and no , leading to potential error in data entry. The locations of the arterial accident data are less precise than for the freeway data which is keyed to roadway log mile designations. The use of Global Positioning Systems (GPS) in accident recording can eliminate this inaccuracy. Information on the direction of travel on the roadway were not provided with the data received from AHTD, but could be made available for more detailed analyses of accident causation and placement of DMS.

5.0 RECOMMENDATIONS

The following are initial concepts for recommendations that may be developed from this study.

5.1 Planning Recommendations:

- Establishment an Incident Management Team comprised of key participants with Metroplan facilitation and staff support.
- Develop a mission statement and key goals and objectives for the Incident Management Program.
- Develop a detailed incident management program for the region which is fully coordinated with the AHTD statewide plan and local plans. Focus plan on prioritized investments for short, medium and long term strategies. Secure key stakeholder buy-in for plan.
- Develop proactive public information and education plan to promote public understanding and support for the benefits of incident management improvements.
- Improve data collection and analysis techniques to demonstrate program impacts, benefits and evaluation. Strengthen vehicle crash databases. Develop incident response time and clearance databases, which are currently not compiled. Increase GIS utilization in incident management activities.
- Standardize incident location reporting using GPS, ultimately as part of an AVL system for tracking emergency vehicles.
- Develop a congestion relief plan, since traffic congestion is a contributing factor in traffic collisions. Include public information and strategies based upon predictive and real-time data, such as advance information on trip times and alternative routing.
- Scrutinize truck traffic data to determine if measures specifically aimed at motor carriers would be appropriate for the region.

5.2 Incident Detection Recommendations

- Develop a phased plan for limited deployment of video surveillance cameras at High Incident Locations (HILs), using information on accidents such as that discussed in Section 4.2 of this report and data from Motorist Assistance Patrol (MAP) activity. Investigate state of the art in detection systems, system costs, and local agency capabilities. Basic systems of detector loops and speed/density trend analyzer software have been used to provide indicators that trigger visual monitoring systems.
- Develop working relationships with area agencies to examine the potential to establish a helicopter (or satellite) traffic surveillance and reporting system. Potentially interested agencies may include the local television and radio stations. The local police departments

often use helicopters in their incident response and search work, and may be interested in access to such service or joint funding.

- Develop a public involvement campaign to encourage the participation of the general public in reporting traffic incidents.

- Formalize the process of receiving and verifying incident detail and location information from cell phone call-in of observed incidents.

5.3 Incident Verification Recommendations

- Support efforts to upgrade cellular phone locator abilities for 911 centers.

- Develop a phased plan for strategic deployment of video surveillance cameras at HILs.

- Consider expansion of MAP to focus on areas of relatively high incident occurrence and key areas outside of potential visual surveillance system to allow rapid diversion of MAP vehicles to incident location for verification.

5.4 Motorist Information

- Develop a system of Dynamic Message Signs (DMS) controlled from centrally coordinated location(s). Initial accident analysis indicates that one high priority for signage placement is near the entry and decision points to the I-30 segment between I-40 and I-440.. Focus on roadways that have HILs and good alternative routes. Freeways without good alternative routes (such as I-40) should receive attention for corrective and mitigative measures. Coordinate priorities for DMS installation with ongoing communications and other construction and development activities.

- Consider development of a website for display of real-time traffic congestion information as part of advanced motorist information system for motorists before they leave their point of origin.

- Develop relationships and agreements with radio and television stations to be able to deploy public service bulletins regarding traffic incident reporting and special events. Information on planned construction activities and special event traffic control can be printed in the local newspaper.

- Support development of the 511 Traveler Information System for the region.

5.5 Incident Response Recommendations

- Consider installing traffic signal priority systems, such as 3M s Opticom system, at all signalized intersections in the RAN and equip all fire, police and ambulance vehicles with transmitters. These devices eliminate conflicts between emergency vehicles and cross-street traffic, saving time for the emergency vehicle and reducing the potential for collisions due to incident response.

- Establish program for strategic placement and coverage of response vehicles, using predictive measures such as historical HILs and high accident times of day discussed in section 4.2 of this report.

- Maintain adequate training of 911 and other key agency operations personnel regarding first response assignments and agency coordination.

- Maintain listing of equipment and personnel resources of participating agencies and associated entities, including contact information for individuals who respond to incidents within a geographic or specialty service area.

- Strategically position tow truck equipment and ambulance services and frequently used materials near areas that have high incident rates to reduce response times.

5.6 Site Management Recommendations

- Coordinate development of new state and local communications systems for better on site management. Maintain effective communication links between operations centers at participating incident management agencies, operations centers and their agency response vehicles, and response vehicle to response vehicle.

- Establish written inter-agency policies and procedures for site control and coordination, including common terminologies, consolidated action plans, span of control, and resource management. Such an Incident Command System typically establishes one person as the incident commander as appropriate for the conditions at the site who is supported by interim commanders and specialty support task leaders under a unified command structure.

- Establish and maintain adequate inter-agency training on site management.

- Establish a pre-defined set of conceptual site management plans for deployment for key segments of roadway at identified HILs under various incident types.

- Provide direct access to centralized database of equipment and personnel resources of participating agencies and supporting service and equipment providers.

- Consider acquiring the use of a mobile camera unit mounted on a hydraulic post, similar to those used by television stations for remote broadcasting, for detailed remote oversite and coordination. The City of Richardson, Texas has recently purchased such a unit to assist in traffic surveillance and incident and event control.

5.7 Traffic Management Recommendations

- Maintain adequately trained traffic operations, fire and hazardous materials response personnel within the responding agencies. Stress the importance of maintenance of traffic flow to the extent possible while maintaining safety of response personnel and the general public.

- Develop a phased implementation plan for a centralized traffic management function or service for the region under the auspices of Metroplan to better employ pre-arranged and as-needed traffic management strategies. Actively manage all available traffic control devices and alternative routes.

- Establish written illustrated manuals for traffic control, placement of response vehicles, and other on-site vehicle-related procedures. Stress the importance of minimal lane closures and prompt reopening of travel lanes. Include such measures as adaptive use of shoulders and service roads as well as alternate routes.

- Focus on HILs for initial emphasis of alternative traffic control and detour route planning. Continue development of location-specific traffic management plans focusing on high accident locations or other incident-critical bridges or segments of roadway.

5.8 Incident Clearance Recommendations

- Conduct a literature search of applicable laws, regulations and ordinances that may need updating or changing to accommodate new incident management policies.

- Develop a uniform policy governing the use of towing and wrecker services. Establish minimum response times, equipment standards. Consider a specified fee schedule.

- Develop a policy for removal of truck cargo from the travel way and from the incident site that balances the value of recovering the commercial cargo with the cost of congestion. Insurance companies usually support strong incident management and favor quick removal by any means. An aggressive policy to push or pull the truck and cargo off the roadway to open traffic should be promoted.

- Develop a policy for prompt removal of disabled vehicles from travel way. To minimize the effects of rubbernecking , promote quick removal or shielding of the vehicle from the immediate incident site.

- Develop a policy for prompt vacating of the site by emergency response vehicles once related dangers have been removed from the travel way.

- Consider acquiring the use of a mobile camera unit for detailed accident documentation to speed the clearing of persons, vehicles and debris from the site and to facilitate accident reconstruction after the fact.

- Develop a data base for response and site clearance times. Information should include initial detection times, initial response, extent and duration of lane closures, and time of clearance of lanes, vehicles and traffic.

References

(1) As defined on page IV-2 in METRO 2025, the RAN is a network of arterials designed to provide feasible alternatives to the area freeway network for intra-regional travel within central Arkansas (additional information may be found on the website at www.metroplan.org).

(2) Incident Management: Detection, Verification, and Traffic Management, prepared by Booz Allen Hamilton, Federal Highway Administration, FHWA-RD-JPO-034. September 1998.

(3) The Texas Transportation Institute also reached similar conclusions in its 1999 Urban Mobility Report, which estimated incident related congestion accounted for over 57% of highway congestion and produced 2.5 billion vehicle hours of delay.

(4) Highway Capacity Manual 2000, Transportation Research Board, Washington, D.C.

(5) The Federal Highway Administration promotes the use of a value of time of $4.00 per hour for analysis of major corridor investments. The Texas Transportation Institute has tracked the value of time for several years, and currently uses a value of over $12.00 per hour in the analysis of High Occupancy Vehicle lanes and other freeway capacity enhancements.

APPENDIX A

Agency Representatives Contacted for Input into Incident Management Plan

Personal and telephone interviews were conducted with agencies currently involved in various aspects of traffic incident management. The persons contacted include the following:

- Mr. Steve Mitchell — Arkansas State Highway and Transportation Department (AHTD)
- Ms. Dorothy Rhodes — AHTD
- Mr. Leonard Hall — AHTD — District 6
- Mr. Brian Wright — AHTD — Motorist Assist Patrol
- Mr. Eric Phillips — AHTD
- Captain George Coffman — Arkansas Highway Police
- Captain Don Hastings — Arkansas Highway Police
- Lt. Gloria Weakland — Arkansas State Police
- Mr. Gary DalPorto — Federal Highway Administration — Arkansas Division
- Mr. William Henry — Little Rock Traffic Control Center
- Mr. Kenny Shaw — Little Rock EMS
- Captain Steve Smith - North Little Rock Fire Department
- Lt. John Brechon — North Little Rock Police Department
- Captain Leonard Montgomery — North Little Rock Police Department
- Ms. Lee Shaw — EMS/911 — North Little Rock
- Mr. Ron Spychalski — MEMS Ambulance Services
- Mr. Jeff Befsancon — Benton Police Department
- Lt. Tom Barnard — Saline County Sheriff s Department
- Mr. Charles Martin — Lonoke County Sheriff s Department
- Mr. Mike Willingham — Skywatch Traffic — KLOVE
- Mr. Allen Alvey — Conway Corporation
- Mr. Junior Phillips — Arkansas Towing Association

SRTMC Project Purpose:

To reduce accidents within High Accident Corridors by improving incident management, providing early warning to motorist of traffic conditions and improving trip planning.

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PARTNERS

BACKGROUND

The regional partnership between SRTC, the Washington State Department of Transportation, Spokane County, the City of Spokane and Spokane Transit Authority was developed to address regional traffic issues through a central location. Together they form the Spokane Regional Traffic Management Center or the SRTMC. Although the typical motorist is usually unaware of jurisdictional responsibility at intersections or transportation facilities, people will recognize increased efficiency as traffic flows smoother throughout the region. The SRTMC will maximize continuities in transportation operations between partnership agencies.

Development of a traffic management center can focus incident management to a central location during peak periods. Areas around the country have experienced up to 60 per cent reduction in lost time due to early detection and improved incident management. Another benefit to the community is the avoidable cost associated with auto emissions, in particular carbon monoxide.

EXAMPLE

Simulating an accident on eastbound Interstate 90 just west of the Thor/Freya Interchange during the evening peak hour, could result in additional 427 kilograms of carbon monoxide emissions, have an additional 9,195 vehicle miles of travel and 2500 lost person hours due to delay. The cumulative impact of a one hour accident that closes one lane of traffic has an estimated economic loss of $24,000. This does not include lost wages from freight and goods delivery.

RELATED SRTMC LINKS

Implementation Plan Architecture Plan

Architecture and Implementation Plan

Arterial and freeway surveillance

WSDOT website

MAPS OF EXISTING AND FUTURE LOCATIONS OF INTELLIGENT TRANSPORTATION SYSTEM DEVICES

Cameras

Dynamic Message Signs

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Contact Us

Forum Registration

Vancouver Area Smart Trek

What is an Intelligent Transportation System?

An Intelligent Transportation System, or **ITS**, is part of the transportation tool kit to better manage the transportation system. ITS uses advanced technology and information to improve mobility and productivity and enhance safety on the transportation system.

It uses real time information to integrate and manage conventional transportation system components such as roads, transit, ramp meters, traffic signals, and managing incidents for more efficient operations and performance.

ITS can:

- Alert motorists, commercial vehicles, and transit operators of congestion by collecting, processing, and disseminating real-time information.
- Provide real-time transit arrival and departure information to passengers allowing them to time their departure from work or home to the transit stop.
- Reduce corridor congestion by rapidly detecting and responding to traffic incidents.
- Reduce travel times, stops and delays by dynamically adjusting traffic signals in response to changing traffic conditions across jurisdictional boundaries and roadway types.

ITS is the application of a range of advanced technologies and proven management techniques to improve mobility and transportation productivity, enhance safety, conserve energy resources and reduce adverse environmental effects.

In the past, it was generally accepted that we could meet the demand for mobility by building more highways and bridges and adding more lanes to roads and streets in our cities. Today, as many areas of the country have built out the road system and pressure exists to curtail sprawl, we must consider new ways of managing traffic. ITS provides new tools to compliment traditional transportation thinking and the approach is catching on worldwide. Deployment of ITS tools and strategies, seen as the next major evolutionary stage of surface transportation, is expected to be the focus of major metropolitan area implementation efforts early in this century, much like the highway system program was the focus of the last 60 years. ITS is no longer an alternative or option in dealing with congestion and increasing highway travel. It is one of the most cost effective ways to obtain a more efficient transportation system without the need to add more lanes and build more highways.

Benefits of ITS

A review of ITS projects around the country, has shown that advanced traffic management can:

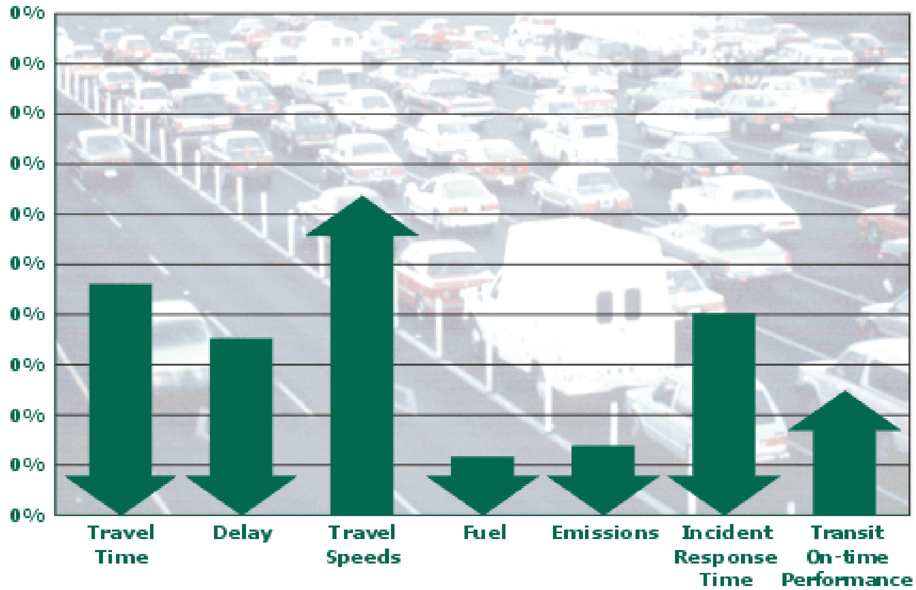
- Decrease travel time 8% to 45%
- Increase travel speed 16% to 62%
- Reduce accidents 10% to 50%

Incident management programs can:

- Reduce IM response times by 40%

Transit management systems can:

- Decrease travel time 15% to 18%
- Increase reliability 12% to 23%



The Vancouver Area Smart Trek Program

The Vancouver Area Smart Trek Program, or **VAST**, is a new Intelligent Transportation System initiative for the region developed as a cooperative effort by public transportation agencies in Clark County (the Cities of Vancouver and Camas, Clark County, the Washington State Department of Transportation Southwest Region, the Southwest Washington Regional Transportation Council, the Port of Vancouver and C-TRAN) to implement a 20-year Intelligent Transportation System (ITS) Plan.

The purpose of the VAST Plan is to:

- Identify regional transportation problems and needs
- Identify potential ITS solutions
- Coordinate both current and future ITS initiatives
- Foster interagency cooperation and coordination
- Provide a program which allows the region to deploy ITS projects in a systematic manner.

The VAST Program consists of a long term ITS vision and plan for the Clark County region. The development of this vision consisted of several key activities: an inventory of the existing transportation system, a needs assessment, an evaluation of ITS strategies that might be appropriate for the Vancouver region, the definition of a VAST system architecture, the identification of a set of ITS initiatives and the development of an Implementation Plan. A detailed description of the VAST program, the ITS initiatives, and the twenty year implementation plan is contained in the Executive Summary (pdf)

It is made up of seven key initiatives around which the VAST Plan has been developed:

Communications Infrastructure - Communications infrastructure is the backbone for all ITS deployment.

Traveler Information - Traveler information provides travelers with the ability to make an intelligent choice regarding mode, route and travel time. It uses static and realtime information

Incident Management - The freeway and arterial incident management plan covers operation of any function, device or system that is dedicated to the response to or monitoring of incidents on arterials and freeways.

Transportation Management - The freeway and arterial transportation management plan covers the operation of all functions, devices and systems installed or developed for managing freeways and arterials.

Traffic Signal System - The existing traffic signal systems in the Vancouver area, while functional, will not continue to meet the growing needs of the signal system operators and local residents.

Transit Priority - Public transit plays an important role in passenger transportation in Clark County. The C-TRAN bus system carries over six million passengers per year on 29 routes. Giving priority for buses at traffic signals can make transit more attractive to travelers by helping make bus travel times shorter and more consistent.

Transit Operation and Management - The two key components of transit operation and management are: (1) transit traveler information systems and (2) transit agency operations and management. Transit traveler information systems can deliver real-time bus arrival information to transit patrons using changeable message signs, the internet and other communication devices. Transit operation and management tools use advanced technology to help transit providers increase efficiency and improve quality of service provided to the public.

Washington State Department of Transportation

WSDOT's Congestion Measurement Approach: Learning from Operational Data

Better Performance Measures are Needed for Decision-Making

Citizens, businesses and public officials in Washington want to know that the state is doing everything it can to alleviate congestion on freeways and highways.

Like many other state transportation agencies, the Washington State Department of Transportation (WSDOT) is faced with addressing public need while coping with stagnant or diminishing levels of funding. In response, WSDOT has developed three distinct strategies:

- Manage traffic breakdowns more aggressively and significantly expand incident response programs.
- Encourage more efficient travel behavior by providing system users with enhanced traffic information.
- Plan system investments with measurable benefits for congestion.

As transportation agencies further develop operations-based approaches to congestion management and carefully weigh system investments in operations as well as capital improvements, new types of performance information and communication are clearly needed. Traditional congestion measurements are based on modeled speed estimates generated from volume and capacity information. They are difficult to communicate, fail to capture subtle changes in real-world system performance, and are inadequate for evaluating impacts on congestion patterns and conditions from specific operational or capital investments.

In May 2002, WSDOT decided to take performance measurement for congestion – how the highways are doing and how WSDOT is doing – in a new direction, and implemented specific congestion measurement principles (see the box, top right). WSDOT seeks congestion measures that can communicate with the public as well as assist the department in developing capital and operational strategies that address congestion. Its congestion measurements track the effectiveness of congestion relief investments, with a focus on measuring travel time, distinguishing between congestion caused by incidents ("non-recurrent" congestion) and congestion caused by inadequate capacity ("recurrent" congestion), and measuring travel time reliability.

WSDOT's Congestion Measurement Principles:

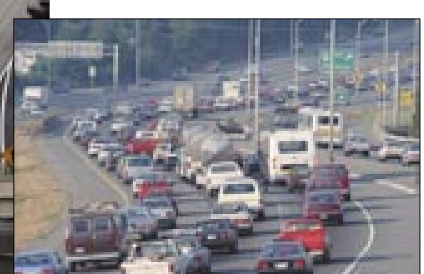
- Use real time measurements (rather than computer models) whenever possible.
- Measure congestion due to incidents as distinct from congestion due to inadequate capacity.
- Show whether reducing congestion from incidents will improve the travel time reliability.
- Demonstrate both long-term trends and short-to-intermediate term results.
- Communicate about possible congestion fixes using an "apples-to-apples" comparison with the current situation (for example, if the trip takes 20 minutes today, how many minutes shorter will it be if we improve the interchange?
- Use plain English to describe measurements.

From the Gray Notebook *for the quarter ending March 31, 2002, available at www.wsdot.wa.gov/accountability/archives/GrayNotebookMar-02.pdf#page=6*

Congestion measurement focus:

- **Real-Time Travel Times**
- **Recurrent and Non-Recurrent Congestion**
- **Travel Time Reliability**

Incident-caused congestion; Southbound Interstate 5 in Seattle (WSDOT Incident Response truck working at the scene).



Non-incident-related congestion; Northbound Interstate 405 near Seattle.

Measures Your Neighbor Can Understand: Travel Times

In May of 2002, as a first step, WSDOT launched a web site-based travel time report (*www.wsdot.wa.gov/pugetsoundtraffic/traveltimes*). These active, real travel times are updated every 5 minutes to provide the public up-to-the-minute information for 11 of the most congested corridors in the Puget Sound region. Another route was added in 2003 for a total of 12.

The collection and analysis of real-time travel time information was the critical element in WSDOT's congestion measurement development. It was also important to develop measurements that were easy to communicate to the public. System performance information in terms of travel times (time to travel from Point A to Point B) is a tool the public and every traveler can relate to and understand.

The popular service is now widely used by commuters, either directly from WSDOT's web sites or indirectly through media that link to WSDOT's information. WSDOT's Travel Times web site had 254,676 page views in June 2003. Television and radio stations use the information daily in their own traffic reports — television news programs scroll the travel times along the bottom of the screen. Newspaper, radio, and television web sites publish the information as well, taking a live feed direct from WSDOT's servers.

www.wsdot.wa.gov/pugetsoundtraffic/traveltimes
The average travel time is the average time for a trip starting at this time during the past few months, derived from WSDOT's archived loop detector data. The current travel time is refreshed at five-minute increments to reflect current conditions.

Distinguishing Between Recurrent and Non-Recurrent Congestion

The ability to identify and measure different types of congestion is key to developing appropriate responses. WSDOT's immediate need to measure the effectiveness of its newly expanded incident response program led to an effort to develop distinct measures of incident-related (non-recurring) and non-incident-related (recurring) congestion.

The ability to identify and measure different types of congestion is key to developing appropriate responses.

Two Times Free Flow: A Temporary Approach

The lack of incident data sets that could be correlated with the archived travel time data required an interim measurement solution. As a first step, WSDOT, in coordination with the University of Washington's Transportation Center (TRAC), developed baseline statistics for travel times on the 11 commute corridors described above for incident and non-incident conditions and analyzed travel time distributions for all monitored trips. Based on the examination of the real-time travel data for 2001 and sample incident data, the study recommended that, until complete incident data could be compiled and correlated, "incident-affected trips" could be defined as *any trip that takes twice as long as a free-flow trip* for that route. These trips have a Trip Time Factor of greater than 2.0 (Trip Time Factor = Actual Trip Time / Free Flow Trip Time).

Using this temporary approach, WSDOT examined archived data for 2001 and 2002 for the 11 routes and compared changes in travel time performance for both recurrent and non-recurrent congestion (as defined by the two times free flow threshold) during peak times. More information is available at *www.wsdot.wa.gov/accountability/peaktime.*

Detailed Analysis

After development of the Washington Incident Tracking System (WITS), a database that logs every incident response, WSDOT and TRAC entered the second phase of development and correlated travel time data with actual incident data. The focus was to identify the causes of congestion on individual highway segments and during particular time periods. Data on incidents

continued on next page

that resulted in congestion were drawn from the WITS database and the Transportation System Management Center (TSMC) incident log.

TRAC's 2003 study, "Measurement of Recurring Versus Non-Recurring Congestion," concludes that non-recurring delay generally ranges between 30 and 50 percent of all peak period delay and that lane blocking incidents generally account for 10 to 35 percent of all non-recurring delay. The study shows that the causes of congestion vary considerably from one location to another, and with respect to peak and off-peak periods. Correlating incidents with real travel time data also showed that some occurrences of extreme congestion were not related to recorded incidents, even though traffic flows behaved as if under incident conditions. Factors of non-recurring congestion include:

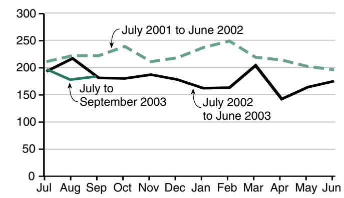
- Lane blocking accidents and disabled vehicles,
- Other lane blocking events, (e.g., debris)
- Construction lane closures,
- Significant roadside distractions that alter driver behavior (e.g., roadside construction, electronic signs, a fire beside the freeway),
- Inclement weather,
- Heavier than normal vehicle merging movements, and
- Significant increases in traffic volume in comparison to "normal" traffic volumes.

This congestion relationship and measurement is complex and requires further analysis. The effect of non-recurrent congestion on predictable, reliable highway travel is dramatic, and WSDOT continues to develop measurement tools for analyzing and communicating the reliability of highway corridors (see below).

Incident Response: Is It Worth It?

On February 13, 2002, WSDOT signed a Joint Operations Policy Statement (JOPS) with the Washington State Patrol (WSP) to integrate resources for responding to incidents and increasing security. JOPS established a target for WSDOT's Incident Response Team (IRT) that all incidents on highways be cleared within 90 minutes.

Average Clearance Time for Incidents Lasting Over 90 Minutes
3-Year Comparison: July 2001 to September 2003



The 2002 Washington Legislature funded an additional 19 incident response vehicles. Today, the IRT has 44 units that rove on 35 highway segments statewide during peak periods, with most of the units concentrated in the central Puget Sound region. Tracking changes in non-recurrent congestion and reliability will help the agency evaluate its investment in IRT.

WSDOT conducted a disabled vehicle case study on a section of I-405 where incident response vehicles were recently deployed in order to calculate the delay savings gained. Comparison with and without IR shows an average seven-minute reduction in clearance time.

Using a disabled vehicle incident that occurred on I-405 at milepost 13.5 (21.7 km), WSDOT calculated the savings to other motorists in fuel and other operating costs at $5,800 per incident. Cost of time savings is even greater, at more than $7,000 per incident. In order to calculate the savings, WSDOT applied volume information provided by loop detector data, and the volume of commercial truck traffic to other types of traffic, provided by HPMS data (for more information visit *www.wsdot.wa.gov/accountability/GrayNotebookJun-03.pdf#page=48*).

Measuring What Matters: Travel Time Reliability

Route	Route Description	Miles	Peak Time	Avg. Travel Time Without Incidents	Avg. Travel Time With Incidents	95% Reliable Travel Time
I-5	Everett to Seattle	23.7	7:25 am	37 minutes	56 minutes	62 minutes
I-405	Tukwila to Bellevue	13.5	7:40 am	22 minutes	34 minutes	43 minutes
SR 167	Renton to Auburn	8.8	4:25 pm	15 minutes	26 minutes	39 minutes

If a commuter begins the route at the Peak Time, she can expect to be on time for work 19 out of 20 working days a month (or 95% of trips), if she allows for the 95% Reliable Travel Time. From www.wsdot.wa.gov/accountability/archives/graynotebookJun-02.pdf#page=11

Travel time reliability and predictability is of utmost importance to the public. Variability in travel times leads to frustrating and costly uncertainty for commuters and haulers.

Travel time reliability and predictability is of utmost importance to the public.

WSDOT uses archived loop data to calculate a reasonable approximation of the "worst case" travel time scenario using the travel time at the 95th percentile (95 percent of the travel times are equal to or less than this marker) for a particular route.

In June 2003 WSDOT launched a new web page called "Calculate Your Commute" that provides a 95 percent reliable travel time for web users at *www.wsdot.wa.gov/pugetsoundtraffic/traveltimes/reliability*. Travelers using the service can choose one of 12 Puget Sound commute routes, the direction of travel and the time they plan to leave in 5-minute intervals from 6 a.m. to 7 p.m. The 95 percent reliable times presented on the web page are based on archived weekday travel time data for 2002.

Where the Data Comes From

In the Puget Sound region, operational data are collected from more than 4,000 induction loops embedded in the pavement of the state highway system. These loops are arrayed to gather data for each lane at roughly 360 highway locations.

Loops provide two measurements: vehicle count and the length of time each vehicle occupies the loop. This data is then used to estimate traffic volumes and speeds. Speed estimation using single loops is accurate to 5 or 10 mph (8 to 16.1 kph) in free-flow steady speed conditions. WSDOT has also installed "speed stations" (double loops) at about 100 locations in the freeway system. These stations provide accuracy to within 1 or 2 mph (1.6 to 3.2 kph) at ordinary driving speeds.

Data from the loop detectors are relayed to a centralized Transportation System Management Center (TSMC), where they are automatically converted into a color-coded map depicting traffic flow, as shown below. This digital traffic flow map is updated approximately once per minute, twenty-four hours per day. The map can be accessed on the Internet at *www.wsdot.wa.gov/pugetsoundtraffic/cameras*. In addition, the measurements from the speed stations and single loop detectors are used to adjust freeway ramp meter timing and inform traffic managers about conditions on the freeway system. Travel times are calculated using speed and volume data from multiple loops in a series along the freeway.

At any given time, approximately eight percent of freeway loops are flagged as out of reliable operation. The Unviersity of Washington's Transportation Center (TRAC) developed detailed quality control procedures that WSDOT uses to detect loop failures, exclude bad data, and support the level of accuracy that is needed for traffic management and reporting traffic conditions to the public.

Next Steps

The use of loop technology presents limitations and challenges. As an aging technology, loop detectors may become less cost effective or less accurate than emerging technologies, such as automatic vehicle locators (AVL). The system also requires regular investments in maintenance and replacement, as well as detailed quality control procedures to detect loop failures and exclude bad data.

WSDOT is exploring other ways to gather travel time information in areas where it is not feasible to expand loop infrastructure. WSDOT has begun to use roadside speed cameras (machine vision) to estimate traffic speeds on state highways in Pierce County, south of Seattle. The data is processed in essentially the same way as loop data, and displayed in the same format on a digital flow map of highways in the Tacoma area (see the flow map at right).

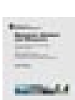
Another ITS data project focuses on correlating weather elements and congestion data to predict weather-related congestion and incidents.

For Future Research

Practitioners would benefit from further research in the mining, application, and interpretation of ITS data. Suggested research topics include:

- Applying travel times and reliability measures to planning and decision making,
- Forecasting travel times, delay, and reliability,
- Developing travel time measures for highway segments without ITS data, and
- Cost-benefit analysis of operational and capital strategies that improve reliability and travel times.

WSDOT also publishes annual travel time comparisons as part of its widely distributed quarterly performance report *Measures, Markers and Mileposts*, also referred to as the *Gray Notebook*. A comprehensive web based archive and index of the *Gray Notebook* allows easy public access to all current and previously published congestion related performance measures (*www.wsdot.wa.gov/accountability/graybookindex.htm*). The *Gray Notebook* editions can be electronically accessed at www.wsdot.wa.gov/accountability.



For more information, please contact:

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Appendix C:

Ohio Budget Testimony

Ohio Department of Transportation
Budget Testimony
Director Gordon Proctor

Before the

Ohio House
Finance Committee

February 12, 2003

Chairman Calvert, members of the House Finance Committee, I am Gordon Proctor, director of the Ohio Department of Transportation. On behalf of Governor Bob Taft, I thank you for this opportunity to present the proposed ODOT budget for 2004-2005. It is my privilege to be here and to represent the 6,000 men and women of ODOT. I thank you for the time you are affording me.

It is a cliche for the director of transportation to say that we are standing at a crossroads. However, we are. You and I - collectively - the General Assembly, the Administration, the public at large - we must decide how we will manage our transportation system.

In simple terms, we have 21st century traffic and 21st century demands upon a highway system that was planned in the 1950s, built in the 1960s to meet the needs of the 1980s. Our system served us well for the last half of the 20th century. Now, we face the task of updating it to serve Ohio's needs for the first half of the 21st century.

We do stand at a crossroads. How we deal with this budget will have a large bearing on how we as a state rebuild our transportation system for the rest of this decade. This budget will carry us through State Fiscal Year 2005. By then, half of this decade will be over. How we proceed in this budget will set the stage for what we do for the rest of this decade - for the first decade of the 21st century.

We have a choice. If conditions are left unchanged, ODOT's Major New Construction Program will fall to zero by 2005. The state's rebuilding of dangerous interchanges, the widening of highways, the state assistance to major transit projects will end. Local governments face the task of rebuilding the one-in-seven local bridges that are structurally deficient. Less than 10 percent of local roads are wide enough to meet current safety standards. They don't want these conditions to continue. They seek our help.

Figure 1 - Prime Location

Ohio lies within 600 miles of nearly 70 percent of North America's Manufacturing capacity. This puts Ohio in a competitive position.

For the past year, good work has been done by the General Assembly's Motor Vehicle Fuel Tax Task Force. The General Assembly appointed a broad cross section of transportation experts and interest groups to review Ohio's transportation needs. That task force also recommended Ohio raise additional transportation revenue.

Governor Taft and I agree with those task force findings.

Governor Taft has proposed a far-reaching transportation plan to deal with these issues. If this financing plan is approved, we will increase local government assistance substantially. State revenue for our townships will increase by $63 million a year. State revenue for our counties will increase $105 million a year. State revenue for our cities will grow an additional $121 million a year. With that our townships, counties and cities will rebuild aged bridges and widen unsafe roads.

The Governor's plan ensures ODOT's new construction program can continue to address high-priority projects across Ohio. The Governor's plan provides steady, predictable revenue which will allow ODOT to work with its cities, its counties and its regions to plan for a better transportation system for their 21st century needs.

This plan and this budget call for a six-cent fuel tax increase, spread evenly over three years. It also calls for $175 million in higher fees - a $5 increase in registration and license fees and a $15 fee on title transfers. This plan would raise about $570 million when fully implemented in three years.

Of that $289 million will go to local governments, $289 million will go to ODOT. In addition, the fee increases will go to the Ohio Department of Public Safety to provide it with a stable and dedicated source of new revenue.

The Governor has taken a hard step. He has proposed new revenue. But he recognizes - as do I - that failing to act will lead to more accidents, more congestion, less reliability on our highways and it will reduce Ohio's competitive advantage.

Interstate System

Let me give some examples, starting with the interstate highway system. By the end of the upcoming state biennium, Ohio's interstate highway system will be on the verge of its 50th anniversary. The interstate highway network in Ohio:

- comprises only 7 percent of state highway mileage but;
- carries 52 percent of Ohio's traffic;
- carries 83 percent of Ohio's truck freight;
- moves nearly $1.1 trillion worth of commodities annually; and
- Ohio's roadway network - and primarily the interstates - handles 14 percent by value of the entire nation's truck freight, the third highest amount nationally.

The system is disproportionately important because of Ohio's strategic location. As shown in Figure 1, within a day's drive of Ohio lies 50 percent of North America's population and 70 percent of North America's manufacturing capacity. This location causes Ohio to have the country's fourth-largest interstate highway system which serves as a critical component of America's freight network, as shown in Figure 2.

As Figure 2 illustrates, Ohio is literally a crossroads for America's freight. This graphic depicts America's major highways. The darker and wider the highway, the more freight it carries. Ohio's highways are more densely used for freight shipments than those in almost any state.

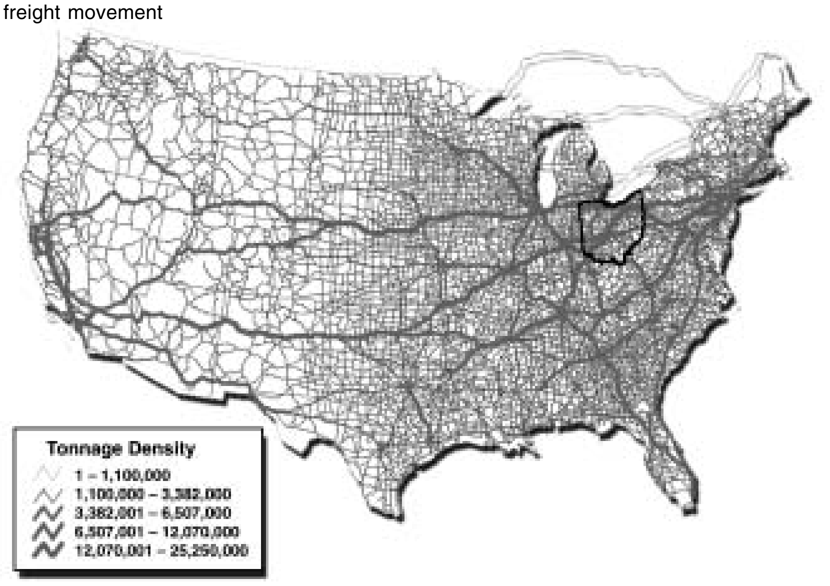
Although our geographic size is 35th among all states, Ohio has:

- The nation's 10th largest highway network;
- The fifth highest volume of overall traffic;
- The fifth highest volume of truck traffic;
- The fourth largest interstate system;
- The third greatest value of truck freight; and
- The second largest inventory of bridges.

This large transportation system has allowed Ohio to take advantage of its competitive location and has allowed the state to be a major exporter of manufactured products. Ohio's economy is the seventh largest in America and the 23rd largest in the world. We are third overall in manufacturing nationally, we are second in automotive manufacturing, we are second in fabricated metals and we are *second in the number of manufacturing jobs tied to exports*. An estimated $336 billion in raw materials and products move into Ohio each year and an estimated $409 billion in products moves out of Ohio each year. Another $275 billion moves within the state and $810 billion moves through Ohio annually.

Figure 2 - Highway Freight Density

Ohio is one of America's freight-shipping centers. The wider the band, the heavier the freight movement



Our transportation network hums. It works 24/7 moving $1.8 trillion dollars worth of products annually.

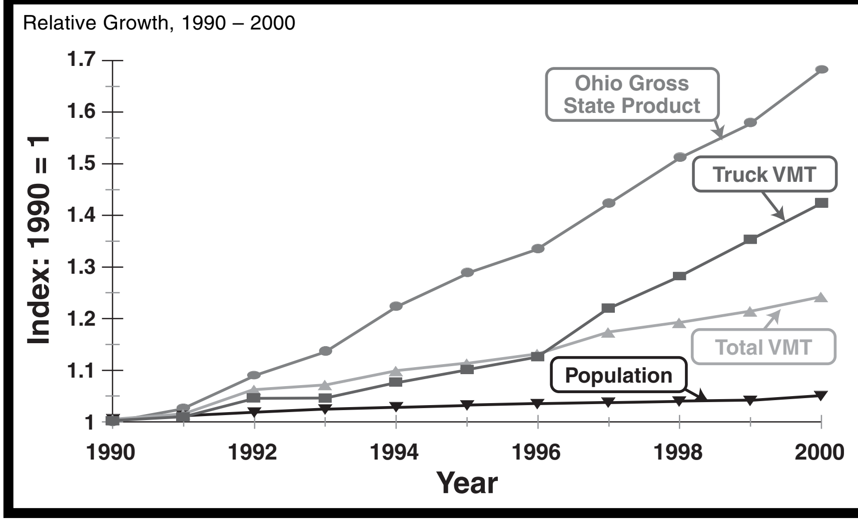
It is no wonder that our interstate system is seriously strained. Truck traffic rose 42 percent between 1990 and 2000 and it rose 78 percent in the past 25 years. It is expected to rise 62 percent more in the next 20 years. Interstate highways in the downtowns of every major Ohio city carry at least 15,000 trucks daily and several carry 20,000. By 2020, ODOT forecasts 30,000 trucks a day will be the norm for urban intestates in Cincinnati, Cleveland, Columbus, Dayton and Toledo.

Our interstates are the conveyor belt for Ohio's Just in Time economy. As shown in Figure 3, truck traffic rises commensurately with the increase in state Gross Domestic Product. Several factors drive this trend. Just in Time inventory is essential today. Manufactured goods are more complex and have more components which must be shipped for assembly. Also international trade is growing in importance. International trade makes up 27 percent of America's gross domestic product, up from 11 percent in 1970. By 2025 it is estimated 37 percent of America's GDP will be tied to international trade.

Trade is movement. As we trade more, as we produce more, as our economy grows more, travel and traffic increase.

The down side is the interstate highways, in every urban core, are congested, high-accident locations. These

Figure 3 - Ohio Economic and Travel Indices



urban interstates were designed in the 1950s to meet the traffic volumes of the 1980s. Today, few of them operate adequately.

Interstate 75 in Toledo carries 19,000 trucks a day. It is 43 percent over capacity and it averages 100 accidents per year per mile. A 17-mile stretch of I-75 in Cincinnati carries 184,000 vehicles a day, including 14,000 trucks and it averages 80 accidents per year per mile. I-75 in Dayton carries 20,000 trucks per day and averages 80 accidents per year per mile.

The most congested location is the overlap of Interstate 70 and Interstate 71 in downtown Columbus, the figurative and literal crossroads of Ohio. In that juncture the interstates are 114 percent over capacity and average 274 accidents per mile per year. That equals more than one accident for every business day of the year. Within a 2.5 mile radius of the junction, the routes experienced 2,037 accidents over a three-year period.

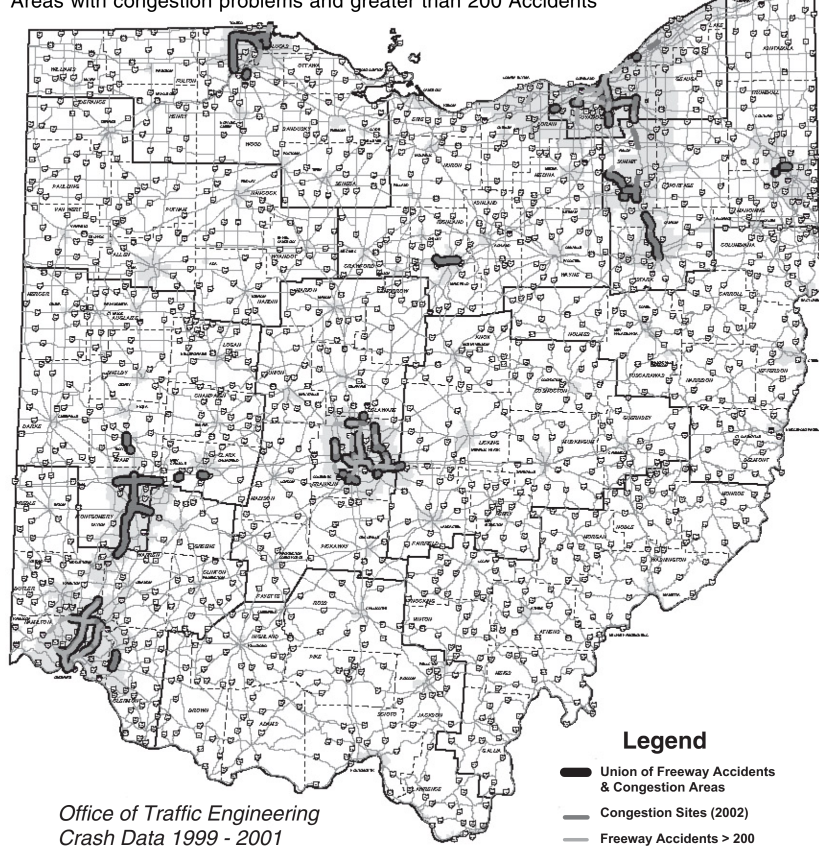
Forty-three percent of all freeway accidents in Ohio occur on just 12 percent of the freeway network. These locations are shown on the map, Figure 4, of high-congestion/high-accident freeway locations. These locations are primarily outdated cloverleaf and "loop ramp" interchanges, they are freeway merge areas and they are the core, downtown urban interstates.

Ohio had experienced a steady drop in accidents and fatalities between the mid-1960s and 1990. Since 1990, the number of crashes and fatalities has fallen little, as shown in Figure 6. ODOT believes two factors influence this lack of progress. First is the suburbanization of Ohio, where more people have moved to fringe urban areas and are driving on inadequate two-lane roads. Second, is the rising congestion on the interstate highways. Drivers expect free-flow conditions on freeways. However, the leading accident type on Ohio's freeway system is rear-end crashes. Thirty-four percent of all Ohio freeway crashes occur when motorists unexpectedly drive into stopped traffic on the freeway.

ODOT is conducting major studies in virtually all of Ohio's major cities to determine what can be done to fix these urban freeway sections. A tentative price tag for the major projects is $3.45 billion for the projects in Cincinnati, Cleveland, Columbus, Dayton and Toledo.

Figure 4 - Congestion Locations vs. Freeway Crashes

Areas with congestion problems and greater than 200 Accidents



Rural Corridors

Freight volume also spills onto major rural corridors. The accompanying map, Figure 5, illustrates the rural two-lane routes in Ohio which carry at least 30 percent of their volume as truck. These routes are predominately in Northwest Ohio because of the pinch point caused by Lake Erie, the magnitude of the Detroit-Canadian traffic, and the fact Toledo is nearly midway between Chicago and New York. Northwest Ohio always has been a freight center because of its highway, water and rail connection points.

ODOT has a discrete set of "Macro-Corridor Projects" to complete selected rural corridors into an integrated, statewide network. The estimated cost to complete these projects is $1.7 billion. That would upgrade U.S. Route 30 across Ohio, upgrade U.S. Route 24 and complete the remaining corridors. Once completed, 94 percent of Ohio's population would be within a 10-mile drive of a major corridor. This network would provide every region of Ohio with a modern transportation corridor for safe travel and economic development.

Total Capacity Need

The combination of the rural Macro-Corridors and the critical urban interstate projects total $5.1 billion. Those projects do not include all projects requested by communities but they do represent the bulk of the requests before the Transportation Review Advisory Council. To address these projects requires a large sustained investment over time. With a new construction program of $250 million annually, - as contained in this budget - ODOT could address 46 percent of these projects over 10 years. If we are successful and increase our federal return, as well, we could have up to a $400 million program over 10 years. That would allow ODOT to address approximately 80 percent of these projects.

Figure 5 - Two-Lane Principal Arterials

Carrying More Than 30% Trucks

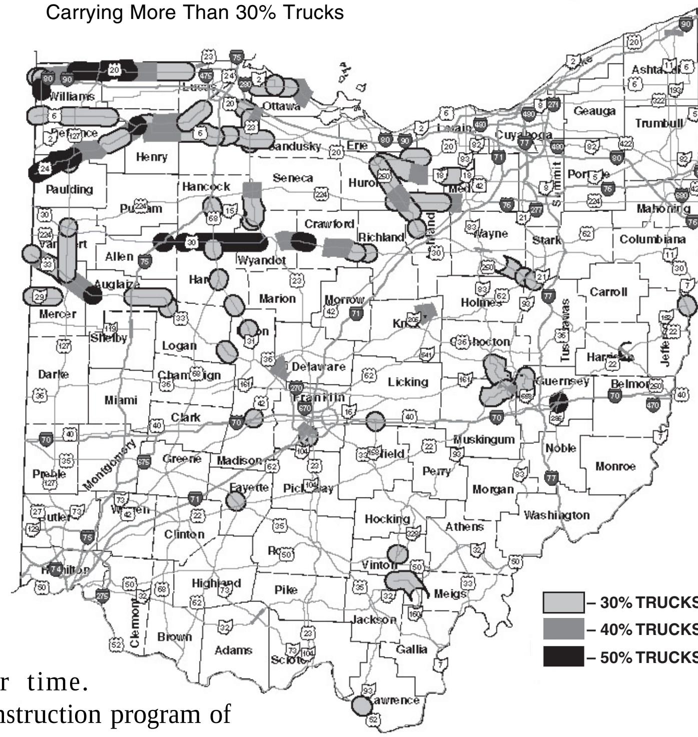
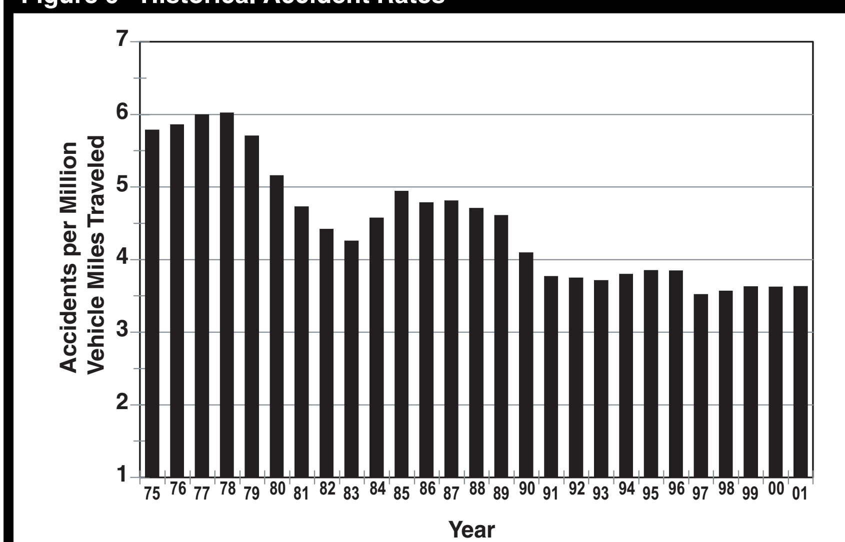


Figure 6 - Historical Accident Rates



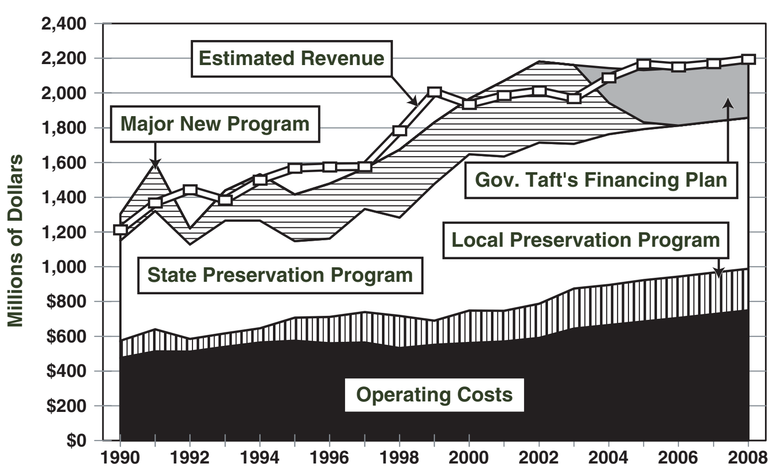
Local Needs

The Motor Vehicle Fuel Tax Task Force heard repeatedly from local governments. They are deeply concerned about the safety and adequacy of their roads and bridges. Please consider that:

- Of the 29,777 miles of county highways, only 9.2 percent meet or exceed the 20-foot minimum safe standard width;
- Ohio's rural routes carry only about 30 percent of Ohio's traffic but they have 70 percent of Ohio's fatalities;
- About 13 percent, or one in seven, of Ohio's local bridges are structurally deficient; and
- About 11,000 of the counties 27,000 bridges, are more than 50 years old.

The cities, the townships, they face similar issues. They are concerned and rightfully so. They are asking for our help. This budget would provide it. In this budget there is a substantial increase in the absolute and proportional share of state assistance to local government. Under current law about 24 percent of the state motor fuel tax proceeds

Figure 7 - ODOT Highway Funding FY 1990-2008



Major New Program Includes: SSI, SE Ohio Plan.
State Preservation Plan includes: Pavement, Bridge and Other preservation.
Operating Costs includes: payroll, labor, maintenance items, equipment, building debt service, heavy equipment, snow & ice removal, planning & research, and rest area maintenance agreements.

go to local governments. That would increase to more than 30 percent.

Biennial Budget Situation

At a time of such great need and great change, ODOT's budget situation is very uncertain. That is why, in part, Governor Taft proposed this transportation package.

ODOT has been fortunate because since 1995 it has had an average Major New Construction program of approximately $350 million annually. It has funded this program through three major sources, internal operating savings, higher bond income and increased federal funding. This program has achieved major accomplishments. ODOT's Major New Construction program eliminated bottlenecks, reduced congestion, improved safety and linked rural areas through improved corridors.

However, without the Governor's financing plan ODOT's biennial budget for 2004-2005 would be an estimated $475 million less than in the current 2002-2003 biennium. This reduction is attributable to several factors:

- ODOT has exhausted past cost savings which had generated excess capital. After eight years of 2 percent budget growth, all substantive operating savings are used.
- ODOT's state bond income would fall from $220 million annually to $103 million without the Governor's proposal. ODOT had borrowed at the $220 million rate since 1996 and used payroll cost savings to make the bond payments. With the operating savings exhausted, ODOT only can afford $103 million in bonds without new revenue.
- ODOT's federal income for this next biennium is less than projected when the 1998 federal transportation act was enacted.
- ODOT's maintenance costs and the amount of money passed through to the locals continues to grow at a nominal rate, requiring additional revenue.

These factors - stagnant federal income, falling bond income, rising maintenance costs and some return of operating cost increases - combine to reduce ODOT's funds for Major New Construction to zero by 2005 unless new revenue is provided. Governor Taft's proposal would allow ODOT to sustain a minimum Major New Construction program of $250 million annually for at least the next decade. This package allows Ohio to have certainty, to plan, to move forward, regardless of the outcome in Washington.

Federal Picture

As I hope you know, Governor Taft has worked tirelessly at the federal level to bring more of Ohio's federal fuel tax revenue back to the state. ODOT, justifiably, should receive an additional $250 million to $300 million more annually from the federal government. ODOT loses about $140 million annually for its "donor state penalty" of receiving back 89 percent instead of 95 percent of the federal highway taxes paid. ODOT also loses about $160 million annually because of the federal tax break on ethanol.

Continuing a federal campaign to address ethanol and equity remains a critical component of any long-term financial strategy for ODOT. Ohio would be remiss to accept these inequities. Also, Ohio cannot rely on only state or only federal funds to meet its new construction needs. Both a state and federal component is necessary to raise sufficient revenue.

It does not appear, however, the federal revenue increases are likely in the upcoming biennium. The federal act expires in October of this year which is in State Fiscal Year 2004. In the past two transportation acts, Congress has been unable to reach agreement when the act expired. Continuing resolutions were enacted and the acts were reauthorized the following fiscal year. Congressional observers are warning ODOT to not expect a new act in October of this year and warn it could be into federal fiscal '04 before a new bill is enacted.

Also, based on past practices and current fiscal balances in the Highway Trust Fund, it is appearing increasingly unlikely significant new expenditures are likely in the first years of the next Act. Expenditures are calculated two years after receipts into the Trust Fund. Even if the ethanol issue is addressed, pay backs to Ohio may not occur until Federal 2006 and later. That puts any significant federal increase beyond the upcoming state biennium.

In other words, *there is no guarantee these much deserved federal dollars will be available in this upcoming biennium.* Even if we are successful in securing these new federal dollars - as I am sure we eventually will be with the help of the Governor and Ohio's Congressional delegation - ODOT lacks sufficient state dollars to match any new federal funds. In other words, our state funds are so depleted that we could not match these higher federal dollars without additional state revenue.

The Governor's state plan ensures a minimum $250 million new construction program. Depending on our success in Washington, new federal revenue can be added to the program. With the base, state program, we can invest $2.5 billion over 10 years. If we receive an additional $100 million in federal highway dollars, the program would be $350 million per year or $3.5 billion over the next decade. If we pick up $150 million more, the program will be $400 million a year, and so on. The Governor's plan ensures a core program which allows us to plan and move forward regardless of the eventual outcome in Washington.

Why can't ODOT be more efficient?

Governor Taft and I ask the taxpayers for additional revenue reluctantly. We understand the difficulty of asking the public to pay more. The first question many will ask is, Why can't ODOT be more efficient? Why can't it generate savings which could be used to meet these construction needs?

Mr. Chairman, members of this committee, Governor Taft, and we at ODOT, share those sentiments. Some of newer members may not realize it but ODOT has had a compact with this committee since 1995 to be efficient. In the 1996-1997 biennial budget, this committee challenged ODOT to save $50 million from its operating budget and to apply those savings to projects. ODOT surpassed that goal easily and in the end saved $108 million in that biennium.

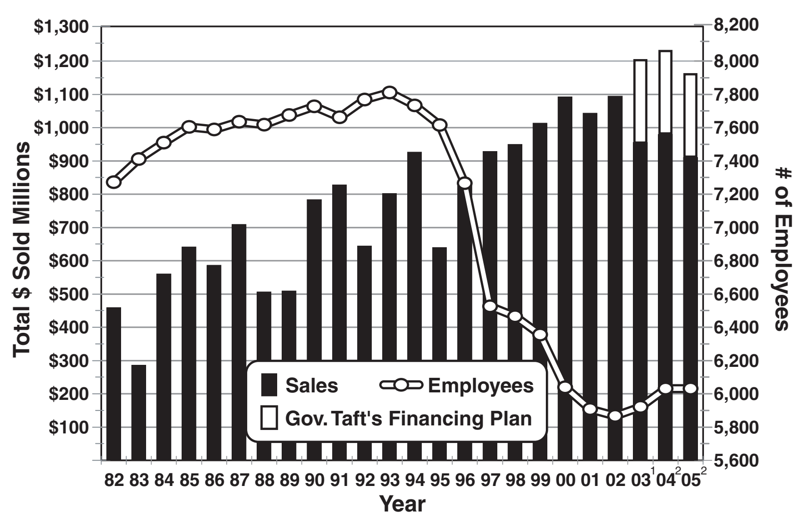
In the next biennium, ODOT pledged to save an additional $35 million but actually saved $95 million. Since those days, we have held our operating growth to 2 percent annually and made savings and efficiencies a way of life at ODOT. ODOT has:

- Reduced its work force from 7,800 people to 6,031 people, a reduction in work force of 23 percent;
- We had the same payroll budget in 2002 that we had in 1995;
- Every single county garage, work unit and district is on a strict budget which compels them to constantly innovate, economize and create greater efficiencies;
- ODOT's payroll today is $108 million less each year than it would be if we had not downsized;
- We have saved $203 million in direct savings and avoided another $600 million - conservatively - in expenditures compared to what operating costs would have been if we had allowed ODOT's budget to grow at historic rates from 1995 to 2003;
- Despite being 23 percent smaller, project delivery has increased from $721 million worth of construction in 1995 to $1.2 billion in 2002.
- Despite being 23 percent smaller, the number of miles of deficient pavement on the freeway system were reduced by 66 percent;
- Despite being 23 percent smaller, the percentage of structurally deficient bridges has been cut by one half;
- Despite being 23 percent smaller, the percentage of damaged or deficient guardrail has been cut 60 percent; and
- Despite being 23 percent smaller we have reduced sign deficiencies by 29 percent and pavement striping deficiencies by 27 percent.

By nearly every major performance measure, ODOT is leaner, more effi-

Figure 8 - Construction / Maintenance Contracts Sold By Fiscal Year Compared to ODOT Full Time Employees

(Excluding Contracts Sold by Locals)

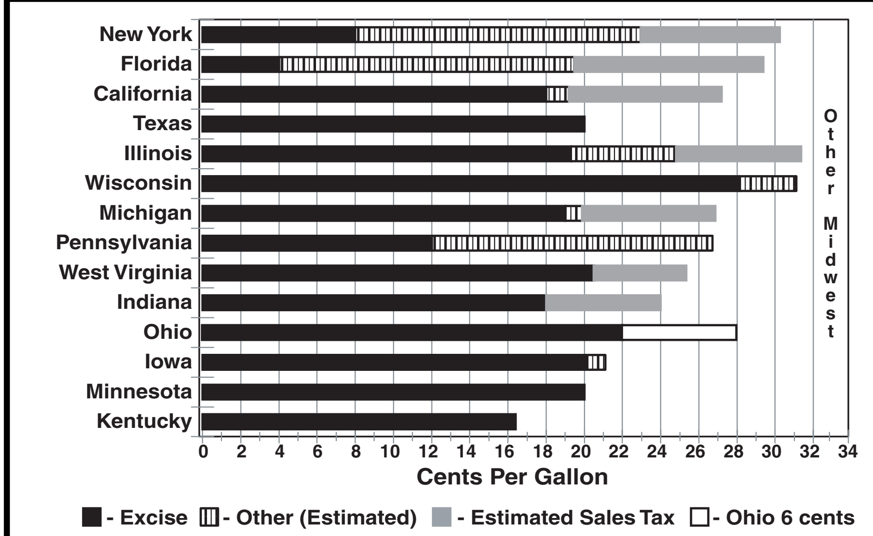


[1]Estimated for FY 2003 [2]Estimates based on submitted budgets for FY 2004 and FY 2005

cient and more effective than ever.

These efficiencies have created savings which we re-invested into our highway system. The North Outerbelt Widening in Columbus was paid for with ODOT operating savings. Much of the Fort Washington Way in Cincinnati project was constructed with state funds paid for with ODOT operating savings. In all, ODOT's savings and the increased bonding that the savings made possible between 1996 and 2002 have generated $931 million in additional construction dollars. That is the equivalent of a gas tax increase of 2.5 cents for eight years.

Figure 9 - Equivalent State Motor Fuel Tax (gasoline only)



Source: www.taxadmin.org/fta

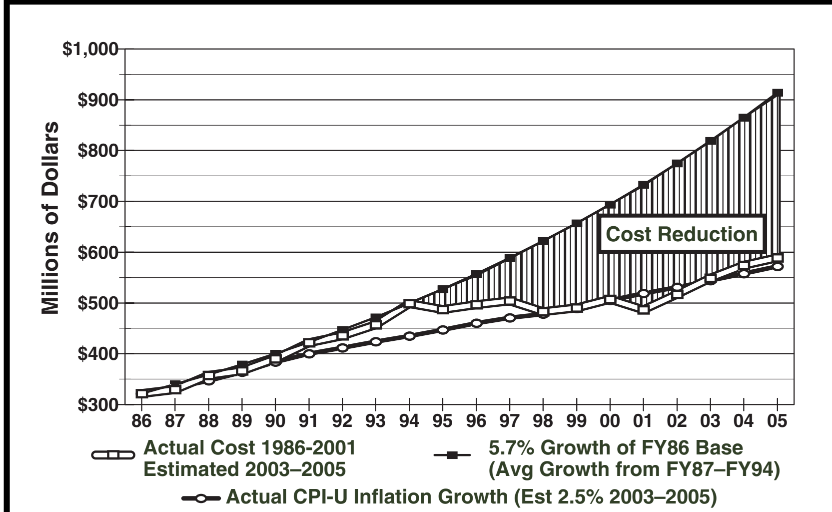
That is what ODOT generated through savings, through efficiencies, through innovation.

However, the days of expecting such large reductions of internal operating savings are over. We are stabilized at 6,031 employees. That is minimal level we need to plow snow, produce construction plans and to inspect construction projects. Operating costs will begin to rise - at about 3 percent in the next year and possibly more depending on contract negotiations, health care costs and other factors.

Mr. Chairman, members of the committee, we have used bonds and other innovative financing to their maximum recommended levels. Our bond indebtedness on state revenue is 17 percent without Governor's Taft plan. Without new revenue, it would not be prudent to acquire additional debt.

Mr. Chairman, members of this committee, the Governor and ODOT have done everything possible to meet Ohio's transportation needs without asking for additional revenue. No doubt we at ODOT are not perfect and that further improvements in our operations are possible.

Figure 10 - ODOT Operating Cost Comparison FY 1986 – 2005



Costs Include: Payroll, Materials, Equipment, Cars & Trucks, Land & Buildings, Building Debt Service, & Custodial Contracts. Costs do not include Snow & Ice Materials or Roadway Maintenance Contracts.

However, the size, scale and scope of investment that Ohio's transportation system faces in the next 20 years is measured in the billions and not millions of dollars. These needs are not going to be met by further internal improvements alone.

I ask for your support of this budget. It builds upon the fiscal prudence ODOT has practiced in recent years. It invests for Ohio's future. It improves the safety of our local roads. It makes our local bridges safer. It will improve our freeways to handle 21st century demands. It will allow us to link our rural areas. It will build a better Ohio.

Chairman Calvert, members of the committee, thank you very much for this time. I apologize for the length of this message but this issue is very important and very complex.

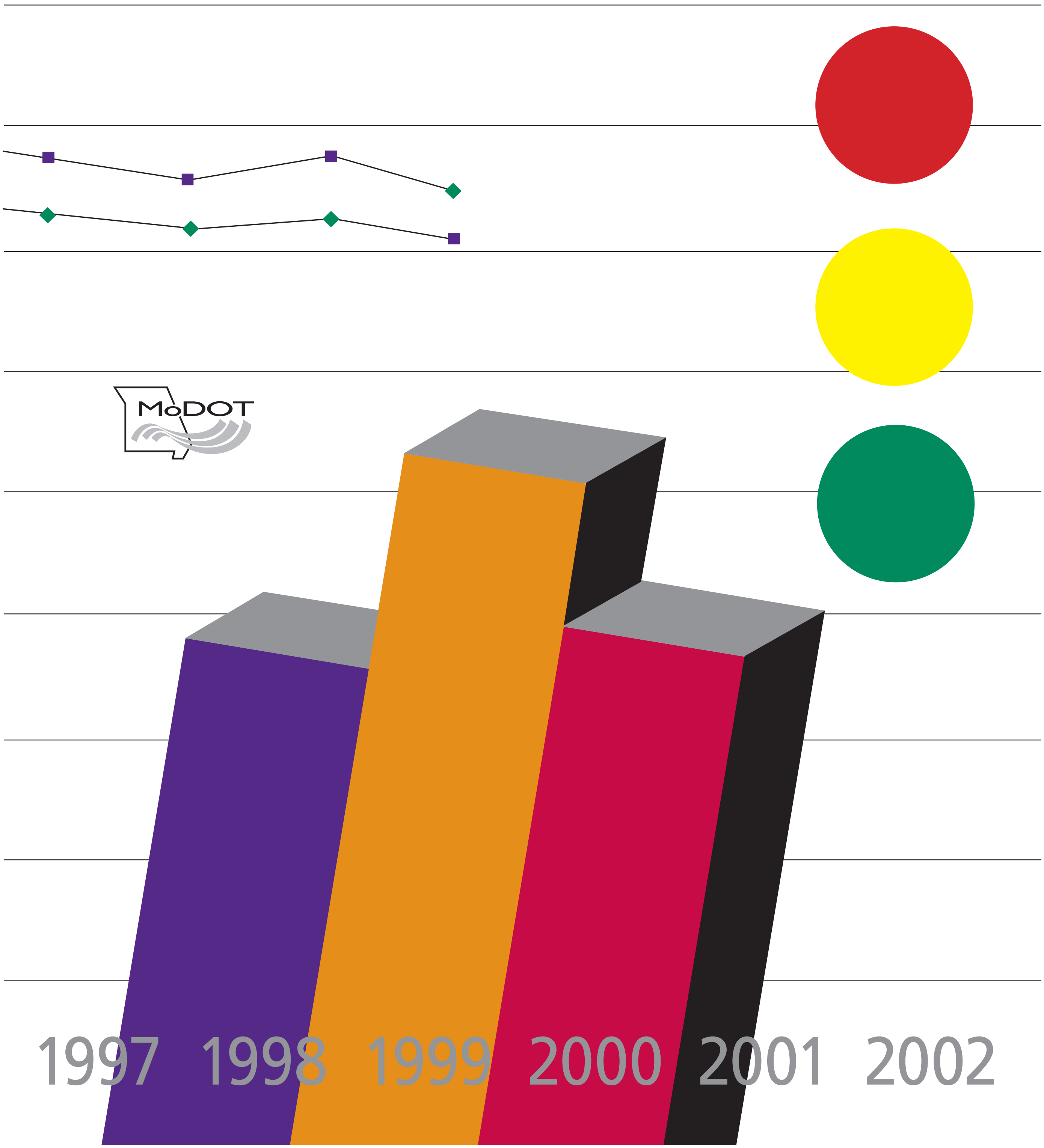
I am happy to answer any questions.

Appendix D:

Missouri Dashboard

MoDOT Dashboard

Measurements of Performance



MoDOT Dashboard
Measurements of Performance

Establishing effective performance management to focus on positive business results can transform an agency into a customer-driven government organization that significantly improves its operation to achieve remarkable success.

MoDOT Dashboard is a semiannual report that will allow the department to assess their overall progress and demonstrate accountability.

Our Mission Is:

Taking care of and improving Missouri's transportation system

"Performance measurement is a critical function for MoDOT and we have made considerable progress managing the taxpayers' money wisely as it relates to transportation. We will continue to look for efficiencies in our operations."

Henry Hungerbeeler
Director
Missouri Department of Transportation

MoDOT Dashboard

Revised June 17, 2003

KEY:
(G) – The target was met or exceeded (for the time period in which data is collected)
(Y) – The trend was positive, but the target was not met (or not target established)
(R) – The trend was negative and the target was not met (or no target established)
--- The measure is under development.

Performance Measure	Trend	Comments
Take better care of what we have		
Traffic fatal and injury crash rates compared to national average	Y	Fatal and injury crash rates (2001) – Trend for fatal crash rate is decreasing but rate still higher than national rate; the injury crash rate is meeting the performance goal (Pages 1 & 2)
State system traffic fatality and injury crash trend	G	Fatality and injury crash totals – Five-year trend for 2001 is decreasing (Pages 3 & 4)
Percent of major highway miles in good or better condition	R	There has been a decrease of major highway miles in good or better condition since 2000 (Pages 5 & 6)
Percent of deficient bridges	Y	Although statistics show a decrease in the percentage of deficient bridges on the state system, there is still a significant gap in the deficiency on the state system compared to all states (Page 7)
Roadway Congestion Index (RCI) for Kansas City and St. Louis compared to national average	Y	We have met the goal of being below the national average but the overall trend in RCI is increasing (Pages 8 & 9)
Percentage of statewide striping program completed		New measure - in the process of gathering data (Page 10)
Mowing costs vs. herbicide costs	G	Costs were above baseline for the herbicide program and below the baseline for the mowing program (Pages 11 & 12)
Net assets at year end	Y	Preliminary FY 03 financial statements indicate net assets are decreasing (Page 13)
Finish what we've started		
Percentage of dollars delivered as programmed	G	Result was <5% of dollars programmed for SFY 2002 (Page 14)
Percentage of projects delivered as programmed	Y	Deviation was 9% for SFY 2002 (Page 15)
Percentage of projects delivered on time	R	Target was not met (Page 16)
Percentage of projects delivered within budget	G	Result was <3% of programmed dollars (Page 17)
Build public trust		
Percent of customer satisfaction		New measure – in the process of gathering data (Page 18)
Percent of funding level target utilized by programmed projects by category for the 2005-2009 STIP	G	(Page 19)

Distribution of funds	G ●	FY 2002 indicates construction and maintenance expenditures continue to comprise the largest expenditures of the department (Page 20)
Revenue dispersion	G ●	Revenue dispersion is relatively constant. Federal revenues appear to be below normal for FY 2003, however, the federal advance construction funds were received in May 2003. (Page 21)

Take Better Care of What We Have

Traffic fatal and injury crash rates compared to national average

Desired Trend: ↘

Results: ○ (Y) Fatal and Injury Crash Rates – 2001 trend for fatal crash rate is decreasing but rate still higher than national rate; the injury crash rate is meeting the performance goal.

Last Update: 1/1/2003

Strategic Goal:
Improve safety on the transportation system

Performance Goal/Target:
The goal is for Missouri's state system fatal and injury crash rates to be less than the national fatal and injury crash rates

Green - Both fatal and injury crash rates for Missouri are less than the national fatal and injury crash rates.
Yellow - Only one of Missouri's crash rates, fatal or injury, is lower than the national fatal and injury crash rates.
Red - Both fatal and injury crash rates for Missouri are more than the national fatal and injury crash rates.

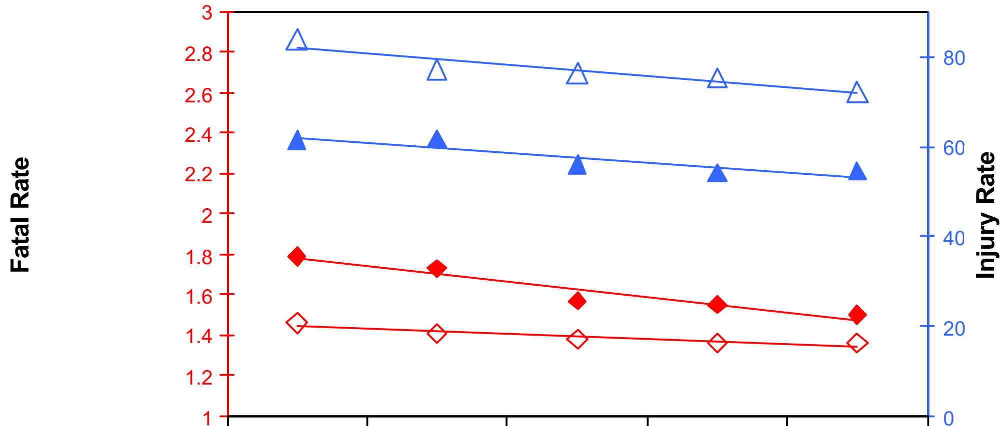
Performance Measures:
(1) Number of Missouri State System Fatal Crashes per Hundred Million Vehicle Miles (HMVM)
(2) Number of Missouri State System Injury Crashes per Hundred Million Vehicle Miles (HMVM)
(3) National Fatal Crash Rate per HMVM
(4) National Injury Crash Rate per HMVM

Additional Information:
MoDOT's fatal and injury crash rates are for the last complete year of data available in TMS (year 2001). The information comes directly from the report titled, "Accident and Rates by Route Marking – Statewide".

The national statistics come from the "Traffic Safety Facts 2001: A Compilation of Motor Vehicle Crash Data from the Fatality Analysis Reporting System and the General Estimates System", published by USDOT – National Highway Traffic Safety Administration.

Fatal and Injury Crash Rates

(state system compared to national average)



	1997	1998	1999	2000	2001
◆ MO - Fatal	1.79	1.73	1.57	1.55	1.5
◇ National - Fatal	1.46	1.41	1.38	1.36	1.36
▲ MO - Injury	61.46	61.82	56.03	53.98	54.64
△ National - Injury	83.88	77.09	76.33	75.27	72.01

Take Better Care of What We Have

State system traffic fatality and injury crash trend

Desired Trend: ↘

Results: ● (G) Fatality and Injury Crash Totals – Five year trend for 2001 is decreasing.

Last Update: 1/1/2003

Strategic Goal:
Improve safety on the transportation system

Performance Goal/Target:
The goal is to decrease fatality and injury crash trends on all Missouri roads.

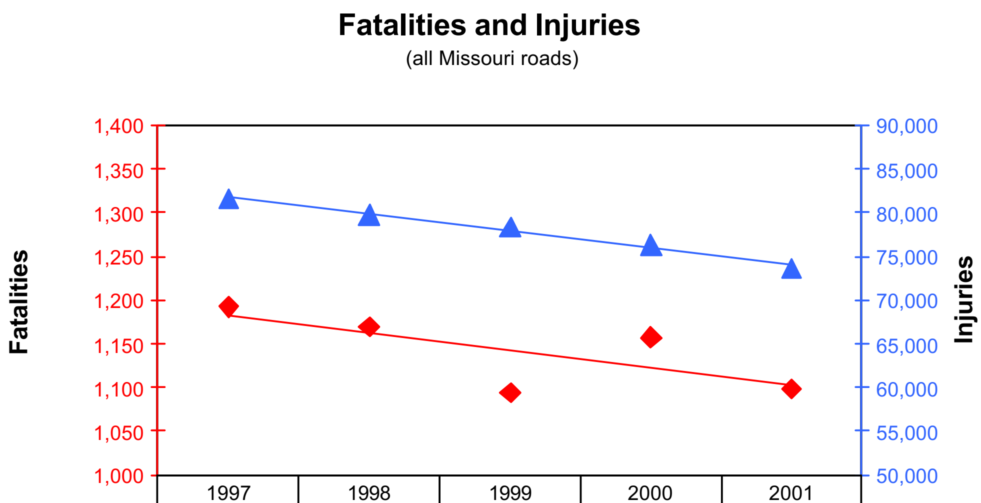
Green - Both fatality and injury crash rates for Missouri show a downward trend
Yellow - Only one of Missouri's crash rates, fatality or injury, is a downward trend
Red - Both fatality and injury crash rates for Missouri show an upward trend

Performance Measures:

(1) Five-year trend of fatality totals for all Missouri roads
(2) Five-year trend of injury totals for all Missouri roads

Additional Information:
The Missouri State Highway Patrol (MSHP) compiles fatality and injury totals for all Missouri roads on a yearly basis. The fatality and injury totals come directly from the MSHP report titled, "Statistical Analysis Center – 2001 Missouri Traffic Safety Compendium".

Fatality and injury information is not used for planning purposes since it is dependent on the number of fatalities and injuries per fatal accident and injuries per injury accident, not the number of fatal and injury crashes. Fatal and injury accident rates are reported in another dashboard measure. Fatal and injury accident rates are dependent on the total number of fatal and injury crashes, which we can more easily influence.



	1997	1998	1999	2000	2001
◆ Fatalities	1,192	1,169	1,094	1,157	1,098
▲ Injuries	81,570	79,765	78,297	76,338	73,618

Take Better Care of What We Have

Percent of major highway miles in good or better condition

Desired Trend: ↑

Results: ● (R) There has been a decrease of major highway in good or better condition since 2000.

Strategic Goal:
Improve the condition of the state's roads and bridges

Performance Goal/Target:
Increase the number of miles considered in good or better condition to:

50 percent on National Highway System (NHS) and remaining arterials with the additional stipulation that 85 - 90 percent of the Interstate must meet the condition goal

Green -	Greater than 1 percent increase
Yellow -	0-1 percent increase
Red -	Any decrease

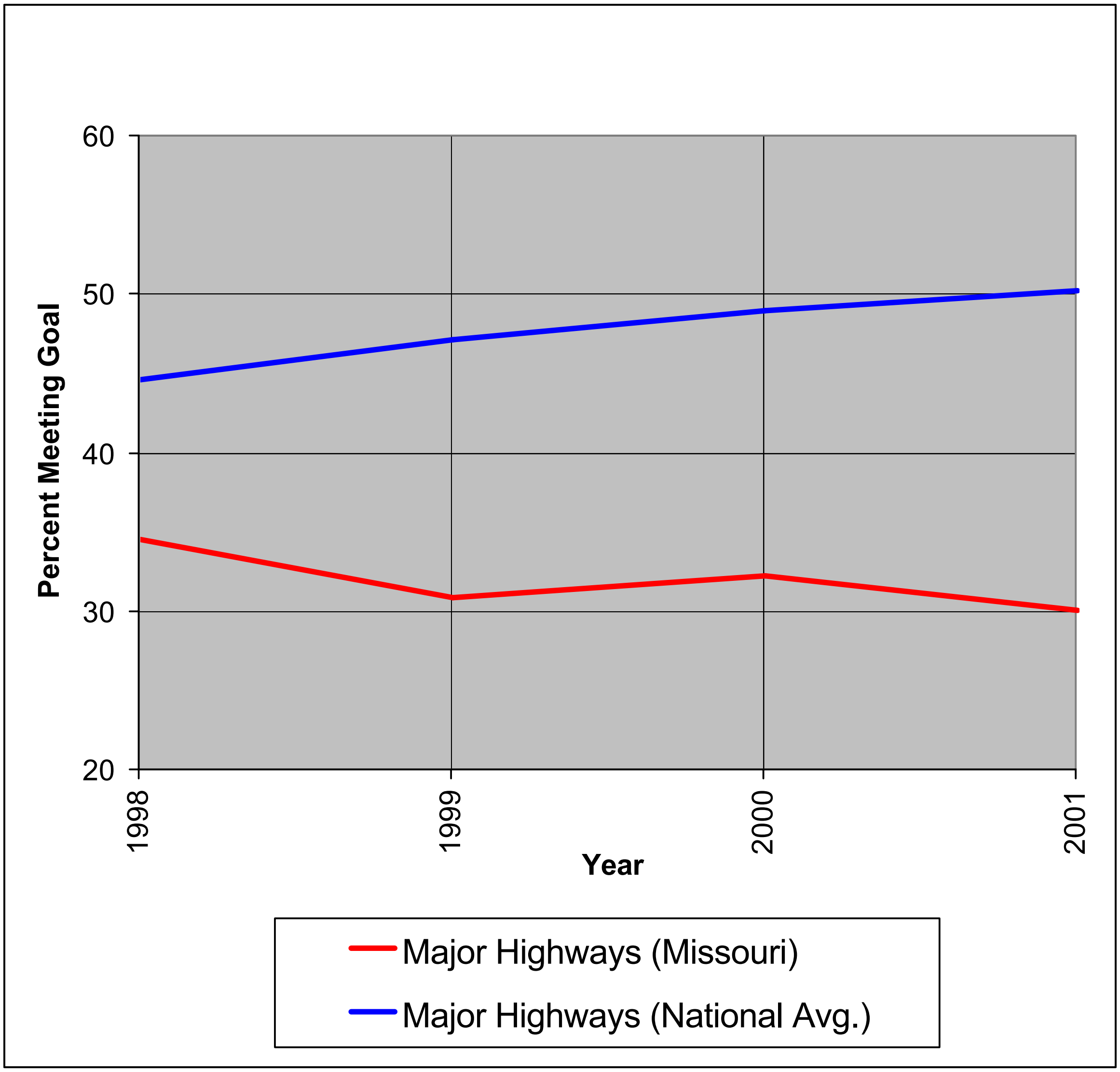
Performance Measures:
Lane miles of pavement that meet the desired condition measure, based on the International Roughness Index (IRI)

Additional Information:
"Major Highways" are defined as those functionally classified as "Arterials". This includes the Interstate system, the National Highway System (NHS), and in general the numbered routes, such as US 63, US 54, US 65, US 60, etc.

The IRI is an internationally accepted measure of pavement smoothness. It is collected annually on all arterial pavements (this includes the Interstate and NHS). An Automatic Road Analyzer operated by Transportation Planning performs this task. IRI is a non-subjective measure of roughness that is also used to report roughness to the Federal Highway Administration for inclusion in the Highway Performance Monitoring System and is thus available for use in comparisons to surrounding states. It has shown good correlation to public perception of pavement quality and to the physical condition of pavements as well.

Results are reported for the Interstate, remaining NHS and remaining arterial system individually as well as collectively.

Percent of Major Highways in Good or Better Condition



Note: All percentages for Missouri Major Highways calculated using 0.02 mile segments from ARAN data using average IRI values. Average for National Highways from FHWA Highway Statistics Manual based on IRI.

Take Better Care of What We Have

Percent of deficient bridges

Desired Trend: ↓

Results: (Y) Although statistics show a decrease in the percentage of deficient bridges on the state system, there is still a significant gap in the deficiency on the state system compared to all states.

Last Update: 3/4/2003

Strategic Goal:
Improve the condition of the state's roads and bridges

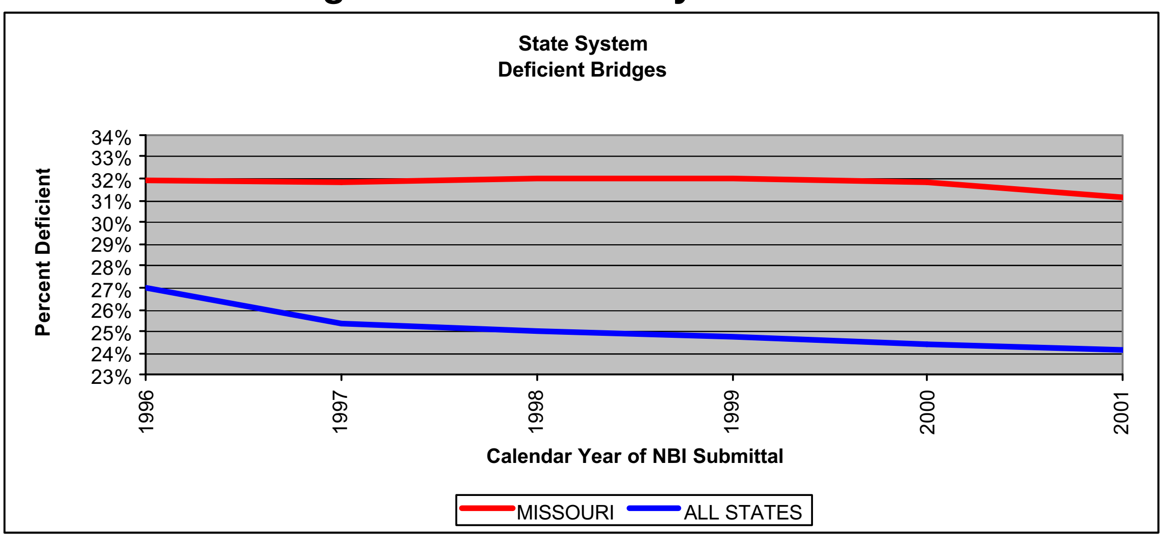
Performance Goal/Target:
Reduce the number of deficient bridges

Green -	Greater than 1.0 percent decrease
Yellow -	0 – 1.0 percent reduction
Red -	Greater than 1.0 percent increase

Performance Measures:
Percent of deficient bridges on the state system

Additional Information:
Deficient structures are determined using Federal Highway Administration criteria for all structures submitted as part of the National Bridge Inventory. This analyses is based on load capacity, physical condition and geometrics. Structures are determined to be either structurally deficient or functionally obsolete. In general deficient structures are no longer considered to be adequate to serve the needs of the public due to poor condition, insufficient load capacity, insufficient roadway width or insufficient clearances.

Percent of Bridges on the State System that are Deficient



Take Better Care of What We Have

Roadway Congestion Index for Kansas City and St. Louis compared to national average

Desired Trend: ↘

Results: (Y) We have met the goal of being below the national average but the overall trend in RCI is increasing.

Last Update: 1/1/2003

Strategic Goal:
Improve safety on the transportation system

Performance Goal/Target:
The goal is to keep the trend for Roadway Congestion Index (RCI) below the national trend for "large urban areas". The RCI estimates congestion levels using a formula that measures the density of traffic.

Green - Both St. Louis and Kansas City MPO's are below the national trend for "large urban areas"

Yellow - Only one, St. Louis or Kansas City, MPO is below the national trend for "large urban areas"

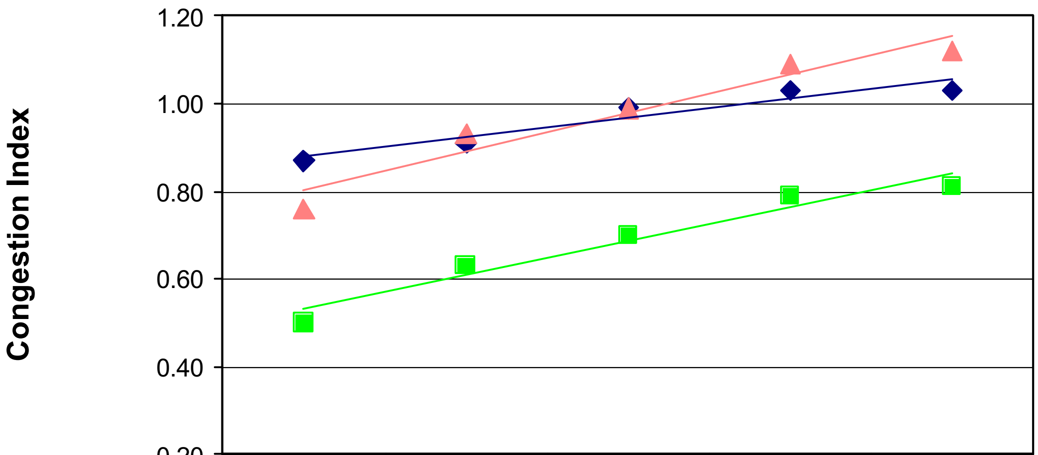
Red - Both St. Louis and Kansas City MPO's are above the national trend for "large urban areas"

Performance Measures:
St. Louis and Kansas City MPO area and national trend lines for RCI

Additional Information:
The St. Louis and Kansas City boundaries include external state data (Illinois and Kansas respectively; MPO regions). Each region will also include state and non-state routes. Both regions are compared to "large urban area" categories. The data was obtained from Exhibit A-18 of "The 2002 Urban Mobility Report" published by Texas Transportation Institute (TTI). The reported years are based on available data from the referenced report and may not be available on a yearly basis. MoDOT does not produce any data in the report.

Roadway Congestion Index

(St. Louis & Kansas City MPO vs. National Avg.)



	1982	1990	1994	1999	2000
◆ St. Louis	0.87	0.91	0.99	1.03	1.03
■ Kansas City	0.50	0.63	0.70	0.79	0.81
▲ National	0.76	0.93	0.99	1.09	1.12

Year Reported

Take Better Care of What We Have

Percentage of statewide striping program completed

Desired Trend: ○

Results: 100% completion of the program.
**In process of gathering data – this is an example.*

Last Update:

Strategic Goal:
Improve the safety of Missouri's transportation system

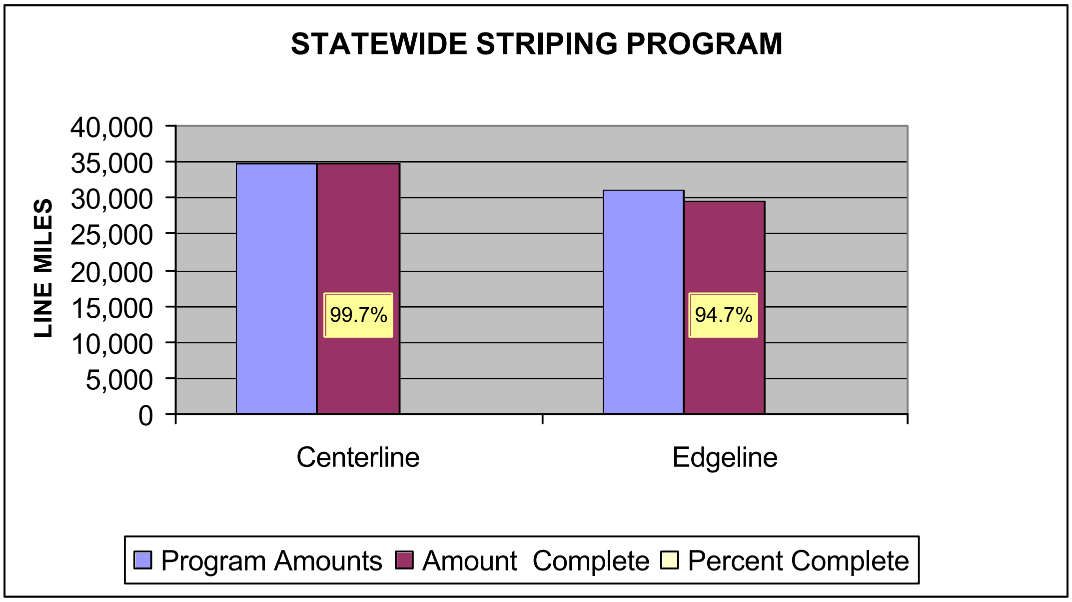
Performance Goal/Target:
Centerline stripe on 100% of programmed line miles for calendar year 2003
Edgeline stripe on 100% of programmed line miles for calendar year 2003

Green - ***Measure under development – definition to be determined***
Yellow - ***Measure under development – definition to be determined***
Red - ***Measure under development – definition to be determined***

Performance Measures:
100% completion of striping for calendar year 2003

Additional Information:
Centerline stripe all roads
Edgeline stripe all roads > 1000 average daily traffic

In process of gathering data – this is an example.



Take Better Care of What We Have

Mowing costs vs. herbicide costs

Desired Trend: Remain below the baseline for mowing costs and remain above the baseline for herbicide costs.

Results: ● (G) Costs were above baseline for the herbicide program and below the baseline for the mowing program.

Last Update: March 31, 2003

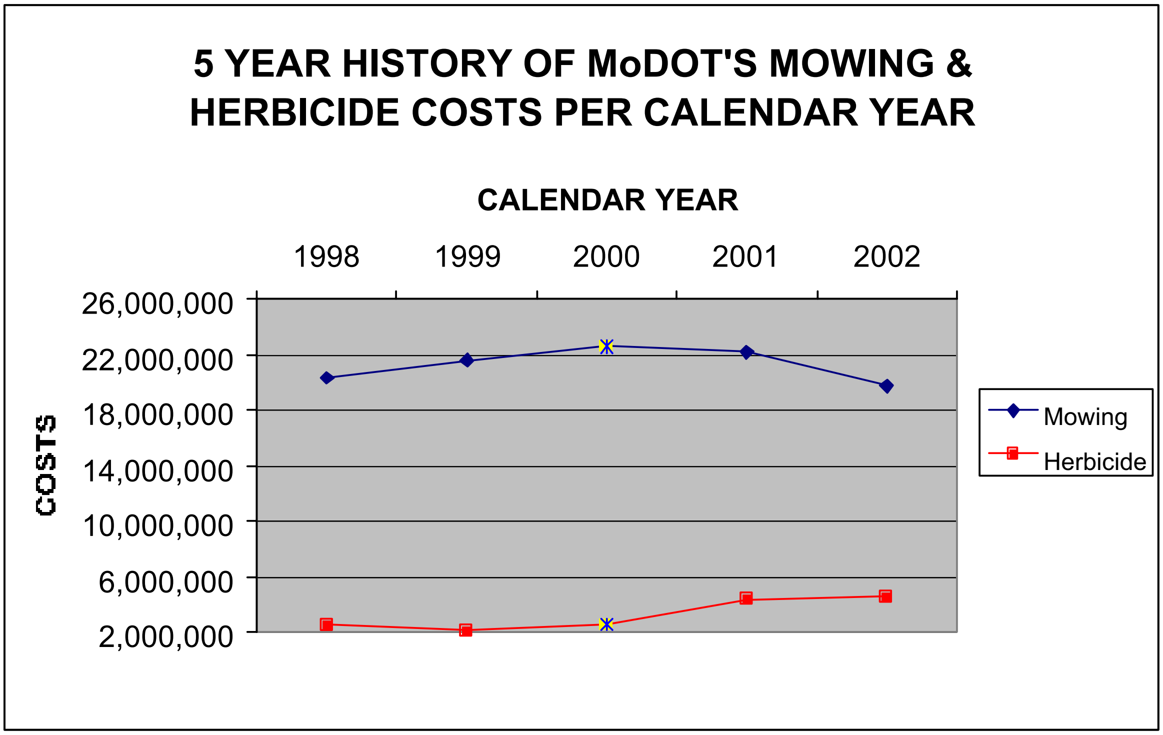
Strategic Goal:
Improve maintenance of the state's highway system

Performance Goal/Target:
Remain below the baseline for mowing costs
Remain above the baseline for herbicide costs

Green -	Mowing costs are below the baseline and herbicide costs are above the baseline
Yellow -	Mowing costs and herbicide costs both increase
Red -	Mowing costs are above the baseline and herbicide costs are below the baseline

Performance Measures:
Mowing costs vs. herbicide costs
Because the expense of herbicides is more cost efficient, we will increase the usage of herbicides until it reaches the level at which it is no longer cost efficient.

Additional Information:
The goal/target for the mowing program is to remain below the baseline.
The goal/target for the herbicide program is to remain above the baseline.
(Calendar Year 2000 was chosen as the baseline due to the fact that a new mowing policy was put into place that year. The policy states that herbicides are to be used in order to reduce the need to mow.) The maximum amount of herbicide expense vs. mowing expense needed to reach the highest level of cost efficiency on roadside maintenance is unknown at this time. This level will be determined as we move forward with this measure.



* Denotes baseline

Take Better Care of What We Have

Net assets at year end

Desired Trend: The department's overall financial condition will improve, or at a minimum, remain steady over the past year

Results: (Y) Preliminary FY 03 financial statements indicate net assets are decreasing.

Last Update: June 30, 2002

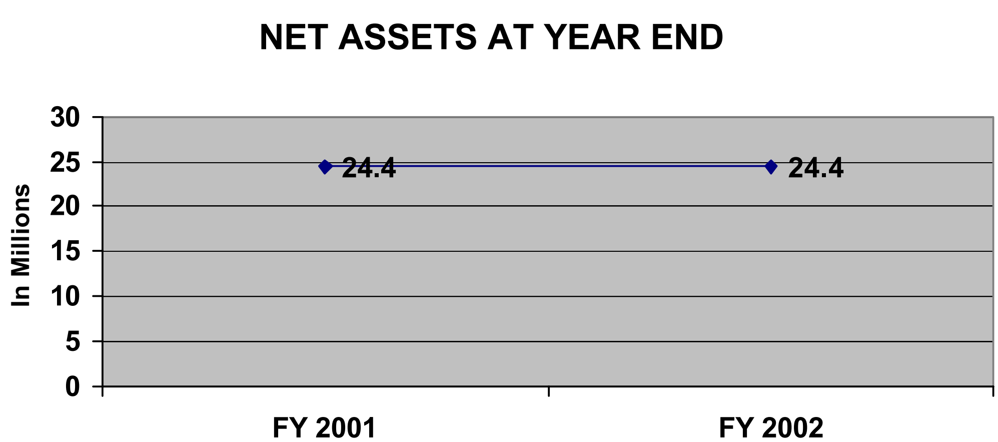
Strategic Goal:
Demonstrate responsible use of taxpayers' money

Performance Goal/Target:
The department's overall financial condition will improve or remain steady over the past year.

Green -	Net assets remain stable or increase at year end
Yellow -	Net assets at year end are $250 million - $500 million less than previous year
Red -	Net assets at year end are less than the previous year by $500 million or more

Performance Measures:
Net assets at year end

Additional Information:
Net assets, as reported below, include all assets of the department, including capital assets (with infrastructure), less all liabilities, including current liabilities and long-term bonds and other debt. Overall, the department's financial condition, as measured by its net assets, remained steady. Information related to assets was first available with the implementation of GASB 34 in FY 2002. Historical information prior to FY 2001 is not available.



Finish What We've Started

Percentage of dollars delivered as programmed

Desired Trend: → 5%

Results: ● (G) <5% of dollars programmed based on SFY 2002

Last Update: 6/04/2003

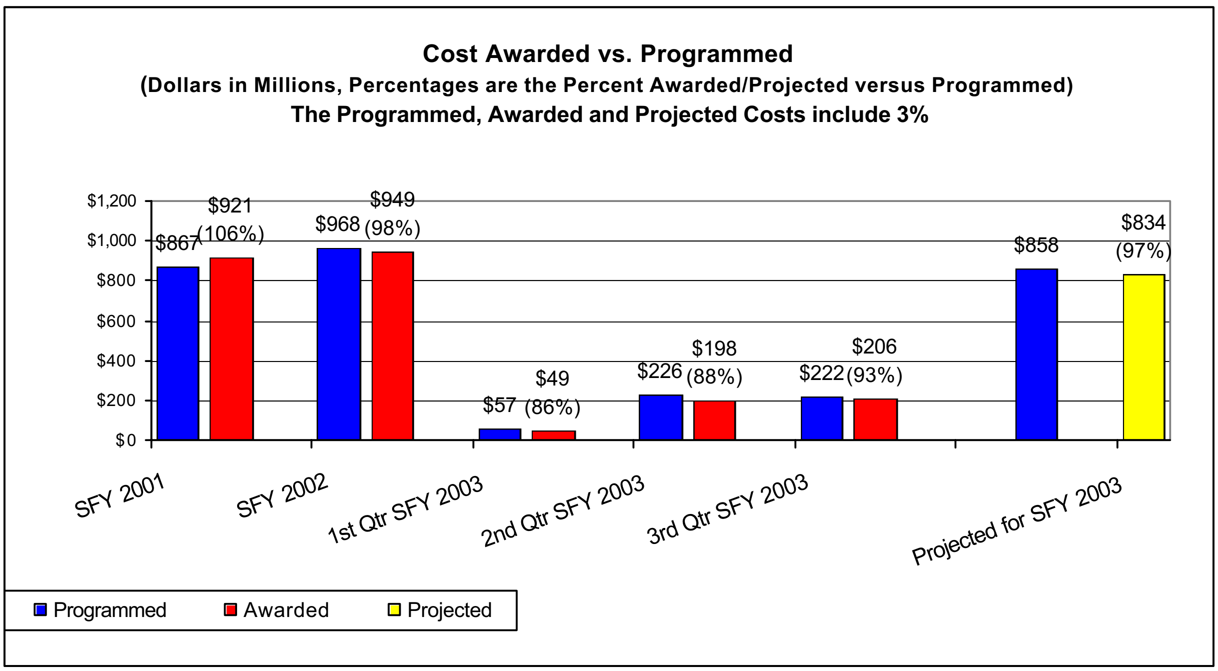
Strategic Goal:
Deliver the STIP on time and within budget

Performance Goal/Target:
Deliver projects within 5% of dollars programmed

Green	- <5% of dollars programmed
Yellow	- between >5% – 10% of dollars programmed
Red	- >10% of dollars programmed

Performance Measures:
Percentage of dollars awarded compared to the dollars programmed for award in the same quarter of the current Statewide Transportation Improvement Program

Additional Information:



Finish What We've Started

Percentage of projects delivered as programmed

Strategic Goal:
Deliver the STIP on time and within budget

Desired Trend: → 100%

Results: (Y) Deviation was 9% for SFY 2002

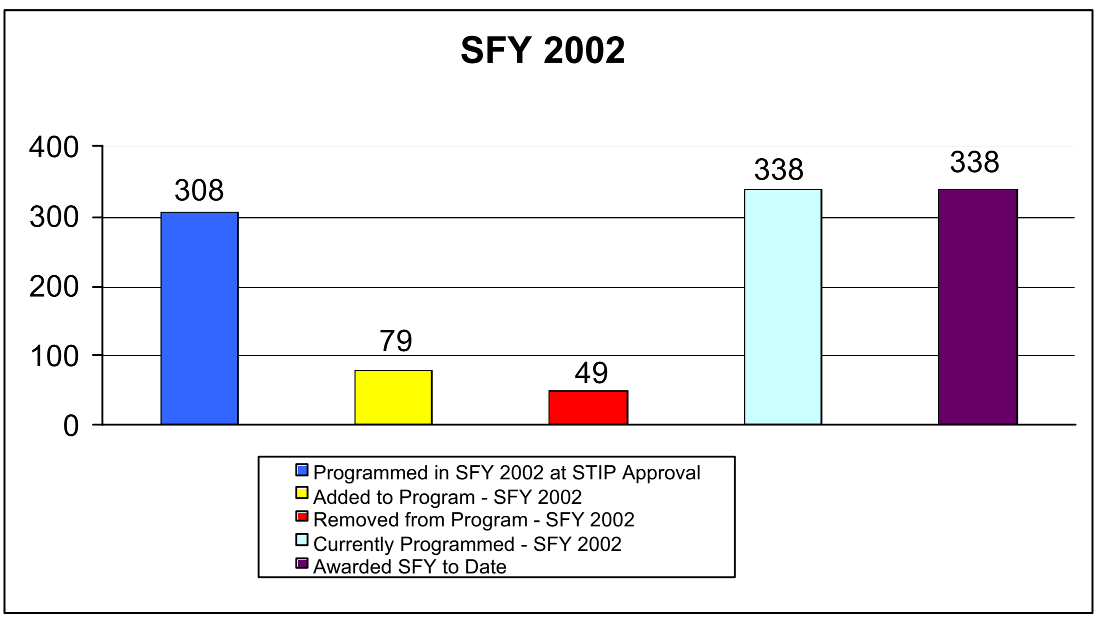
Last Update: 6/04/2003

Performance Goal/Target:
Deliver projects within 5% of the number of projects programmed

Green	- within 5% of the number of programmed projects
Yellow	- within 5% - 10% of the number of programmed projects
Red	- deviating more than 10% of the number of programmed projects

Performance Measures:
Percentage of the number of projects awarded in the same fiscal year programmed of the current Statewide Transportation Improvement Program

Additional Information:



Finish What We've Started

Percentage of projects delivered on time

Strategic Goal:
Deliver the STIP on time and within budget

Desired Trend: ↗

Results: ● (R) Target was not met.

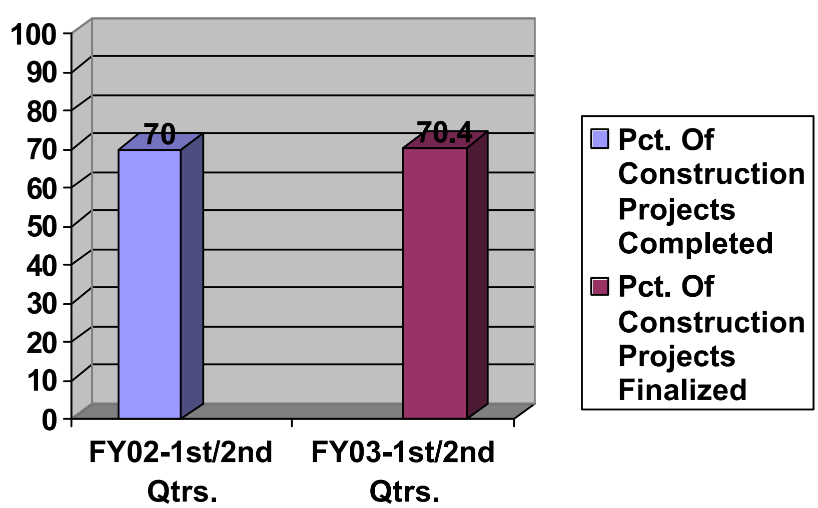
Last Update: 02/03

Performance Goal/Target:
Shorten the time allowed to complete a project and distribute project awards strategically throughout the year.

Green	- 85-100 percent on time
Yellow	- 75-85 percent on time
Red	- Less than 75 percent on time

Performance Measures:
Percentage of projects completed on time as specified in the project contract

Additional Information:
For the first six months of FY03, 70.4 percent of all projects have been completed on time (126 of 179). The monthly percentage has improved each month since August. It should be noted that MoDOT has delivered record levels of projects the last three years utilizing a stable number of contractors. As fewer projects are tackled in future years, on-time completion should improve. Measure changed from Projects "completed" to Projects "finalized" at the start of FY03. Interestingly, the percentages are virtually the same.



Finish What We've Started

Percentage of projects delivered within budget

Strategic Goal:
Deliver the STIP on time and within budget

Performance Goal/Target:
To deliver good value for funds taxpayers invest in transportation

Green ≤ 3% of total programmed dollars
Yellow >3 and ≤ 5% of total programmed dollars
Red >5% of programmed dollars

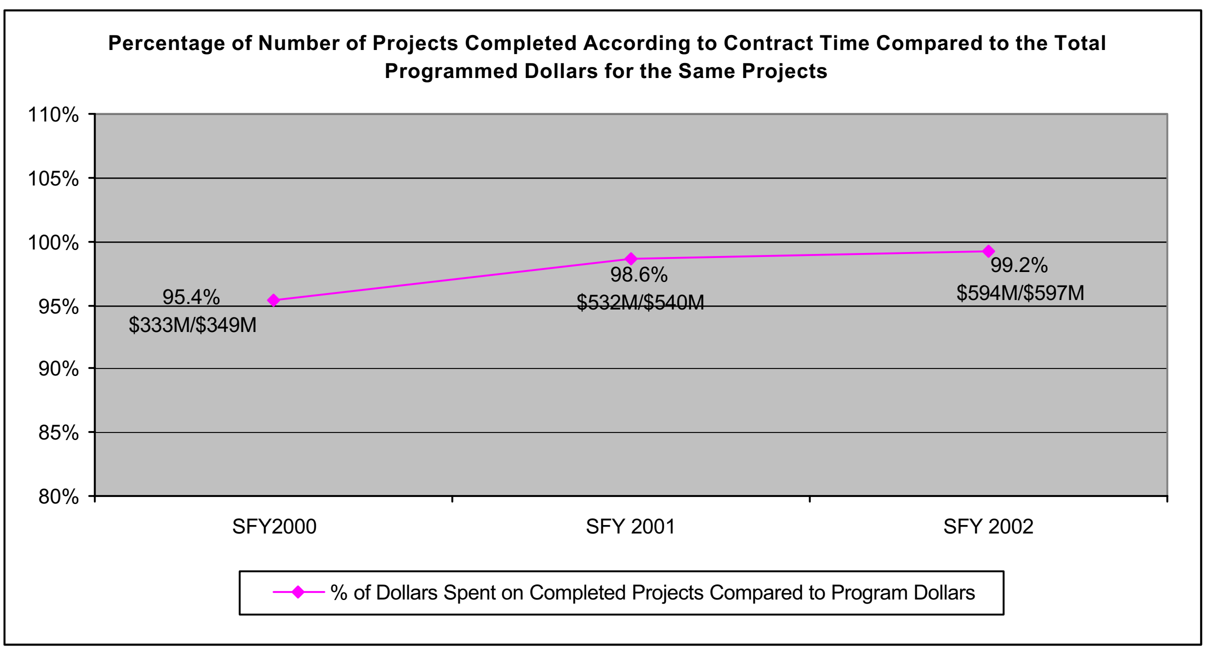
Desired Trend: → 100%

Results: (G) ≤3% of programmed dollars

Last Update: 5/2003

Performance Measures:
Percentage of the annual total dollars spent on completed projects compared to the total programmed dollars for the same projects

Additional Information:



Build Public Trust

Percent of Customer Satisfaction

Desired Trend: ↑

Results: ○

Last Update: 1999

Strategic Goal:
Listen and respond to the public

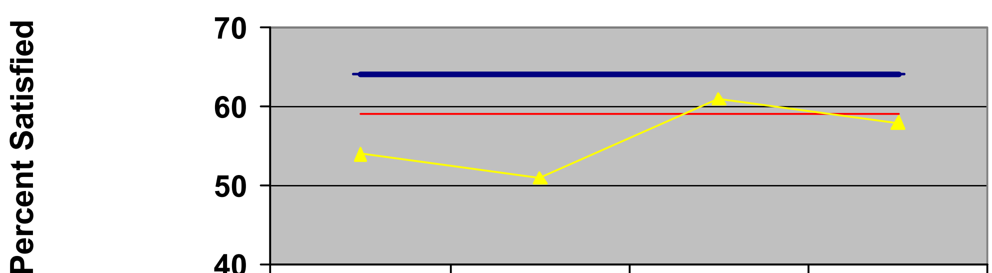
Performance Goal/Target:
The goal is to increase customer satisfaction with the overall performance of MoDOT. Target is 70 percent.

Green - 70 percent or above
Yellow - 50 to 69 percent
Red - 49 percent or below

Performance Measures:
Percent of customers rating MoDOT staff and services satisfactory or better

Additional Information:
Information for this performance measure will be collected from Missouri citizens and MoDOT customers in two separate surveying efforts. The department's Customer Survey 2003, being conducted spring/summer, will serve as our first reference point. Data gathered via Customer Service Center follow-up surveying will supplement this initial information. The baseline is based on data collected by the Constituent Service Quality Survey, conducted in 1999.

Percent of Customer Satisfaction



	1Q FY03	2Q FY03	3Q FY03	4Q FY03
Baseline	64	64	64	64
Survey 2003	59	59	59	59
CSC surveys	54	51	61	58

Dummy data

Build Public Trust

Percent of funding level target utilized by programmed projects by category for the 2005-2009 STIP

Desired Trend: Within 5%

Results: (G) Within 5%

Last Update: 06/04/2003

Strategic Goal:
Demonstrate responsible use of taxpayers' money

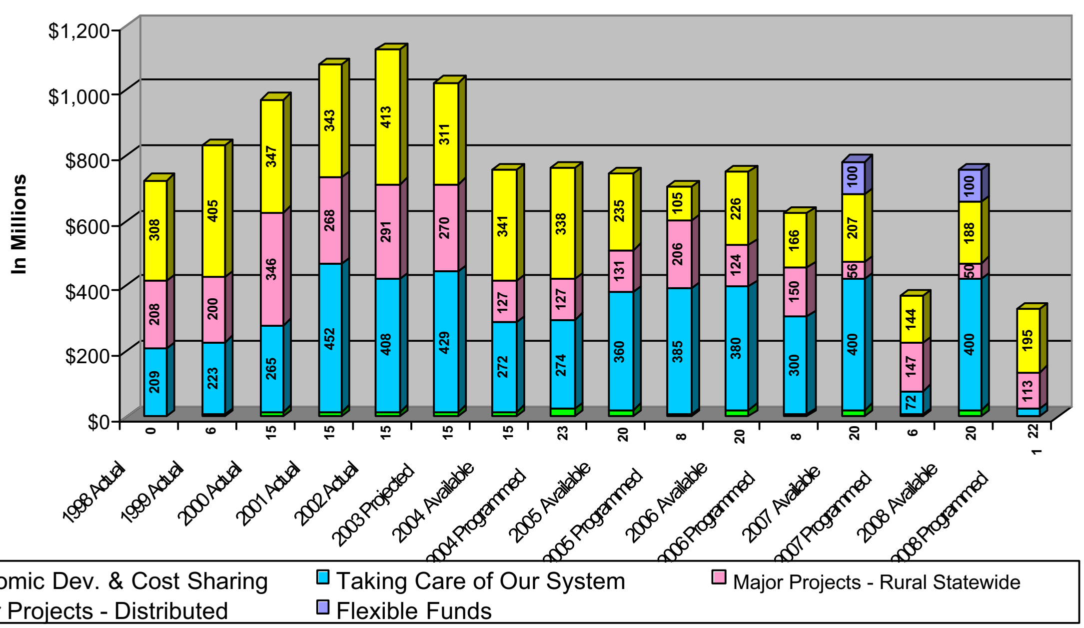
Performance Goal/Target:
Funds programmed for project delivery within 5% of the targets established by the approved funding distributions for each funding category for the current year.

Green - funds programmed within 5% of each funding category
Yellow - funds programmed within 5%-10% of each funding category
Red - funds programmed deviate more than 10% of any funding category

Performance Measures:
Percent of funding level target utilized by programmed projects by category for the 2005-2009 STIP

Additional Information: Performance data shown below is for 2004-2008 STIP. Data will be updated next year for 2005-2009 STIP.

Funding Level Targets Utilized by Programmed Projects



Build Public Trust

Distribution of funds

Desired Trend: Construction and Maintenance expenditures will comprise the largest dollars of the expenditures of the department.

Results: (G) FY 2002 indicates construction and maintenance expenditures continue to comprise the largest expenditures of the department.

Last Update: June 30, 2002

Strategic Goal:
Demonstrate responsible use of taxpayers' money

Performance Goal/Target:
More dollars will be spent on maintenance and construction of our transportation system than other activities.

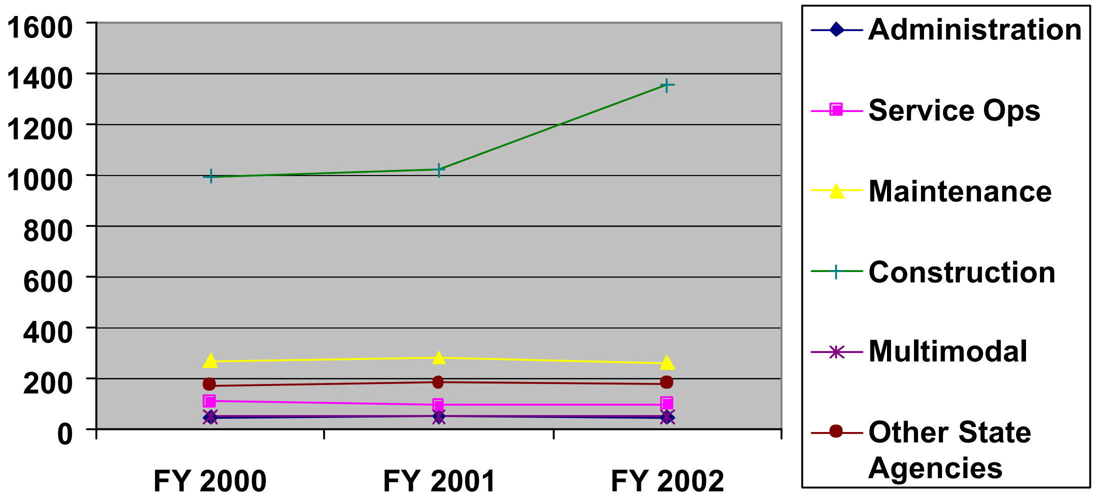
Green - The ratio of construction and maintenance expenditures is more than 1.5:1 of other appropriations.

Yellow - The ratio of construction and maintenance appropriation expenditures is more than 1.25:1 of other appropriations.

Red - The ratio of construction and maintenance appropriation expenditures is less than 1.25:1 of other appropriations.

Performance Measures:
Distribution of funds

Additional Information:



Build Public Trust

Desired Trend: Revenue dispersion will remain relatively constant.

Results: (G) Revenue dispersion is relatively constant. Federal revenues appears to be below normal for FY 2003, however, the federal advance construction funds were received in May, 2003.

Last Update: May 2003

Revenue dispersion

Strategic Goal:
Demonstrate responsible use of taxpayers' money

Performance Goal/Target:
Awareness of revenue dispersion, which indicates how dependent the department is on revenue sources from other entities or revenues requiring voter approval

Green - Revenue dispersion remains relatively constant
Yellow - Revenue dispersion includes consistent declines in sources of funds
Red - Revenue dispersion includes significant declines in one or more sources of funds

Performance Measures:
Revenue dispersion

Additional Information: