Staff summary

Prepared by
Organizational Results Division
Missouri Department of Transportation

March 2010

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Research Forum Provides Valuable Information to Students and Transportation Researchers

A summary of the 2010 Spring Research Forum

MoDOT Summary Statement

On February 24, 2010, the Department held a Spring Research Forum in Columbia, Missouri. The Forum invited research professionals in the transportation industry to participate in panel presentations, followed by a brief question and answer session. Additionally, MoDOT presented their 2010 Innovative Researcher of the Year to Dr. Carlos Sun from the University of Missouri – Columbia for his research evaluating the Motorist Assist Programs in St. Louis.

Research Forum Summary

Mara Campbell, Director of Organizational Results, welcomed the participants of the research forum and thanked them for their attendance.

Featured Speakers

Ms. Campbell introduced Kevin Keith, MoDOT's Chief Engineer. Mr. Keith thanked everyone for their attendance. He explained that MoDOT is using research to solve problems in a practical and innovative way. For example, over the past six years, MoDOT has saved nearly $1 billion dollars thanks to the innovative principles behind Practical Design. Mr. Keith stated that the biggest need for ground-breaking research is in the area of maintenance. In fiscal year 2009, approximately $800 million of the budget is spent on maintaining our current system, and with the impending financial "cliff," using this budget to its fullest potential is imperative. To conclude, Mr. Keith fielded questions from the research forum participants.

Ms. Campbell introduced Ken Foster, Federal Highway Administration (FHWA) – Missouri Division. Mr. Foster discussed FHWA's role in Missouri transportation as well as their role in MoDOT's research projects. He discussed how FHWA, MoDOT and researchers work together. Mr. Foster fielded questions from the research forum participants.

Panel Presentations

Ms. Campbell introduced the panelists presenting on Adaptive Signals: Michael Sullivant of Rhythm Engineering, Jessica Hutton of Midwest Research Institute (MRI) and Julie Stotlemeyer from MoDOT. The panel discussed the success of artificial intelligence in traffic signals, specifically on an 11 signal section on MO 291 in Lee's Summit, Missouri.

During lunch Bill Stone, Organizational Performance Administrator, discussed MoDOT's research needs. Mr. Stone discussed how MoDOT gathers, filters, and selects research ideas and research proposals. Further, Mr. Stone explained how researchers can get involved with MoDOT's research program. Lastly, he provided examples of successful innovative proposals and/or partnerships that have occurred over the past few years.

Research Forum Summary *(cont'd.)*

Ms. Campbell introduced the panelists presenting on the research conducted for the New I-64 Project: Ron Morris from MoDOT, Thomas Ryan of HDR, Inc. and Bill Stone from MoDOT. The panel discussed the successes of the integration of work, traffic flow, projects and local economic impact that occurred on the I-64 Project in St. Louis, Missouri.

Ms. Campbell introduced the panelists presenting on work zones: Praveen Edara from the University of Missouri – Columbia, Troy Pinkerton, and Bill Stone from MoDOT. The panel discussed the successes the traffic and work zone modeling spreadsheet created by Mr. Edara. The spreadsheet provides transportation professionals a user-friendly work zone analysis tool that is most successful on rural interstates, divided roadways, and multilane undivided highways.

Round Robin Question and Answer Session

Research forum participants then took part in a topic specific, round robin question and answer session. Participants had the opportunity to discuss both on a national and high-level overview research with Mara Campbell; the research process, administration of research, and the request for research problem statements form with Bill Stone; technical aspects of research with Jennifer Harper; and traffic specific questions with Troy Pinkerton, Dan Smith and Julie Stotlemeyer.

Wrap Up

Ms. Campbell reminded everyone that the timeline to submit research statements is April 30, 2010. Additionally, she requested that all participants complete a short evaluation of the forum. She thanked everyone for their participation and involvement with MoDOT research.

Welcome

Transportation Research Forum

February 24, 2010

Innovative Researcher of the Year

Dr. Carlos Sun
University of Missouri

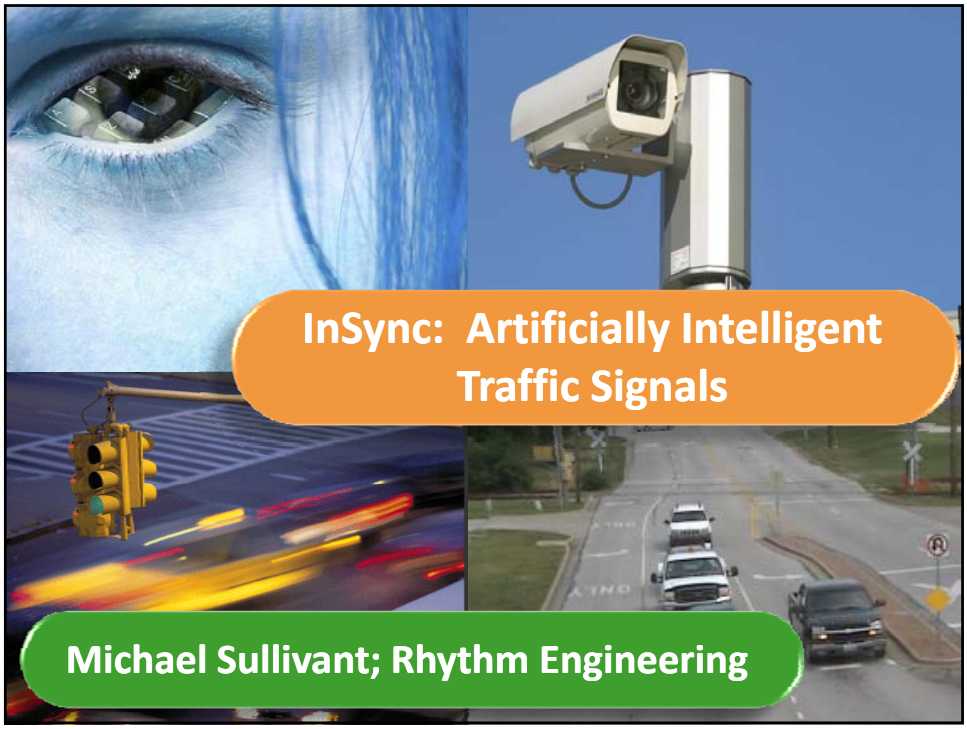
February 24, 2010

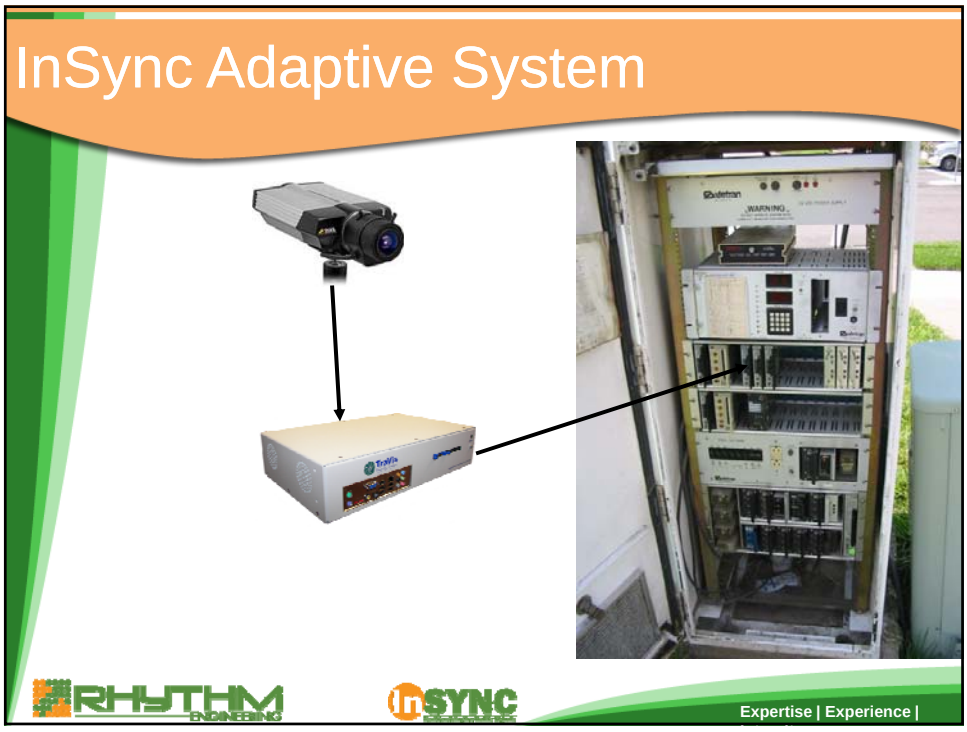
Federal Highway Research Perspective

Ken Foster, FHWA

February 24, 2010

Appendix B


InSync: Artificially Intelligent Traffic Signals
Michael Sullivant; Rhythm Engineering


InSync Adaptive System
RHYTHM ENGINEERING
InSYNC
Expertise | Experience |

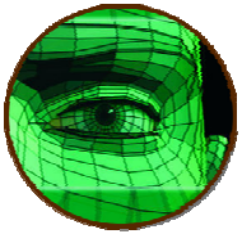
Music: From Analog to Digital

Analog vs. Digital

Analog vs. Digital

RHYTHM ENGINEERING InSYNC

Expertise | Experience |



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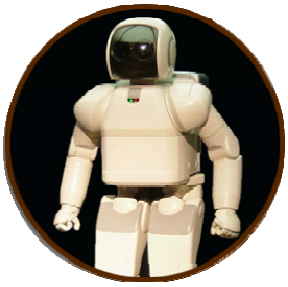


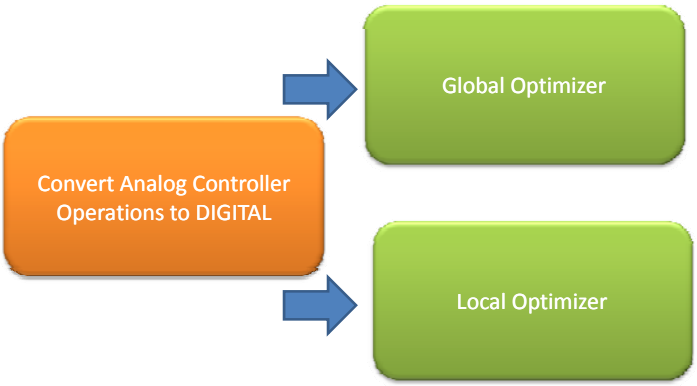
TraVis™

Traffic Vision

InSync™

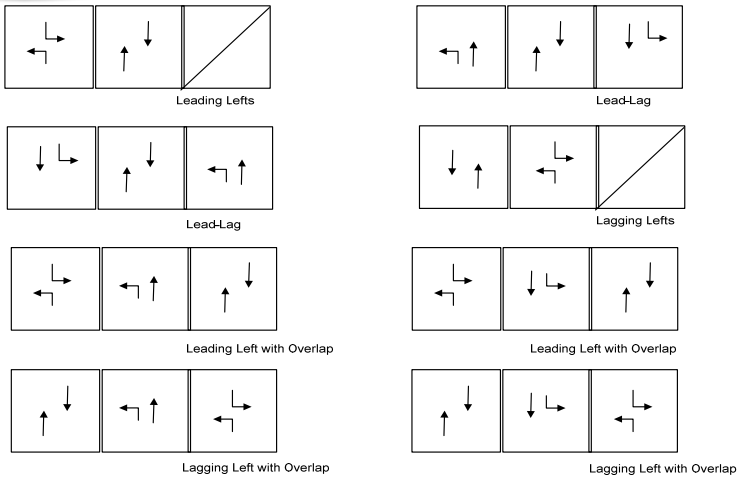
The Brain

Architecture



Expertise | Experience |

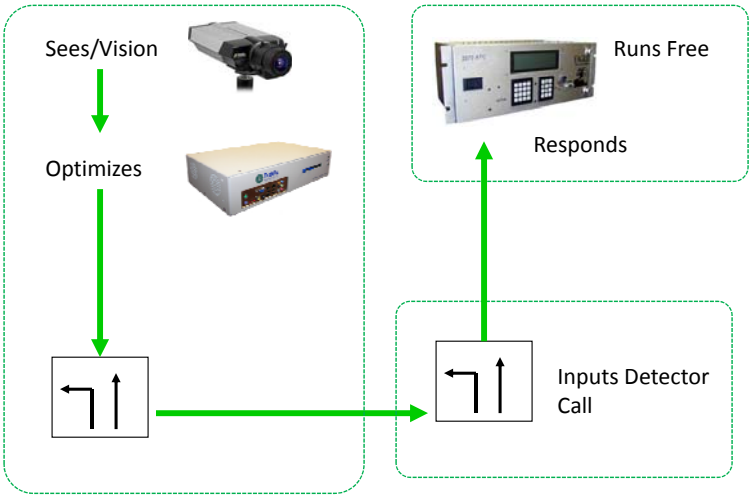
Sequences and States



Note: The same phase combination is possible for the East-West direction

Expertise | Experience |

InSync Adaptive System



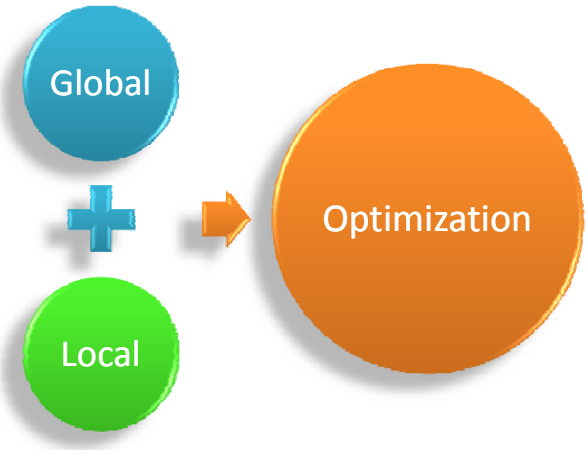
Expertise | Experience |

Three Decisions

- What Sequence to Pick?
- When to Initiate States?
- Duration of States?

Expertise | Experience |

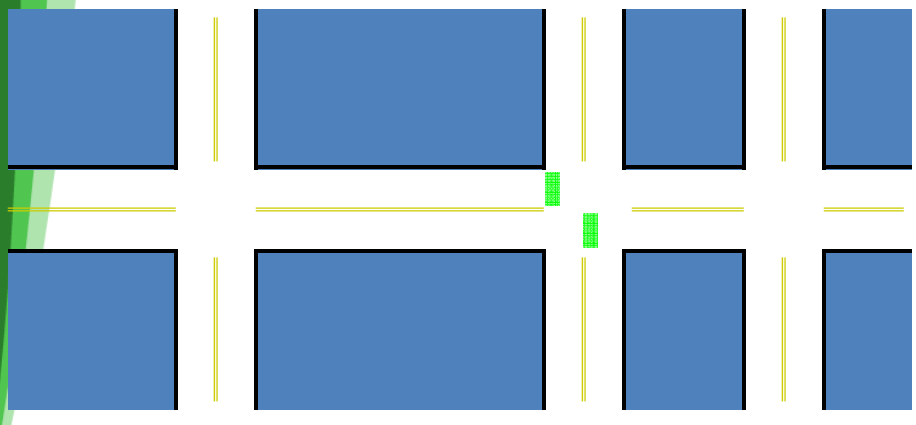
Traffic Flow Optimization



RHYTHM ENGINEERING InSYNC

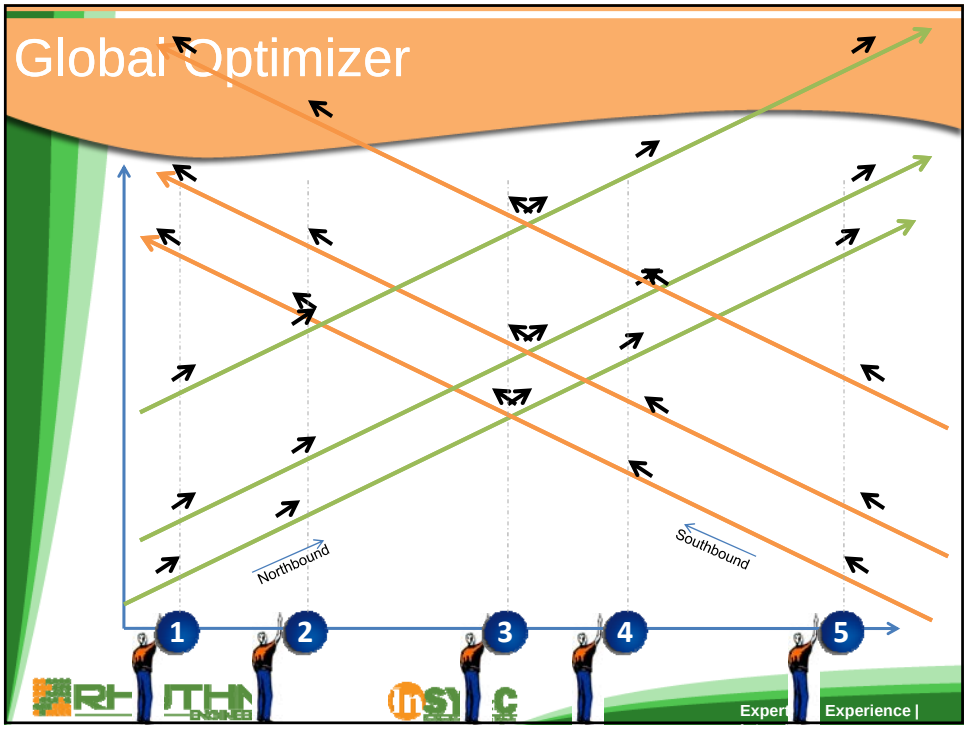
Expertise | Experience |

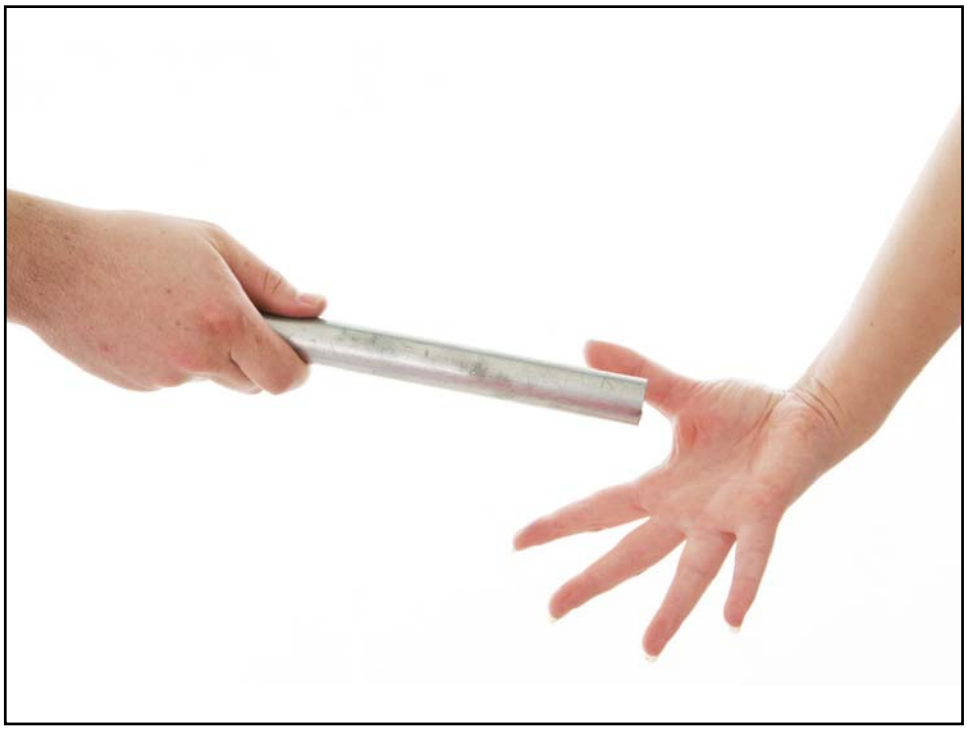
Global Optimizer

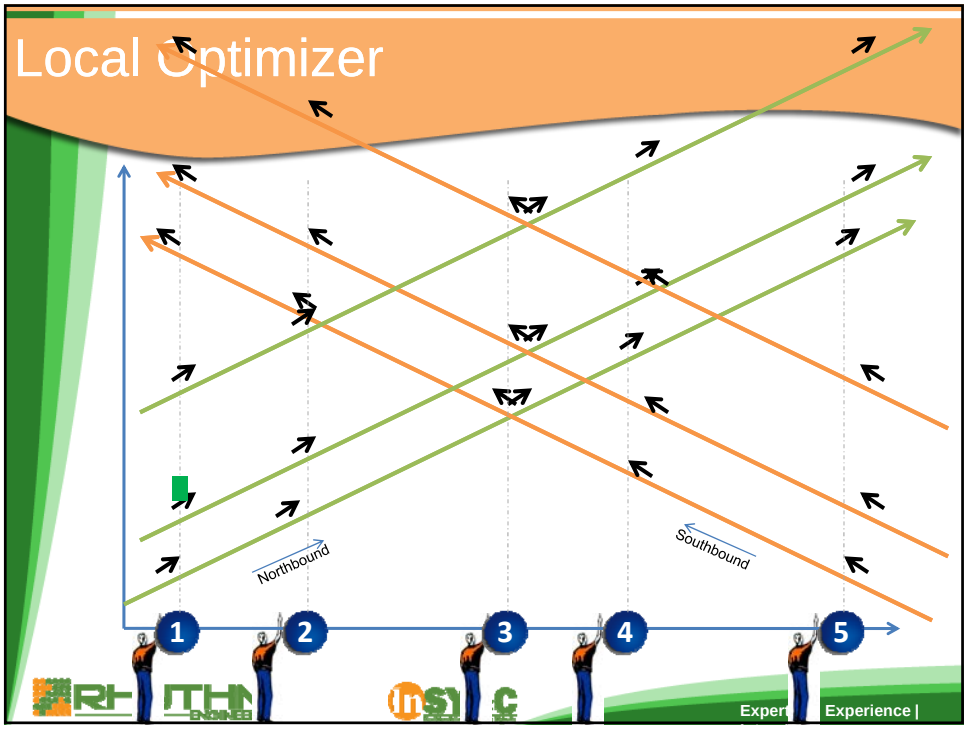


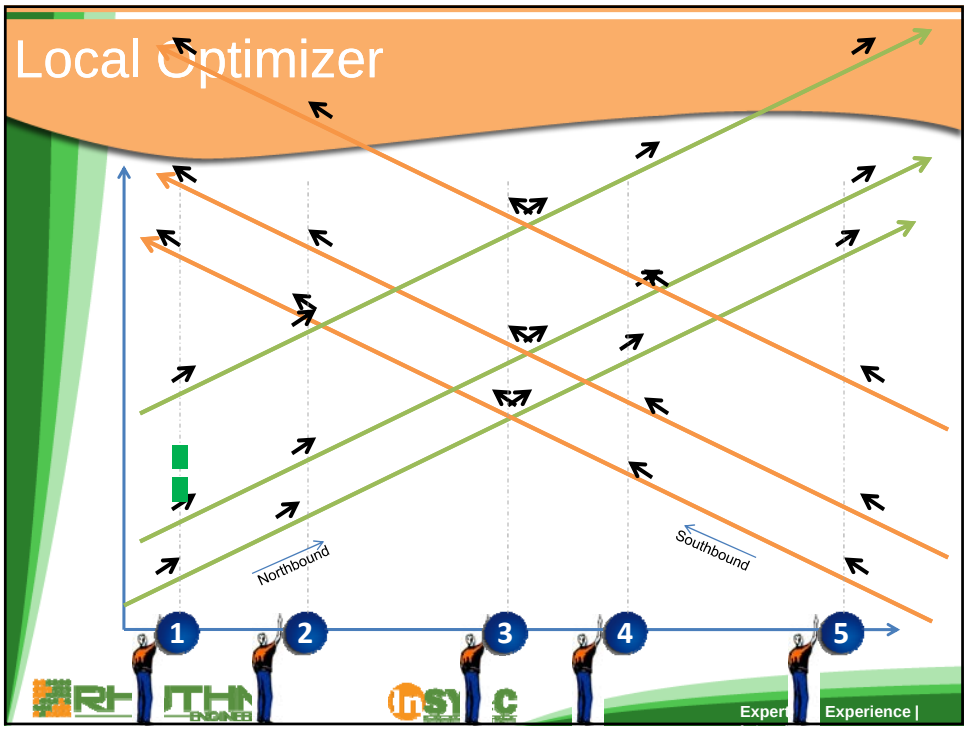
RHYTHM ENGINEERING InSYNC

Expertise | Experience |


Global Optimizer
Northbound
Southbound
1
2
3
4
5
Experience |




Local Optimizer
Northbound
Southbound
1
2
3
4
5
Expert Experience |


Local Optimizer
Northbound
Southbound
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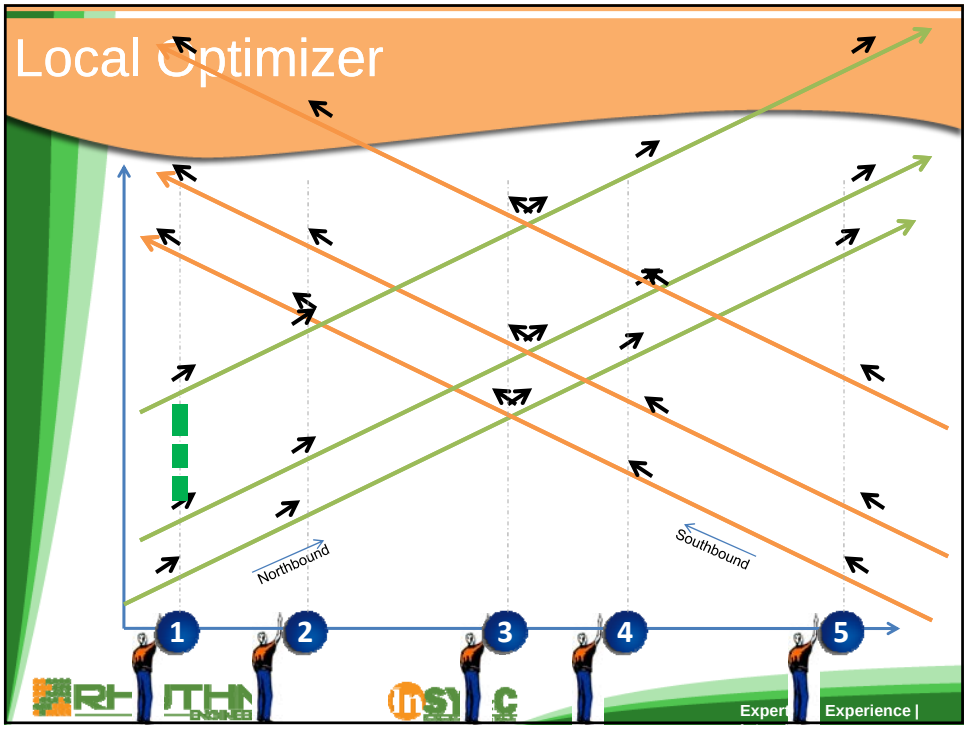
Expert Experience |


Local Optimizer
Northbound
Southbound
1
2
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THANK YOU
RHYTHM
InSYNC
Expertise | Experience |

Appendix C

Evaluation of InSync System on Route 291 in Lee's Summit

MoDOT Research Forum

February 24, 2010

Jessica Hutton, MRI

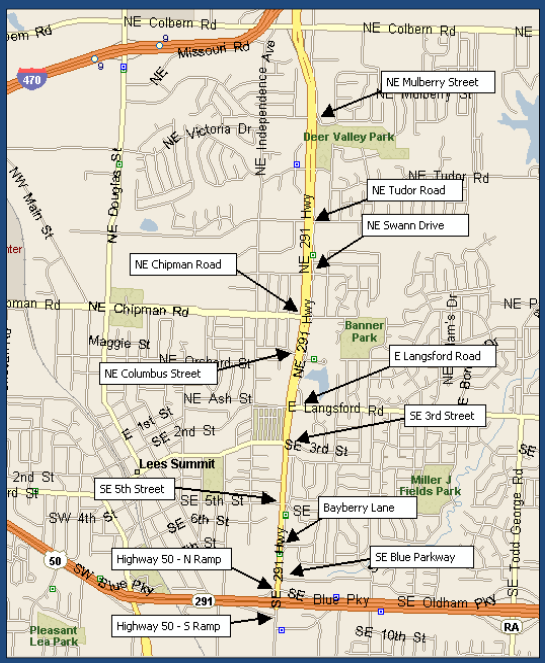
MRI

Map of Study Corridor

- 12 signals from Mulberry on north to US 50 EB ramps on south

- 3 study periods
  - Before (Nov 2008)
  - One month after (April/May 2009)
  - Five months after (Sept 2009)

- Purpose was to evaluate operational performance of InSync system on this corridor

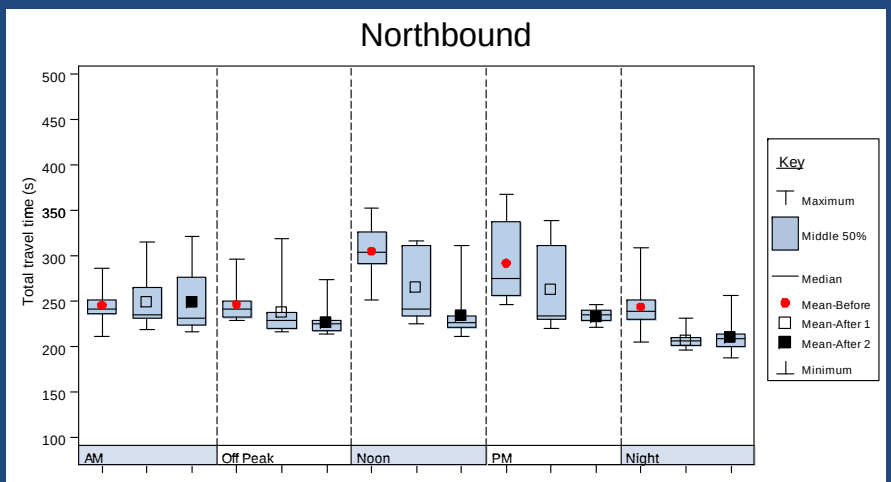


MRI

Study Elements

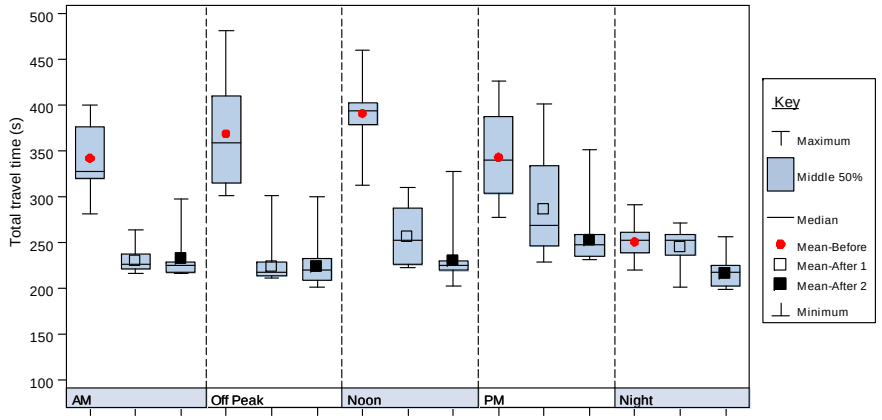
- Travel time study
  - Travel time over corridor
  - Individual intersection delay
  - Fuel consumption and emissions
  - Number of stops
  - Time spent at congested speeds
  - Minor street delay
  - Turning movement count
  - 5 times of day: AM peak, AM off peak, noon peak, PM peak, night off peak
- Minor street delay study
  - 4 intersections: Tudor, Chipman, Columbus, Langsford
  - 3 times of day: AM peak, AM off peak, PM peak
- Volume comparison
  - Volumes taken in 3 locations, both directions of travel
  - Evaluated for noticeable shifts in traffic volumes or patterns
- Turning movement comparison
  - Chipman Road
  - 6:30 am to 6:30 PM
  - Manual counts taken in field with handheld Jamar counter
  - Camera counts recorded by Rhythm and provided to MRI
  - Compared 15-minute counts

MRI



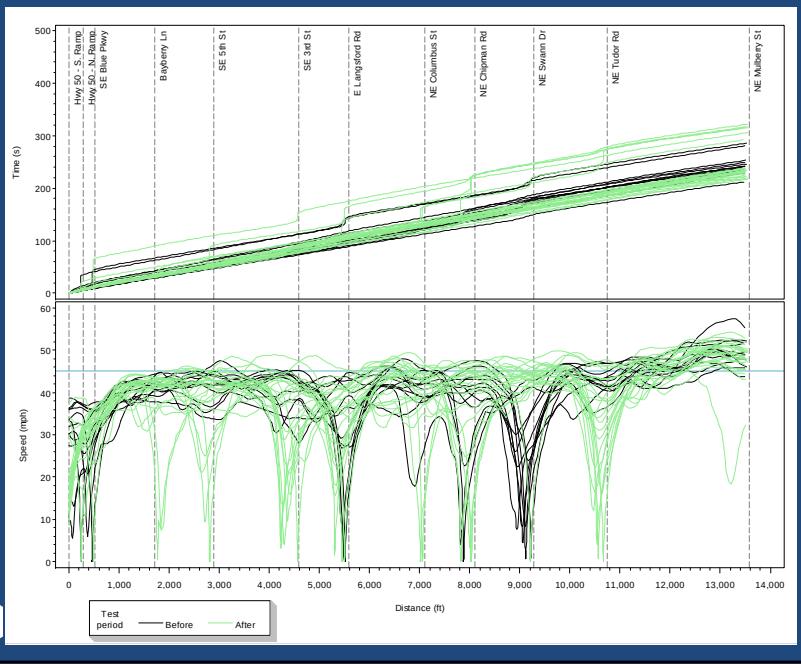
N	12	12	12	12	13	12	11	12	12	13	10	12	12	12	12
Min	212	219	217	229	216	214	252	225	211	247	220	221	205	197	188
Median	241.5	235.5	231	241.5	229	225	304	241	226.5	275	234	235	239	206	209.5
Max	286	315	322	297	319	274	353	317	311	368	339	247	309	232	256
Mean	246.1	250.3	250.0	247.1	239.8	227.8	305.5	266.7	235.0	292.4	264.4	234.8	244.5	208.0	211.2
Std Dev	20.4	33.3	41.4	21.5	30.9	15.9	26.0	40.4	28.3	45.6	47.5	7.3	26.3	10.2	16.7

Southbound



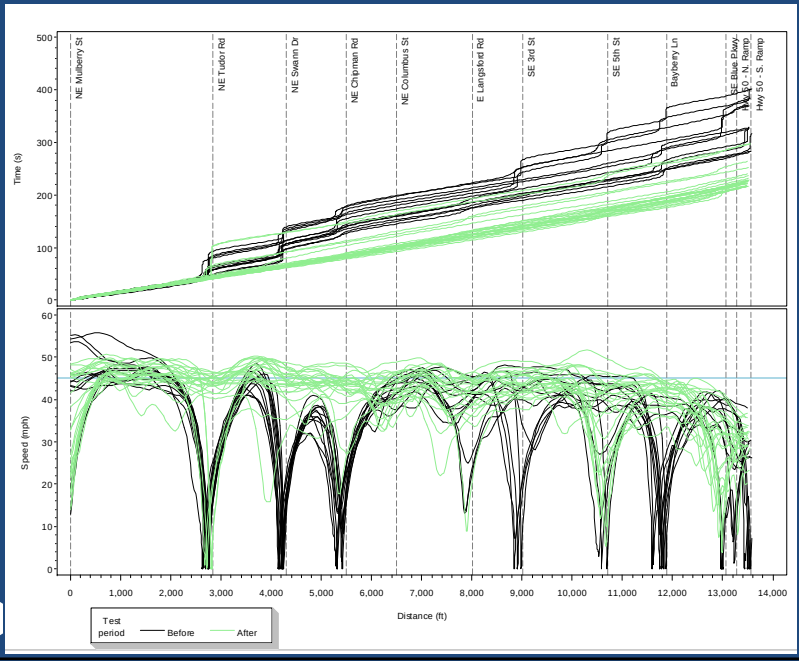
N	12	12	12	12	12	12	10	12	12	11	10	12	12	12	12
Min	281	216	216	301	211	202	313	223	203	278	229	231	220	201	199
Median	328	226	225	359.5	217.5	220	394	252.5	225.5	340	269	247.5	253	253	217.5
Max	401	264	298	482	302	300	461	310	328	427	402	352	291	272	257
Mean	342.7	231.3	234.8	369.6	225.9	225.9	391.5	258.2	231.5	343.6	288.1	254.8	251.2	246.7	217.9
Std Dev	41.6	14.3	29.8	55.7	24.9	26.3	38.7	34.7	31.6	46.4	58.1	32.5	18.7	18.7	17.2

AM Peak Northbound



MRI

AM Peak Southbound



Travel Time Run Results

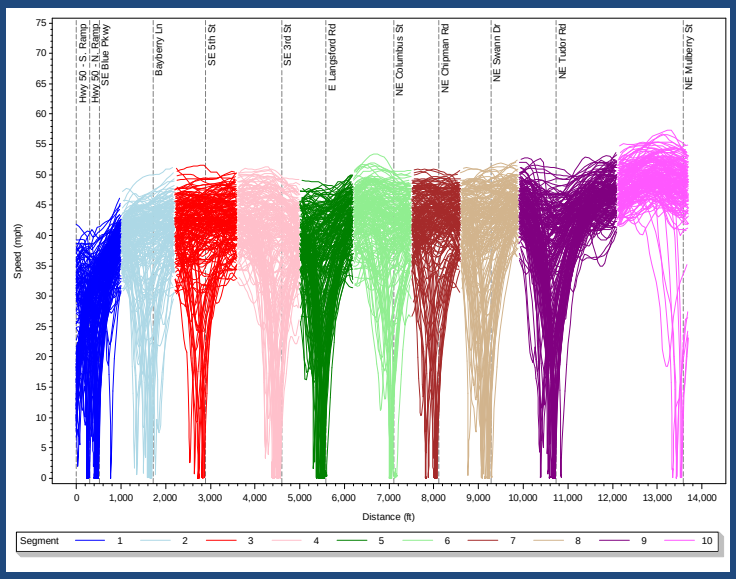
Northbound

Time period	Travel time (sec) Before	After	Difference	Standard error	P-value
AM Peak	246	250	4	11.5	0.724
AM Off Peak	247	234	–13	8.4	0.130
Noon Peak	306	251	**–55**	12.6	**<.001**
PM Peak	292	248	**–44**	13.7	**0.003**
Night Off Peak	244	210	**–34**	6.6	**<.001**

Southbound

Time period	Travel time (sec) Before	After	Difference	Standard error	P–value
AM Peak	343	233	**–110**	10.7	**<.001**
AM Off Peak	370	226	**–144**	13.4	**<.001**
Noon Peak	392	245	**–147**	13.6	**<.001**
PM Peak	344	270	**–74**	17.5	**<.001**
Night Off Peak	251	232	**–19**	7.6	**0.019**

Segments for Individual Intersection Analysis



Intersection	Time period	Delay (sec) Before	After	Difference	Standard error	P–value
US 50 Ramps and Blue Parkway	AM Peak	13.4	12.5	–0.9	4.8	0.849
	AM Off Peak	12.5	7.0	–5.5	2.3	0.024
	Noon Peak	19.6	15.1	–4.6	5.8	0.441
	PM Peak	14.5	17.1	2.7	6.7	0.694
	Night Off Peak	11.1	14.7	3.6	5.2	0.497
Bayberry Lane	AM Peak	2.6	3.7	1.2	1.3	0.369
	AM Off Peak	5.8	3.1	–2.7	2.1	0.199
	Noon Peak	4.4	6.7	2.3	2.2	0.319
	PM Peak	11.6	6.4	–5.2	3.1	0.101
	Night Off Peak	2.5	0.9	–1.6	1.1	0.148
5th Street	AM Peak	2.7	4.7	2.0	1.9	0.308
	AM Off Peak	4.0	3.1	–0.9	1.5	0.546
	Noon Peak	5.7	3.9	–1.9	1.7	0.277
	PM Peak	10.1	3.5	–6.7	3.4	0.058
	Night Off Peak	1.9	0.4	–1.5	1.3	0.277
3rd Street	AM Peak	3.6	7.1	3.6	1.9	0.07
	AM Off Peak	5.1	4.6	–0.6	1.4	0.679
	Noon Peak	22.7	4.9	–17.9	4.6	< .001
	PM Peak	20.2	4.6	–15.6	5.0	0.004
	Night Off Peak	0.3	0.7	0.3	0.8	0.678
Langsford Road	AM Peak	7.7	7.5	–0.2	3.1	0.958
	AM Off Peak	10.8	3.5	–7.3	1.7	< .001
	Noon Peak	18.3	5.8	–12.5	7.2	0.09
	PM Peak	23.9	4.9	–19.1	7.0	0.01
	Night Off Peak	11.5	4.1	–7.3	3.2	0.028
Columbus Street	AM Peak	3.1	4.9	1.8	2.6	0.496
	AM Off Peak	3.8	3.6	–0.2	2.0	0.928
	Noon Peak	6.3	4.6	–1.7	3.0	0.585
	PM Peak	5.2	3.4	–1.8	2.3	0.441
	Night Off Peak	3.7	0.0	–3.6	1.4	0.015
Chipman Road	AM Peak	5.9	8.5	2.5	5.6	0.654
	AM Off Peak	2.7	1.8	–0.8	0.6	0.188
	Noon Peak	3.0	6.1	3.1	3.3	0.364
	PM Peak	1.8	4.3	2.5	3.5	0.485
	Night Off Peak	2.8	0.4	–2.4	1.1	0.038
Swann Drive	AM Peak	11.3	2.4	–8.8	1.9	< .001
	AM Off Peak	6.3	3.0	–3.3	2.2	0.149
	Noon Peak	9.8	2.8	–7.0	3.0	0.028
	PM Peak	4.6	5.4	0.8	2.8	0.767
	Night Off Peak	4.5	0.3	–4.2	1.7	0.02
Tudor Road	AM Peak	1.7	6.1	4.4	2.2	0.049
	AM Off Peak	2.7	6.6	3.8	2.2	0.092
	Noon Peak	20.2	5.1	–15.1	4.7	0.003
	PM Peak	6.5	5.4	–1.1	3.4	0.754
	Night Off Peak	12.5	4.3	–8.3	3.3	0.016
Mulberry Street	AM Peak	–0.8	–0.4	0.4	0.7	0.563
	AM Off Peak	–0.7	3.2	3.9	3.2	0.23
	Noon Peak	–0.2	1.1	1.2	2.3	0.59
	PM Peak	–0.9	–0.6	0.3	0.3	0.36
	Night Off Peak	–0.3	–2.1	–1.8	1.2	0.129

Intersection	Time period	Delay (sec) Before	After	Difference	Standard error	P–value
Mulberry Street	AM Peak	6.9	9.9	3.0	4.3	0.497
	AM Off Peak	5.1	18.1	13.0	5.2	0.017
	Noon Peak	23.8	17.9	–5.9	7.1	0.414
	PM Peak	10.1	27.4	17.3	7.5	0.03
	Night Off Peak	1.5	12.4	10.9	6.4	0.096
Tudor Road	AM Peak	27.2	8.5	–18.7	6.2	0.005
	AM Off Peak	31.1	6.2	–25.0	6.2	< .001
	Noon Peak	36.8	4.8	–32.1	3.6	< .001
	PM Peak	32.3	8.7	–23.6	7.4	0.003
	Night Off Peak	14.3	11.2	–3.0	5.0	0.545
Swann Drive	AM Peak	28.3	1.6	–26.7	0.8	< .001
	AM Off Peak	13.6	0.6	–13.0	3.1	< .001
	Noon Peak	22.3	1.2	–21.1	2.8	< .001
	PM Peak	4.4	1.3	–3.1	1.1	0.008
	Night Off Peak	3.1	0.6	–2.5	1.3	0.059
Chipman Road	AM Peak	19.2	2.1	–17.1	1.7	< .001
	AM Off Peak	16.0	1.1	–14.9	3.0	< .001
	Noon Peak	18.8	2.3	–16.4	3.6	< .001
	PM Peak	3.2	13.6	10.3	3.2	0.003
	Night Off Peak	3.5	2.2	–1.3	2.1	0.54
Columbus Street	AM Peak	2.1	2.0	–0.1	0.4	0.779
	AM Off Peak	13.3	2.0	–11.4	3.1	< .001
	Noon Peak	2.9	5.8	2.9	1.5	0.068
	PM Peak	3.1	5.9	2.8	1.6	0.084
	Night Off Peak	6.0	2.0	–4.0	3.0	0.184
Langsford Road	AM Peak	4.3	3.0	–1.3	1.2	0.298
	AM Off Peak	18.8	2.2	–16.6	2.9	< .001
	Noon Peak	22.6	6.0	–16.6	7.0	0.024
	PM Peak	50.9	6.3	–44.6	4.5	< .001
	Night Off Peak	6.3	1.6	–4.6	2.3	0.051
3rd Street	AM Peak	12.1	1.6	–10.6	3.1	0.002
	AM Off Peak	17.3	1.4	–15.9	4.5	0.001
	Noon Peak	27.4	5.2	–22.2	5.6	< .001
	PM Peak	3.6	8.7	5.1	2.8	0.075
	Night Off Peak	4.3	1.3	–3.0	1.9	0.122
5th Street	AM Peak	9.5	5.2	–4.2	2.7	0.123
	AM Off Peak	7.8	5.1	–2.7	2.4	0.261
	Noon Peak	3.7	7.1	3.4	3.5	0.334
	PM Peak	15.2	3.8	–11.4	3.2	0.001
	Night Off Peak	1.0	1.7	0.7	0.7	0.331
Bayberry Lane	AM Peak	18.4	2.9	–15.5	2.2	< .001
	AM Off Peak	21.0	2.3	–18.7	2.2	< .001
	Noon Peak	10.0	4.2	–5.8	2.7	0.041
	PM Peak	16.4	4.3	–12.2	3.8	0.003
	Night Off Peak	1.5	1.7	0.3	0.4	0.489
Blue Parkway and US 50 Ramps	AM Peak	25.3	10.4	–14.9	4.1	< .001
	AM Off Peak	33.6	8.3	–25.2	5.1	< .001
	Noon Peak	47.9	11.7	–36.2	5.3	< .001
	PM Peak	17.1	20.3	3.1	7.5	0.677
	Night Off Peak	16.7	15.3	–1.4	3.3	0.67

Number of Stops

Direction	Study period	Average number of stops				
		AM peak	AM off peak	Noon peak	PM peak	Night off peak
NB	Before	0.6	0.8	1.8	1.5	1.6
	After	0.7	0.4	0.6	0.7	0.3
	Percent change	*17*	*–50*	*–69*	*–57*	*–81*
SB	Before	3.9	4.6	4.7	2.6	1.8
	After	0.2	0.3	0.6	1.2	1.3
	Percent change	*–95*	*–95*	*–88*	*–56*	*–31*

MRI

Average speed and time spent in congestion

Direction	Time period	Test period	Average speed (mph)	Average time ≤ 3 mph (sec)	Average time ≤ 20 mph (sec)	Average time ≤ 30 mph (sec)
NB	AM peak	Before	37.6	7.6	21.9	40.8
		After	37.4	13.2	26.8	46.8
		Percent change	*–0.4*	*73.0*	*22.1*	*14.7*
	AM off peak	Before	37.5	7.0	20.8	42.8
		After	39.8	5.2	11.9	25.65
		Percent change	*6.0*	*–25.0*	*–42.8*	*–40.1*
	Noon peak	Before	30.4	53.4	76.1	100.5
		After	37.4	14.6	22.6	45.4
		Percent change	*23.2*	*–72.8*	*–70.2*	*–54.8*
	PM peak	Before	32.2	47.4	67.5	92.8
		After	37.5	13.0	25.4	47.5
		Percent change	*16.5*	*–72.5*	*–62.3*	*–48.8*
	Night off peak	Before	38.0	16.9	35.6	54.9
		After	44.1	1.6	7.8	16.6
		Percent change	*15.9*	*–90.2*	*–78.2*	*–69.9*
SB	AM peak	Before	27.3	59.3	113.9	158.3
		After	39.8	5.4	12.4	28.6
		Percent change	*45.8*	*–90.9*	*–89.1*	*–81.9*
	AM off peak	Before	25.5	82.2	138.6	188.1
		After	41.0	5.3	8.9	19.2
		Percent change	*61.0*	*–93.6*	*–93.6*	*–89.8*
	Noon peak	Before	23.8	104.7	161.9	204.7
		After	38.3	11.0	21.2	38.8
		Percent change	*60.9*	*–89.4*	*–86.9*	*–81.1*
	PM peak	Before	27.3	70.5	112.5	151.2
		After	34.8	15.8	40.2	73.0
		Percent change	*27.3*	*–77.5*	*–64.2*	*–51.7*
	Night off peak	Before	36.9	19.9	42.4	60.8
		After	40.0	10.8	24.8	38.8
		Percent change	*8.4*	*–45.7*	*–41.5*	*–36.1*

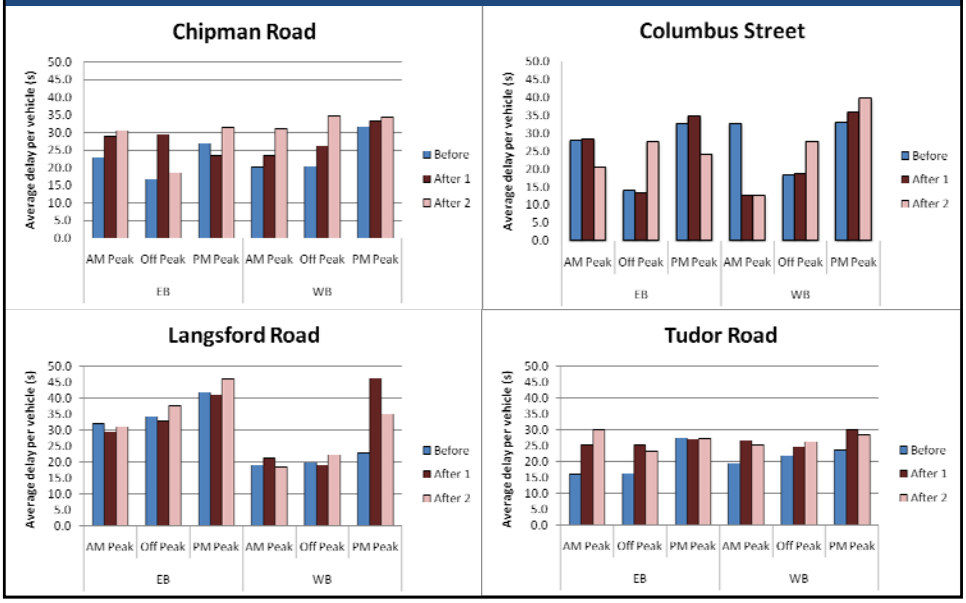
MRI

Average fuel consumption and emissions

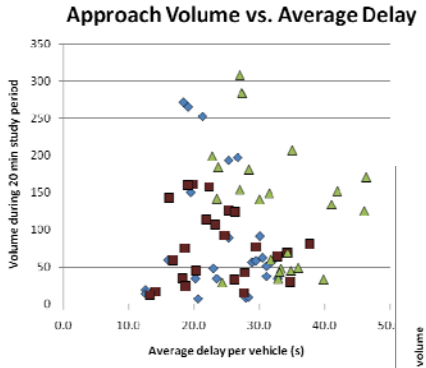
Direction	Time period	Test period	Average fuel consumption (gal)	Average HC (g)	Average CO (g)	Average NO_x (g)
NB	AM peak	Before	0.11	9.70	113.00	5.86
		After	0.12	10.30	117.85	6.38
		Percent change	*4.5*	*6.2*	*4.3*	*8.8*
	AM off peak	Before	0.11	10.50	122.60	6.61
		After	0.11	9.20	109.60	5.42
		Percent change	*0.0*	*–12.4*	*–10.6*	*–18.0*
	Noon peak	Before	0.12	12.00	132.10	7.30
		After	0.12	10.25	118.85	6.26
		Percent change	*–4.2*	*–14.6*	*–10.0*	*–14.2*
	PM peak	Before	0.12	11.60	130.70	7.00
		After	0.12	10.35	120.45	6.44
		Percent change	*–4.2*	*–10.8*	*–7.8*	*–8.1*
	Night off peak	Before	0.12	11.30	134.10	7.38
		After	0.11	8.90	112.45	5.41
		Percent change	*–8.3*	*–21.2*	*–16.1*	*–26.8*
SB	AM peak	Before	0.13	14.00	137.50	9.08
		After	0.11	8.30	97.80	4.55
		Percent change	*–19.2*	*–40.7*	*–28.9*	*–49.9*
	AM off peak	Before	0.13	14.10	137.50	8.80
		After	0.11	8.10	97.70	4.40
		Percent change	*–19.2*	*–42.6*	*–28.9*	*–50.0*
	Noon peak	Before	0.14	15.00	146.40	9.36
		After	0.11	9.25	108.35	5.40
		Percent change	*–21.4*	*–38.3*	*–26.0*	*–42.4*
	PM peak	Before	0.13	12.50	126.50	7.41
		After	0.11	10.85	118.70	6.70
		Percent change	*–15.4*	*–13.2*	*–6.2*	*–9.6*
	Night off peak	Before	0.12	9.50	104.10	5.63
		After	0.11	8.65	99.05	4.99
		Percent change	*–8.3*	*–8.9*	*–4.9*	*–11.5*

MRI

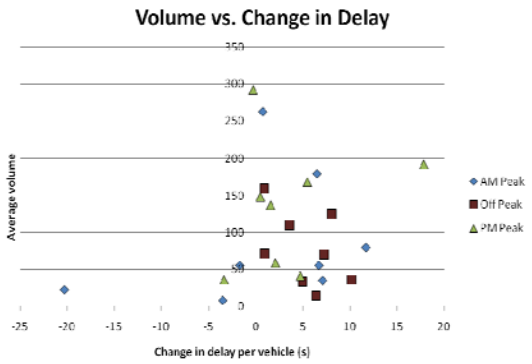
Minor Street Delay Study



Minor Street Delay



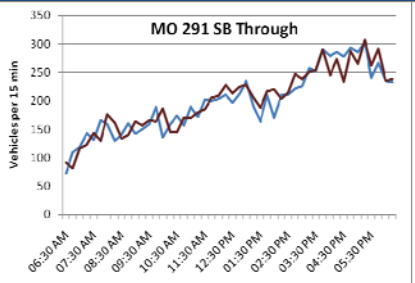
Graph below shows the difference between the before-period delay and the average of the delay measured in the two after periods. Shows that most approaches experienced an increase in average delay between 0 and 10 seconds.

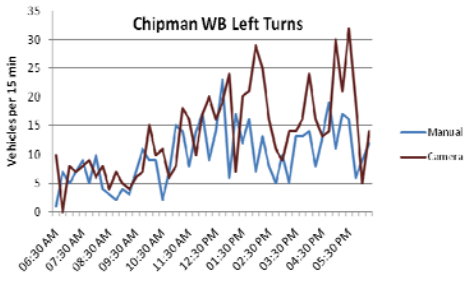


Graph above shows that there was no apparent relationship between volume and delay.

MRI

Turning movement count comparisons at Chipman





Graphs and tables indicate that camera counts typically counted more cars than the manual count, and that both count methods provided similar counts for mainline through movements and less similar counts for other movements.

MRI

Approach	Direction	Manual count	Camera count	Percent difference
NB	Right	526	1,020	93.9
	Through	9,679	9,483	–2.0
	Left	1,457	1,760	20.8
	Total	**11,662**	**12,263**	5.2
SB	Right	1,145	1,700	48.5
	Through	9,529	9,614	0.9
	Left	631	861	36.5
	Total	**11,305**	**12,175**	7.7
EB	Right	2,116	2,153	1.7
	Through	697	1,126	61.5
	Left	1,246	1,528	22.6
	Total	**4,059**	**4,807**	18.4
WB	Right	447	704	57.5
	Through	672	1,073	59.7
	Left	469	649	38.4
	Total	**1,588**	**2,426**	52.8

Conclusions

- InSync system resulted in:
  - shorter travel times for through traffic
  - reduced delay for through traffic
  - reduced time spent in congestion
  - fewer stops along the corridor
  - reduced fuel consumption
  - reduced emissions
  - Increase in average delay per vehicle on minor streets
- Most noteworthy improvements:
  - Average travel time reduction of 2.5 minutes (40%) during AM off Peak and Noon Peak in Southbound direction
  - No statistically significant increase in travel time during any time period
  - Average number of stops decreased by ~90% in many instances
  - Average speed increased 5 to 10 mph in many time periods

MRI

Conclusions

- System provided improvement during times of worst delay without harming other times of day
- Increased delay experienced by traffic on minor streets was outweighed by improvements for mainline traffic
- Traffic volume counts indicated that improvements were not due to changes in traffic patterns
- System appears to be a good investment for MoDOT in this location

MRI

Best Applications for InSync

- Locations where traffic growth is expected
- Locations where traffic demand shifts are not easily addressed by time-of-day plans
- Locations with a high number of incidents or special events
- Locations where unbalanced directional demand makes it hard to coordinate timing plans in both directions
- Locations where travel times are substantially higher than free flow

MRI

Future Research Opportunities

- Safety Analysis
  - Lee's Summit PD anecdotally says crashes have been reduced
  - Also believe red-light running has been reduced
- Study of left-turning vehicle delay
  - This study did not capture delay experienced by vehicles turning left from 291 onto side street
- Benefit-cost evaluation
  - Can extrapolate from data in this study, but…
  - Should consider possible negative consequences to minor street traffic
  - Need to make good assumptions about the times of day that were not evaluated, or extend study
- Long-term effectiveness
  - Will the corridor function well into the future without manual retiming?

MRI

Questions?

Jessica Hutton
Midwest Research Institute
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Update on MoDOT's Research Activities and Needs

Missouri Department Of Transportation
Bill Stone, MoDOT

February 24, 2010

Research Overview

- Organizational Results Division
- National Research Efforts
- MoDOT's Research Process
- MoDOT's Research Needs

Organizational Results

- Organizational Results Division
  - Structure
  - Roles and Responsibilities
  - Informational Exchanges
  - Website
  - Innovations Library
  - Performance Measures

Informational Exchanges

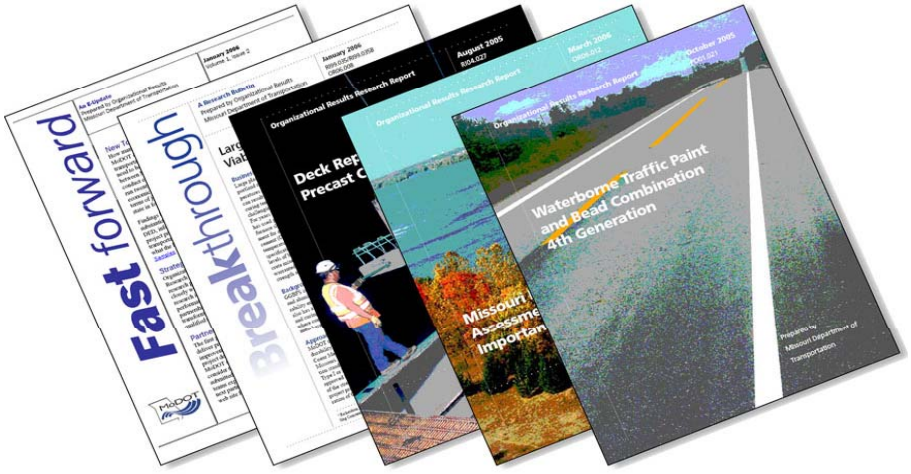
- Transportation Knowledge Networks
  - 3 Regional Networks
    - West
    - Midwest
    - East
  - Comprise a National TKN led by RITA at USDOT
  - Reciprocal agreements allowing the free sharing of information

Informational Exchanges

- Transportation Library Connectivity Pooled Fund - TPF-5 (105)
  - MoDOT is a sponsor of the Pooled Fund and member of the MTKN
  - Support the TKN concept and existing information organizations
  - Emphasis has been on pulling groups together, providing basic library sources, and running pilot projects

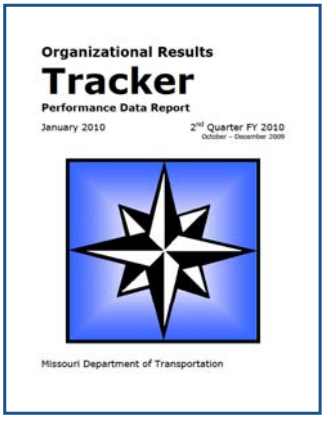
MoDOT Website Update

Innovation Library



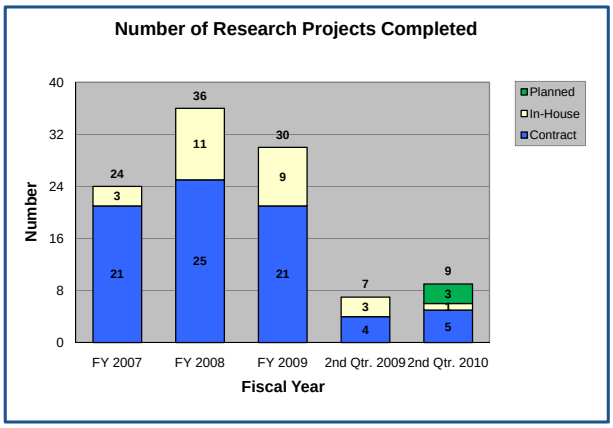
Performance Measures

- OR Division Tracker
  - Compilation of measures to evaluate Division performance
  - Compiled on a quarterly basis
  - Includes both Engineering and Business activities



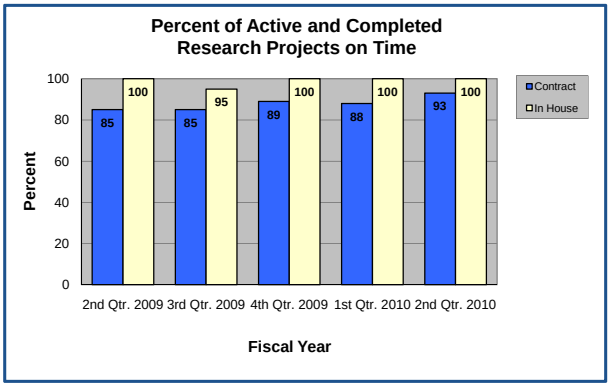
Performance Measures

- Research Projects Completed



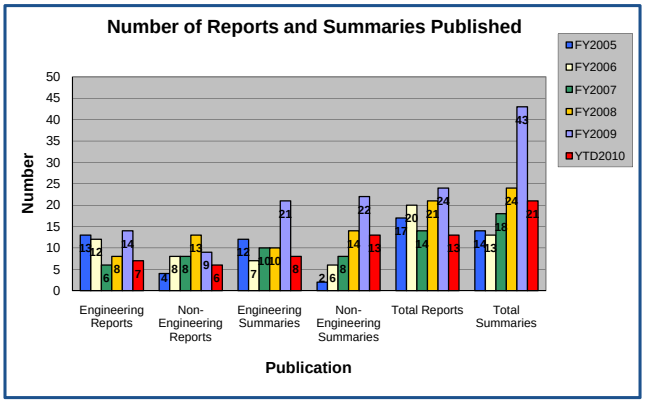
Performance Measures

- Research Projects On-Time



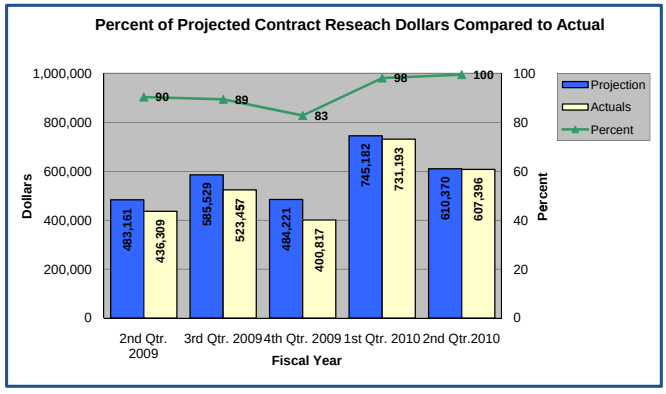
Performance Measures

- Reports and Summaries Published



Performance Measures

- Projected Contract Research Dollars Compared to Actual



National Research Efforts

- Federal Highway Administration
- Transportation Research Board
- AASHTO
- SHRP2
- Pooled Funds

National Research Efforts

- Federal Highway Administration
  - Partnership Agreement
  - Development of Annual Work Program
  - Statewide Planning and Research Funds
  - Quarterly Status Reports
  - Meet with on Regular basis to discuss Research issues
  - Turner Fairbank Research

National Research Efforts

- Transportation Research Board / AASHTO
  - TRB / AASHTO Committees
  - Panel Nominations
  - National Research Problem Statement Development
  - National Project Prioritization

National Research Efforts

- Pooled Fund Projects
  - Opportunity to partner with other states to leverage research funds
  - Actively involved in 20 pooled funds
    - MoDOT lead on Recycled Asphalt Shingles pooled fund
    - J-Turn Research Study with Iowa
    - Low Cost Safety Improvements Pooled Fund Study

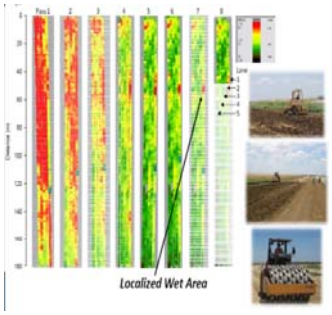
National Research Efforts

- SHRP2 Overview
  - Established by Congress - Managed by Transportation Research Board
  - Funded 4 year program ($205 million)
  - Does not have direct opportunities to implement the advancement in technology and research

Participation by transportation agencies bring these advancements to the implementation stage.

SHRP2 Involvement by MoDOT

- Project R07 – Performance Specifications
  - Specifications are being drafted by consultant
  - Pilot project to utilize Intelligent Compaction (IC)
  - Project in District 6 along Route 141 being discussed as pilot project



Research Process

- **Research Statement Form and Instructions posted on Website:**

Organizational Results
Research Statement Form

Research Process

- **Submittal Form**
  - **Complete all six areas of the attached research statement form and submit via mail or electronically**
  - **Research statements should be limited to a maximum of two pages.**
  - **Deadline for Submittals is April 30,2010**
  - **All submittals will receive an e-mail acknowledgement within five business days after receipt**

Research Process

- Review Process
  - MoDOT staff will review the research statement and determine its impact on MoDOT's Tangible Results
  - Seek MoDOT champion for research statement
  - Compile internal and external research statements
  - Research statements shared with MoDOT Senior Management

Research Process

- Prioritization Process
  - Determine which research statements to move to project level in consultation with MoDOT Senior Management
  - Compare research statements selected to available research budget
  - Organizational Results makes final recommendation to MoDOT Senior Management for RFPs

Research Needs

- Research that improves MoDOT operations or processes
  - Better, Faster, Cheaper
  - Provides Value
  - Implementable
- Forward thinking – items that will affect MoDOT in the next 5 years

Research Needs

- Minor Roads
- Work Zone Improvements
- Traffic Management
- Missouri River Freight Corridor Assessment and Development Plan

Research Needs

- More timely Customer Feedback
- Strategies to Reduce Energy Consumption
- Performance Specifications

Questions

Contact Information:

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Appendix E

Economic and Regional Mobility Evaluation

Fourth Annual Transportation Research Forum

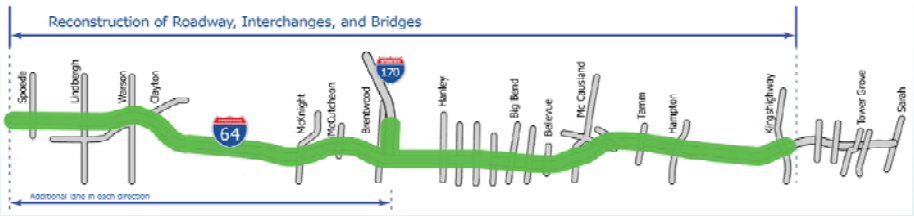
February 24, 2010

Ron Morris, MoDOT
Tom Ryan, HDR
Bill Stone, MoDOT

I-64 Study

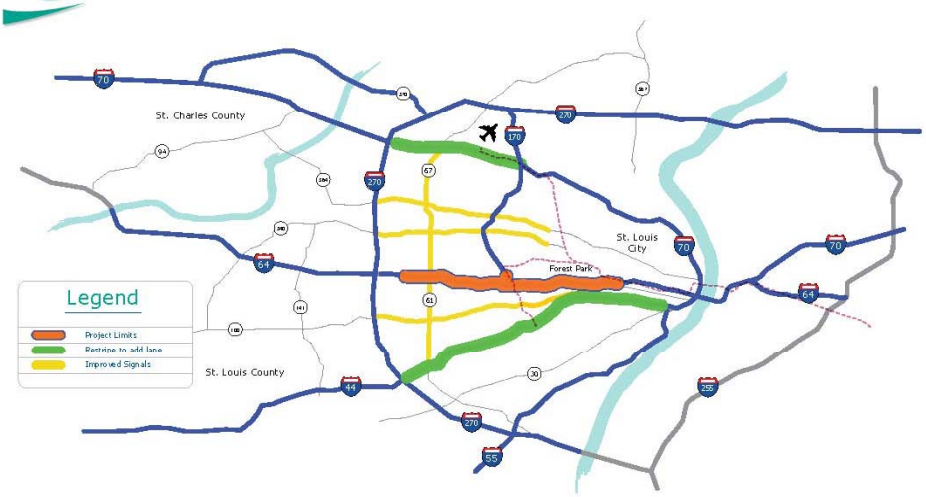
- Why do the evaluation?
- What were the evaluation results?
- How will information gained be used?

What was Built



- 10 miles of roadway
- Direct ramps from I-64 to I-170
- 13 interchanges & 8 major bridges/overpasses
- Additional lane from I-270 to I-170

Regional Impacts



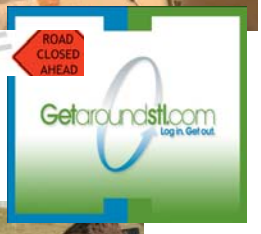
www.thenewi64.org

Regional Concerns

- Congestion on alternate routes
- Impact on businesses and downtown
- Impact to emergency response
- Public information on schedule and alternatives

Project Solutions

- Mobility
- Economics
- Project Communications



Why Do the Evaluation?

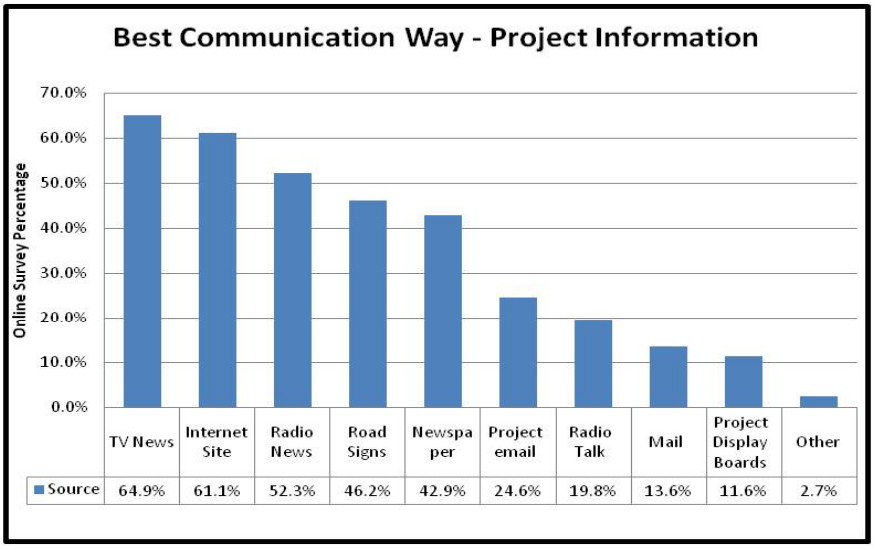
MoDOT wanted to know:

- What solutions worked
- Could solutions be improved
- How could solutions be shared and implementation

Communication

Key Public Indicators - Online Comparison of Both Closures	Western Closure	Eastern Closure	Total
Overall level of satisfaction with how the I-64 closure has been handled	76.7%	78.3%	77.1%
Satisfaction with how well the public kept informed about the new I-64 project	88.7%	85.5%	87.9%
Satisfaction with how well managing to move around the St. Louis area w/ the closure	69.7%	60.4%	67.4%
Satisfaction with timeliness of information being made available	87.5%	85.7%	87.1%
Agreement with "the closure has changed where I shop"	41.5%	47.0%	42.9%
Agreement with "the closure has changed how often I travel to certain areas"	73.3%	76.2%	74.0%
Satisfaction with decision to complete the work by closing I-64 for 2 years instead of 6-8 years w/ lane closures	76.5%	82.5%	78.0%
Survey responses	*1,362*	*444*	*1806*

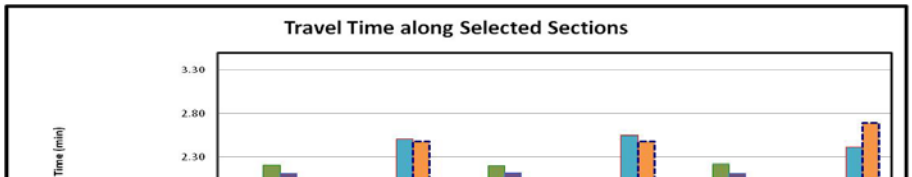
Communication



Communication

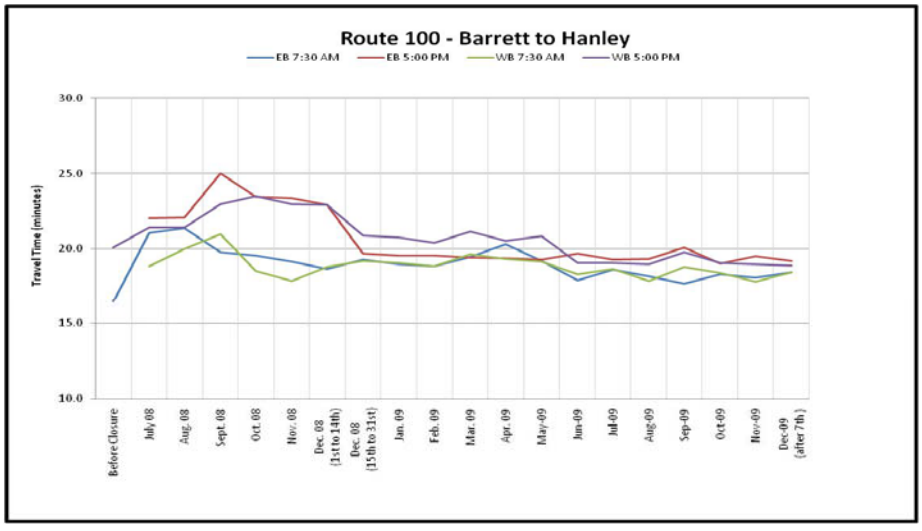
Key Public Indicators - Motorist Assist Comparison of Both Closures	Western Closure	Eastern Closure	Total
Satisfaction with how well managing to move around the St. Louis area w/ the closure	90.0%	90.1%	90.0%
Satisfaction with decision to complete the work by closing I-64 for 2 years instead of 6-8 years w/ lane closures	93.8%	96.1%	94.9%
Survey responses	*3,837*	*3,666*	*7,503*

Mobility

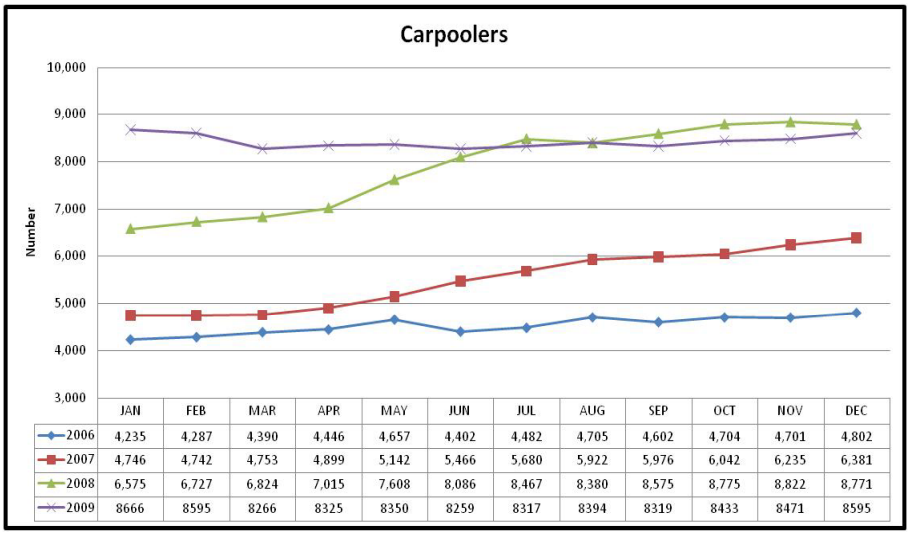


	Aug-Dec '07	Oct-Dec 6 '07	Oct-Dec 6 '09
I-44 EB East of I-270	1.30	1.30	1.00
I-44 WB East of I-270	1.11	1.13	1.13
I-55 SB South of Union Rd	2.22	2.21	2.22
I-55 NB South of Union Rd	2.12	2.13	2.12
I-170 NB North of Page Ave	1.92	1.95	2.01
I-170 SB North of Page Ave	1.86	1.93	1.86
MO370 EB West of Taussig Ave	1.60	1.60	1.65
MO370 WB West of Taussig Ave	1.40	1.41	1.32
I-70 EB East of Airfield Dr	1.23	1.17	1.20
I-70 WB East of Airfield Dr	1.43	1.44	1.44
I-270 NB At Ladue	2.52	2.55	2.42
I-270 SB At Ladue	2.48	2.48	2.69

Mobility



Mobility



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2006	4,235	4,287	4,390	4,446	4,657	4,402	4,482	4,705	4,602	4,704	4,701	4,802
2007	4,746	4,742	4,753	4,899	5,142	5,466	5,680	5,922	5,976	6,042	6,235	6,381
2008	6,575	6,727	6,824	7,015	7,608	8,086	8,467	8,380	8,575	8,775	8,822	8,771
2009	8666	8595	8266	8325	8350	8259	8317	8394	8319	8433	8471	8595

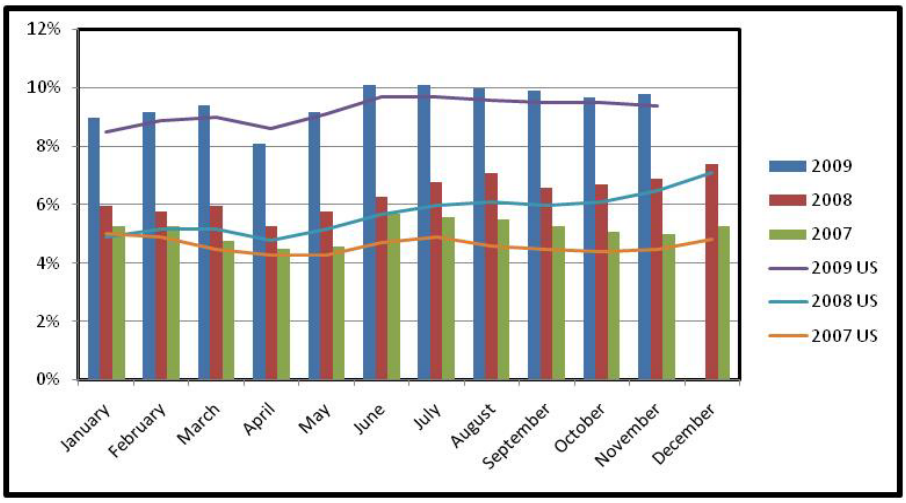
Economy

Table 1: St. Louis I-64 Corridor and Non-Corridor Economic Profile: Second Quarter of Each Year

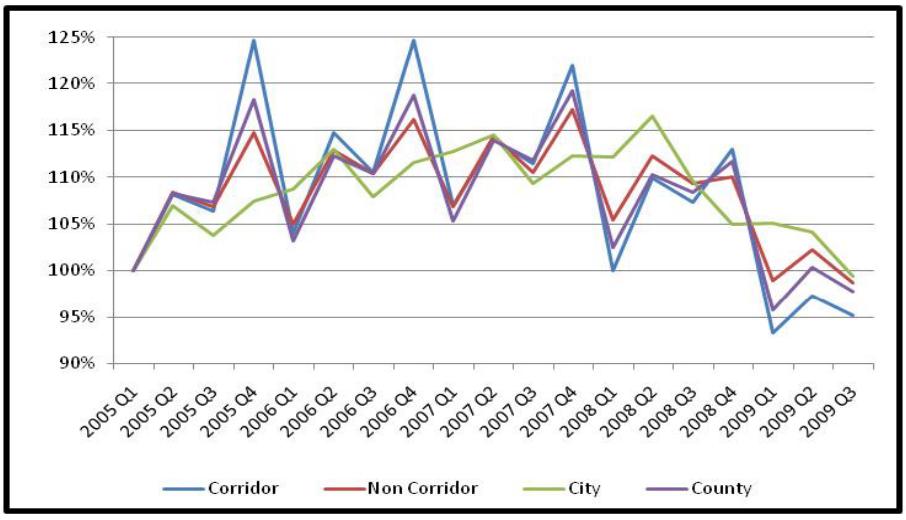
	2nd Quarter 2007		2nd Quarter 2008		2nd Quarter 2009	
	Corridor	Non-Corridor	Corridor	Non-Corridor	Corridor	Non-Corridor
Jobs	201,778	636,941	201,577	631,271	191,098	597,042
# of Establishments	9,482	31,426	9,197	31,131	9,005	30,814
Wages ($ Millions)	$ 2,385	$ 7,055	$ 2,555	$ 7,193	$ 2,293	$ 6,608
Taxable Sales ($ Millions)	$ 950	$ 4,315	$ 914	$ 4,226	$ 811	$ 3,859

Source: MERIC and Missouri Department of Revenue

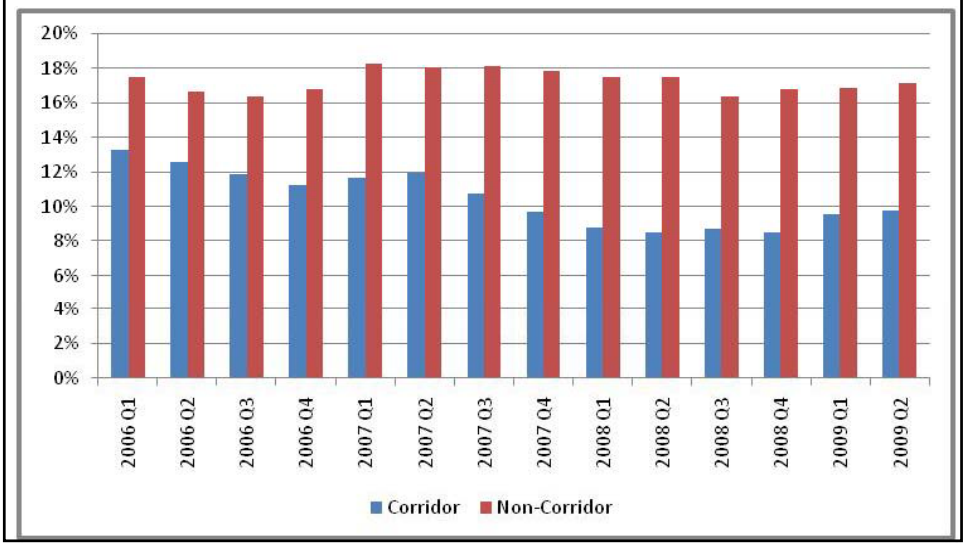
Economy



Economy



Economy



Information Sharing

- MoDOT's Innovation Library - http://www.modot.org/services/OR/byDate.htm
- Presentations at Conferences and Meetings
- FHWA Work Zone Management Team

Implementation

- Development of Best Practices
- Incorporation into MoDOT Business
- Further Evaluation of Results

Project Success

- Regional Coordination
- Enhanced Contractor Involvement:
  - Project Communication
  - Public Outreach
- Maintenance of Traffic
- Green Transportation

Economic and Regional Mobility Evaluation

- Three questions
  - Why do the evaluation?
  - What were the evaluation results?
  - How will information gained be used?

Economic and Regional Mobility Evaluation

Appendix F

Work Zone Panel Presentation

Missouri Department Of Transportation

Dr. Praveen Edara, UMC
Troy Pinkerton, MoDOT
Bill Stone, MoDOT

February 24, 2010

Background

- MoDOT interested in improving management of work zones
- Look for tools that develop effective management plans
- MoDOT met with UMC in Fall 2007 to discuss work zone software tools for estimating traffic impacts
- UMC started a research study in Spring 2008 to identify tools for different work zone configurations

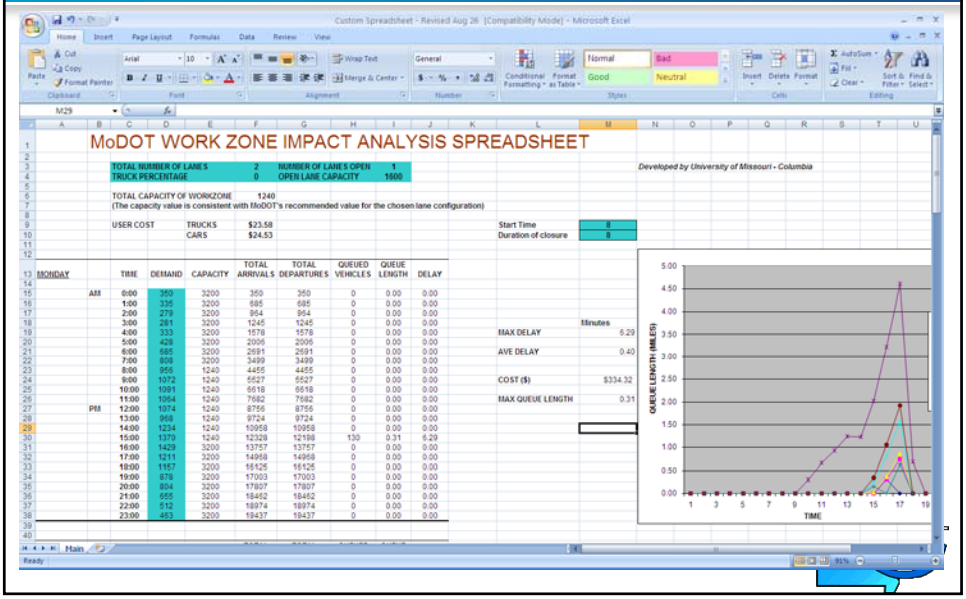
Work Zone Analysis Software

- Software evaluated in this study
  - Quick Zone
  - CA4PRS
  - VISSIM
  - Custom Spreadsheet (newly created in this study)
- Evaluation consisted of
  - Literature review
  - Survey of select state DOT practice on software use
  - Case studies

Study Findings

- Software programs were compared based on
  - Accuracy of results, ease-of-use, input data requirements, output options, and interpretation of results
- Study recommendations
  - Rural interstates (with 2 lanes per direction), divided roadways, and multilane undivided highways
    - Spreadsheet > CA4PRS > VISSIM > Quick Zone
  - Urban roadways
    - VISSIM (driver behavior parameters for MoDOT lane capacities were recommended in the study)
  - Two way one lane (TWOL) with flagger operation
    - Quick Zone, if the input volumes are not high
    - VISSIM, for all other situations

Spreadsheet Demonstration



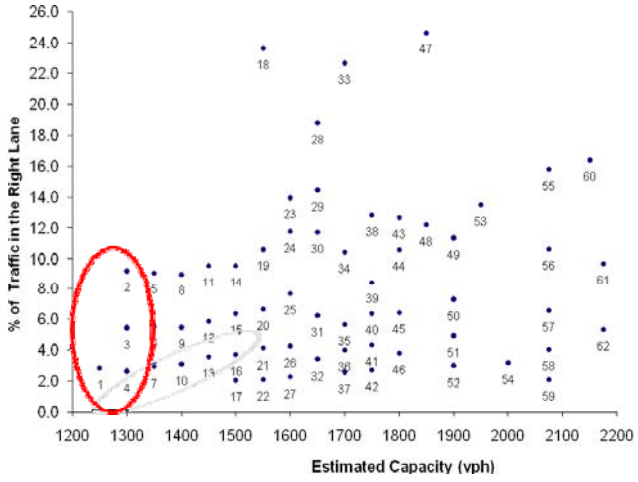
VISSIM Customization

- Default driving behavior parameters in VISSIM do not produce MoDOT capacities for different lane closure configurations
- We recommend parameters for 2 to 1 lane and 3 to 2 lane closure configurations for different truck percentages
- Two car-following and one lane changing parameters were found to be critical in determining capacity of lane closures
- Based on *Exhaustive Search technique* total of 900 unique combinations of these parameters were created and simulated for 30 random seeds

Example: Parameter values for 2 to 1 lane closure

Index	CC1	CC2	SRF	Index	CC1	CC2	SRF	Index	CC1	CC2	SRF
1	1.8	55	0.6	43	1	40	0.55	85	1.7	20	0.3
2	1.8	45	0.6	44	1.2	30	0.4	86	1.6	25	0.4
3	1.8	45	0.5	45	1.2	30	0.35	87	1.8	15	0.2
4	1.8	45	0.5	46	1.3	25	0.25	88	1	55	0.5
5	1.7	45	0.6	47	1.4	15	0.2	89	1	55	0.55
6	1.7	45	0.55	48	1.4	15	0.15	90	1.2	45	0.5
7	1.7	45	0.5	49	1.1	30	0.4	91	1.2	45	0.55
8	1.6	45	0.6	50	1	35	0.4	92	1.6	20	0.3
9	1.6	45	0.55	51	1	35	0.35	93	1.7	15	0.2
10	1.6	45	0.5	52	1	35	0.3	94	1	50	0.45
11	1.5	45	0.6	53	1.3	15	0.15	95	1	50	0.5
12	1.5	45	0.55	54	1	30	0.25	96	1.1	45	0.5
13	1.5	45	0.5	55	1	25	0.35	97	1.5	20	0.3
14	1.4	45	0.6	56	1	25	0.3	98	1	45	0.4
15	1.4	45	0.55	57	1	25	0.25	99	1	45	0.45
16	1.4	45	0.5	58	1	25	0.2	100	1	45	0.5
17	1.4	45	0.45	59	1	25	0.15	101	1.3	30	0.35
18	1.8	15	0.2	60	1.1	15	0.15	102	1.4	25	0.3
19	1.4	40	0.55	61	1	20	0.2	103	1.4	20	0.3
20	1.4	40	0.5	62	1	20	0.15	104	1.5	15	0.2
21	1.4	40	0.45	63	1.8	55	0.55	105	1	40	0.4
22	1.4	40	0.4	64	1.8	55	0.6	106	1	40	0.45
23	1.5	30	0.45	65	1.8	45	0.6	107	1.2	30	0.35
24	1.4	35	0.5	66	1.7	45	0.5	108	1	40	0.5
25	1.4	35	0.45	67	1.6	50	0.6	109	1.1	35	0.45
26	1.4	35	0.4	68	1.7	45	0.6	110	1.5	15	0.15

Example: Parameter values for 2 to 1 lane closure

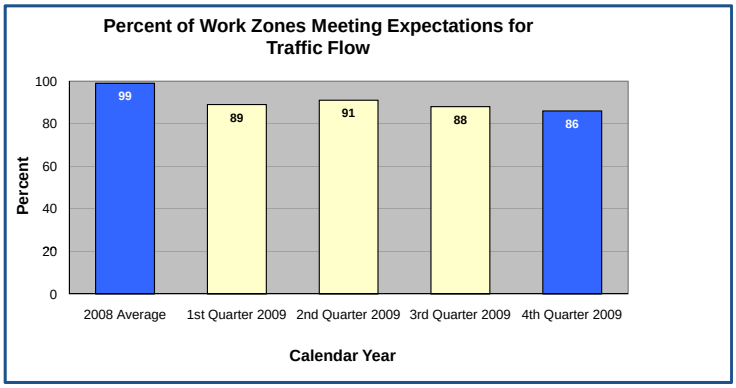


Work Zone Quality Circle

- Work Zone Coordinator in each District
  - Oversees District work zone activities
  - Shares information and best practices at Work Zone Quality Circle meetings
  - Coordinates work zone technical reviews
  - Involved with District Core Team activities

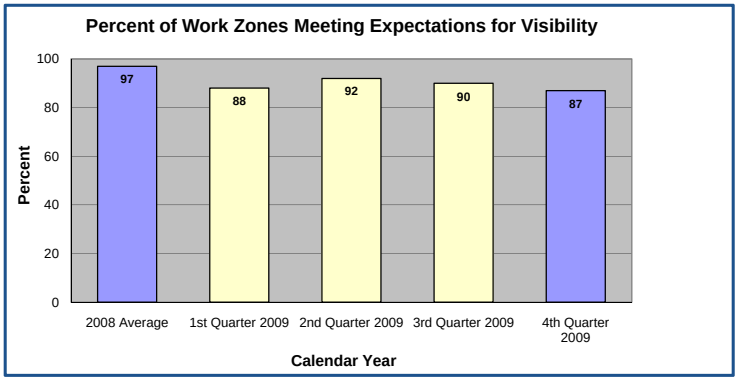
Work Zone Performance Measures

- Tracker Measure – Expectations (1g)

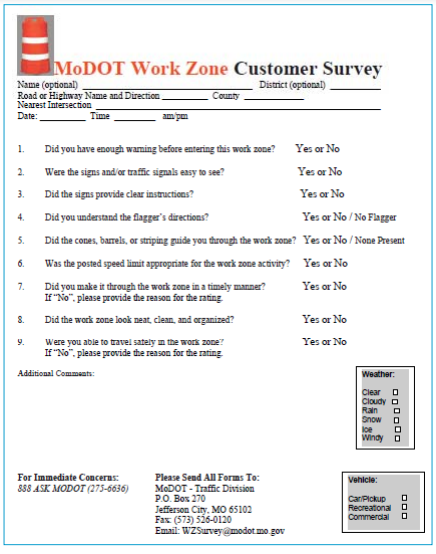


Work Zone Performance Measures

- **Tracker Measure – Visibility (4d)**



Work Zone Customer Survey



MoDOT Work Zone Customer Survey

Name (optional) _____ District (optional) _____
Road or Highway Name and Direction _____ County _____
Nearest Intersection _____
Date: _____ Time _____ am/pm

1. Did you have enough warning before entering this work zone? Yes or No
2. Were the signs and/or traffic signals easy to see? Yes or No
3. Did the signs provide clear instructions? Yes or No
4. Did you understand the flagger's directions? Yes or No / No Flagger
5. Did the cones, barrels, or striping guide you through the work zone? Yes or No / None Present
6. Was the posted speed limit appropriate for the work zone activity? Yes or No
7. Did you make it through the work zone in a timely manner? Yes or No
   If "No", please provide the reason for the rating.
8. Did the work zone look neat, clean, and organized? Yes or No
9. Were you able to travel safely in the work zone? Yes or No
   If "No", please provide the reason for the rating.

Additional Comments:

Weather:
Clear ☐
Cloudy ☐
Rain ☐
Snow ☐
Ice ☐
Windy ☐

For Immediate Concerns:
888 ASK MODOT (275-6636)

Please Send All Forms To:
MoDOT - Traffic Division
P.O. Box 270
Jefferson City, MO 65102
Fax: (573) 526-0120
Email: WZSurvey@modot.mo.gov

Vehicle:
Car/Pickup ☐
Recreational ☐
Commercial ☐

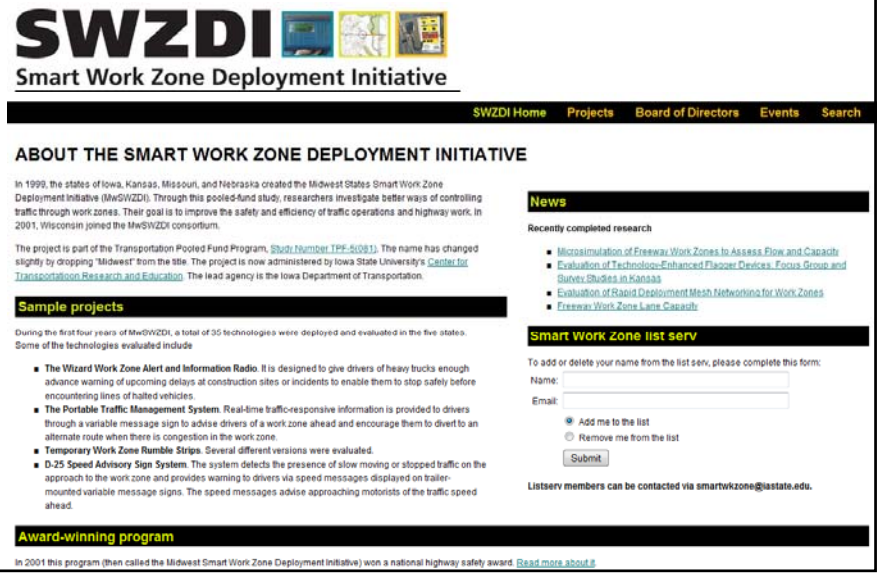
Work Zone Resources

- Associated General Contractors (AGC)
- ATSSA (American Traffic Safety Services Association)
- University Researchers

Work Zone Priorities

- Work zone Management
- Design consistency
- WZ Speed limits and changes in speed limits after initial design
- Law enforcement for night work as a bid item
- Other tools
  - *Early and Later Merge parameters*
  - *Ramp Metering*
  - *Variable Speed limits*
  - *Smart systems*

Research through Pooled Funds



SWZDI
Smart Work Zone Deployment Initiative

SWZDI Home | Projects | Board of Directors | Events | Search

ABOUT THE SMART WORK ZONE DEPLOYMENT INITIATIVE

In 1999, the states of Iowa, Kansas, Missouri, and Nebraska created the Midwest States Smart Work Zone Deployment Initiative (MwSWZDI). Through this pooled-fund study, researchers investigate better ways of controlling traffic through work zones. Their goal is to improve the safety and efficiency of traffic operations and highway work. In 2001, Wisconsin joined the MwSWZDI consortium.

The project is part of the Transportation Pooled Fund Program, Study Number TPF-5(081). The name has changed slightly by dropping "Midwest" from the title. The project is now administered by Iowa State University's Center for Transportation Research and Education. The lead agency is the Iowa Department of Transportation.

Sample projects

During the first four years of MwSWZDI, a total of 35 technologies were deployed and evaluated in the five states. Some of the technologies evaluated include

- **The Wizard Work Zone Alert and Information Radio**. It is designed to give drivers of heavy trucks enough advance warning of upcoming delays at construction sites or incidents to enable them to stop safely before encountering lines of halted vehicles.
- **The Portable Traffic Management System**. Real-time traffic-responsive information is provided to drivers through a variable message sign to advise drivers of a work zone ahead and encourage them to divert to an alternate route when there is congestion in the work zone.
- **Temporary Work Zone Rumble Strips**. Several different versions were evaluated.
- **D-25 Speed Advisory Sign System**. The system detects the presence of slow moving or stopped traffic on the approach to the work zone and provides warning to drivers via speed messages displayed on trailer-mounted variable message signs. The speed messages advise approaching motorists of the traffic speed ahead.

News

Recently completed research

- Microsimulation of Freeway Work Zones to Assess Flow and Capacity
- Evaluation of Technology-Enhanced Flagger Devices: Focus Group and Survey Studies in Kansas
- Evaluation of Rapid Deployment Mesh Networking for Work Zones
- Freeway Work Zone Lane Capacity

Smart Work Zone list serv

To add or delete your name from the list serv, please complete this form:

Name:

Email:

Add me to the list
Remove me from the list

Submit

Listserv members can be contacted via smartwkzone@iastate.edu.

Award-winning program

In 2001 this program (then called the Midwest Smart Work Zone Deployment Initiative) won a national highway safety award. Read more about it.

Questions

Appendix G


Thank You
Please fill out evaluation and leave on table
Your opinion is important to us
February 24, 2010