Research Report
KTC-11-09/SPR414-11-1F

KENTUCKY TRANSPORTATION CENTER

EVALUATION OF THE SAFE PATROL PROGRAM IN KENTUCKY

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Evaluation of the SAFE Patrol Program in Kentucky

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16. Abstract

Members within the SAFE Patrol program have expressed concern that there is a lack of a clear understanding of the value or benefits of the SAFE Patrol program, both among various officials and the general public. The basis of this project is to explain the services provided by the program, and determine the value and benefit of those services. This evaluation report also serves to identify areas of improvement for the program. The result of investigation shows that the other stakeholders are basically satisfied with the SAFE Patrol service whereas some issues should also be addressed to improve the service level.

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EXECUTIVE SUMMARY

The freeway patrol service is a low-cost measure to quickly identify and clear incidents and is currently provided in most states. In Kentucky, it is called the SAFE Patrol. Since the updated service was launched in 2003, the SAFE Patrol has received primarily positive opinions. However, there has some misunderstanding as to the services provided by the SAFE Patrol and the value of that service to the Commonwealth. In order to address those concerns, a comprehensive review and evaluation of the SAFE Patrol Service in Kentucky was conducted. The goals of this evaluation were:

- To help the stakeholders have a better understanding of the services provided by SAFE Patrol in terms of the funding sources, the coverage and service times, working procedures and achievements;
- To determine the merits of the SAFE Patrol service utilizing stakeholder feedback and the experiences/lessons learned from the best practices of freeway service patrols in other states; and
- To evaluate the performance of the SAFE Patrol and conduct sensitivity analysis when the coverage or service time are adjusted in future.

The research team first investigated the SAFE Patrol service in Kentucky. The current SAFE Patrol service was launched in 2003 and it is divided into three areas: west, central and east. Today there are 26 operators, 3 supervisors and 1 branch manager with 30 trucks in the SAFE Patrol program. All the SAFE Patrol staff members are state employees, and the trucks and equipment are owned and maintained by the Division of Incident Management, Kentucky Transportation Cabinet (KYTC). In 2010, the SAFE Patrol operators provided assistance at more than 9,000 incidents and provided a variety of services from supplemental air/fuel to assisting responders at incident scenes. Compared with the service types recommended by Federal Highway Administration (FHWA) in a fully-functioned freeway patrol service, the SAFE Patrol service in Kentucky is comprehensive and fully functional except that the staff training level and service hours and frequencies are slightly lower than recommended by the FHWA.

Secondly, the research team investigated the similar services provided in selected states. The Study Advisory Committee identified the following states for investigation: Florida, Georgia, Indiana, Tennessee, Virginia, West Virginia and Alabama. Some highlights of this investigation are:

- The Road Ranger program in Florida is divided into seven districts plus the Florida Turnpike. Each local office takes charge of the freeway safety patrol service within its district. As a result, the service time and service types vary from district to district. Although the primary funding source is from the state budget, the private sector also participates and provides some sponsorship. For instance, State Farm Inc. sponsors the safety patrol on the Florida Turnpike.
- The freeway patrol service in Georgia is called HERO. It is a key component of the Georgia Department of Transportation's (DOT) Transportation Incident Management program. It has been proven to be able to respond to incidents and clear the blocked lane(s) quickly. The HERO patrol currently covers the busiest metro Atlanta freeways.

- The freeway patrol service in Indiana is called the Hoosier Helpers and is provided in three areas: northwest Indiana close to the Chicago area, the Indianapolis metro area and southern Indiana close to Louisville, Kentucky. The Hoosier Helpers program is under the oversight of the Indiana Department of Transportation (INDOT) and funded by the state.
- The freeway patrol service in Tennessee is called the HELPER. It covers four major cities in Tennessee: Chattanooga, Knoxville, Memphis and Nashville. The HELPER program is recognized as one of the best freeway patrol services in the US. The operational cost is covered by the state funds and partially the federal funds (e.g., Congestion Mitigation and Air Quality Improvement (CMAQ) and Surface Transportation Program (STP)).
- Virginia provides the freeway patrol service in northern Virginia and the Hampton Road area in Virginia Beach. The freeway patrol service in Virginia was considerably downsized in 2008 due to the challenging economy. The coverage, service time, and provided services were also adjusted to fit into the budget constraints.
- West Virginia provides freeway patrol service, namely the Courtesy Patrol, in low-traffic areas and is managed by a non-profit company. The company is retained by the West Virginia Division of Highway. The coverage is more than 30 counties in West Virginia.

Thirdly, the research team conducted a survey aiming to understand stakeholders' opinions on the SAFE Patrol service. The purpose of this task was twofold: 1) evaluate the service performance qualitatively according to the stakeholders' opinions; and 2) promote the service among stakeholders to encourage more usage. The feedback of the surveys indicates that the stakeholders are basically satisfied regarding the performance of the SAFE Patrol. Suggestions for improvements in service include: quicker response to major incidents and expansion in coverage and service hours; additional assistance beyond the incident site with necessary road closures; improved cooperation with highway and bridge maintenance staff and all responding agencies.

Lastly, the research team conducted a quantitative evaluation of the SAFE Patrol program using a discrete-event-simulation tool. Given that there is no commercial simulation software that can easily simulate and evaluate the unique level of service; the research team developed a high-level simulation model to simulate the SAFE Patrol program in Kentucky. While setting up the model, the factors taken into account include: incidents' spatial distributions, temporal distributions, time-variant crew schedules, and the SAFE Patrol program's specific working procedure. The major output of the simulation is the number of incidents reported but not served compared (service request rejection) to the total number of incidents reported. A service request rejection occurs when an incident is reported but the SAFE Patrol operator cannot respond due to the lack of available operators in the area. Specifically, the simulation model was first tailored with the archived data in 2010 and then validated by comparing the simulation outputs of the current SAFE Patrol service with the archived records. The results of the simulations suggested that if the coverage is extended, the central area can still maintain the same level of service whereas the rejection rates would increase east and west unless more operators are recruited. Therefore, there is a need to have more operators in east and west areas if the coverage is to be extended.

CHAPTER ONE

INTRODUCTION

1.1 Background of the SAFE Patrol Program in Kentucky

The SAFE Patrol in Kentucky is involved in a number of activities from assisting motorists on the roadside, to assisting responders with traffic control at the scene of an incident. SAFE Patrol is a program within the Kentucky Office of Highway Safety, Division of Incident Management, and is part of a comprehensive incident management initiative to improve safety and reduce delays caused by nonrecurring congestion. The program is operated on all of Kentucky's interstates and parkways, US 23, and KY 80. SAFE Patrol does not collect any money from the motorists they assist; the program is funded completely by the State. Unfortunately, many people are not familiar with all the activities of the SAFE Patrol and the benefits received from the program. This project would serve to better document the activities and benefits of the program. Findings may also be used to enhance the program where needed.

1.2 Research Objectives

The objective of this study was to do an evaluation of the Kentucky Office of Highway Safety's SAFE Patrol program making use of previous evaluations already performed on these types of programs. The documentation for this evaluation includes a thorough description of the activities associated with the program, identification of areas where the program could be expanded or improved, and identifies the benefits of the program.

1.3 Scope of Work

There are 5 tasks in this project as follows:

- **Examination of Kentucky's SAFE Patrol Program -** The Kentucky Transportation Center (KTC) will document the activities of Kentucky's SAFE Patrol program. This overview includes a comprehensive description of all duties performed and services provided, and a break-down of time allocated to each activity. This information was attained through analysis of the SAFE Patrol website and from information obtained from the Division of Incident Management.
- **Identify and Analyze Comparable Programs of States within the Region** – KTC will analyze highway and Motorist Assist Programs of the States of interest in order to: 1) examine the services they offer, and highlight "best practices"; and 2) compare the level of service to Kentucky's program, to emphasize any areas where Kentucky excels or needs improvement. This was achieved through performing an extensive examination of recent peer-reviewed literature; surveying motorist-assist program web-sites, and inquiring details from relevant staff within each agency.

- **Identify and Interview Stakeholder –** KTC will identify and utilize stakeholders, as appropriate, to gain a better understanding of the program from various user perspectives. Stakeholders include road users and service personnel whose safety is enhanced through the program. This group is extensive and is comprised of individuals making use of the service such as: Fire Departments, Highway workers, law enforcement, Commercial Vehicle Enforcement, and EMS.
- **Discrete-simulation-based analysis of SAFE Patrol operation and sensitivity analysis** - KTC will set up a high-level simulation model based on the available data to analyze the performance of SAFE patrol. Unlike the previous freeway patrol service analysis which was mostly around metropolitan regions with high traffic volumes, the simulation model in this project focuses on evaluating the program performance, including the possibility that there are available SAFE Patrol operators around should an incident occur and investigating whether the current operational schedule is effective or if it could be improved further. In addition, a sensitivity analysis will be conducted with this simulation model to answer such questions as "what if the coverage is expanded with the current number of operators?" or "what if we change the service time?"
- **Development of Recommendations, Final Report and Implementation Plan** - based on the results of the previous tasks, KTC will work to develop (where necessary) recommendations for improving the level and extent of service provided by SAFE Patrol. These recommendations will be included along with the findings and conclusions from the previous tasks, in a final report, which will be the fifth and final deliverable for this project.

CHAPTER TWO

OVERVIEW OF SAFE PATROL PROGRAM IN KENTUCKY

2.1 History

The Safety Assistance Freeway Emergencies Patrol service, or SAFE Patrol, is under the oversight of the Division of Incident Management of KYTC. This program was rolled out in 2004. Prior to 2006, the coverage and provided services were limited and only some areas of I-65, I-75, and I-64 were patrolled.

Figure 1: Old Patrolling Van Prior to 2006

In December 2006, the Division of Incident Management was given the task and responsibility of expanding the SAFE Patrol program in order to provide the services of SAFE Patrol statewide on interstates, parkways, and two highways with heavy traffic in Eastern Kentucky.

The first effort for this task was procuring new patrol trucks and internally recruiting more operators from the district offices and providing these new operators with two weeks of SAFE Patrol training. The content included:

- Traffic Incident Management
- Hazmat
- First Aid/CPR/AED
- Weather Spotter
- Highway Watch
- Homeland Security
- NIMS Training
- Medical-Evacuation Landing Zone
- Customer Service
- Equipment Training
- Radio Training
- Truck Training
- Quick Clearance Law
- Tagging Abandoned Vehicles

Figure 2: SAFE Patrol Operators Received Training[1]

2.2 Current SAFE Patrol Program

2.2.1 Operating Hours and Coverage

As a general rule, the SAFE Patrol operates from 6:00 AM to 10:00 PM, 7 days a week, which includes weekends and holidays [1]. This does vary slightly in some areas depending on the availability of personnel. The Transportation Operations Center (TOC) operators provide radio dispatch for the SAFE Patrol, logging all stops into a computer aided dispatch (CAD) system.

The current SAFE Patrol is divided into three regions: central, western, and eastern. Its coverage is indicated in Table 1 and Figure 3.

Table 1: List of Highways Covered by SAFE Patrol

Interstate	Parkways	Other Roadways
I-75	Louie B. Nunn	US-23
I-64	Wendell H Ford Western KY	KY-80
I-65	Audubon	
I-24	Edward T. Breathitt	
I-71	William H. Natcher	
I-265	Bert T. Combs Mountain	
	Hal Rogers	
	Martha L. Collins Bluegrass	
	Julian Carroll Purchase	

[1] Courtesy of Mr. William Hayes of the Road Assistance Branch, Division of Incident Management

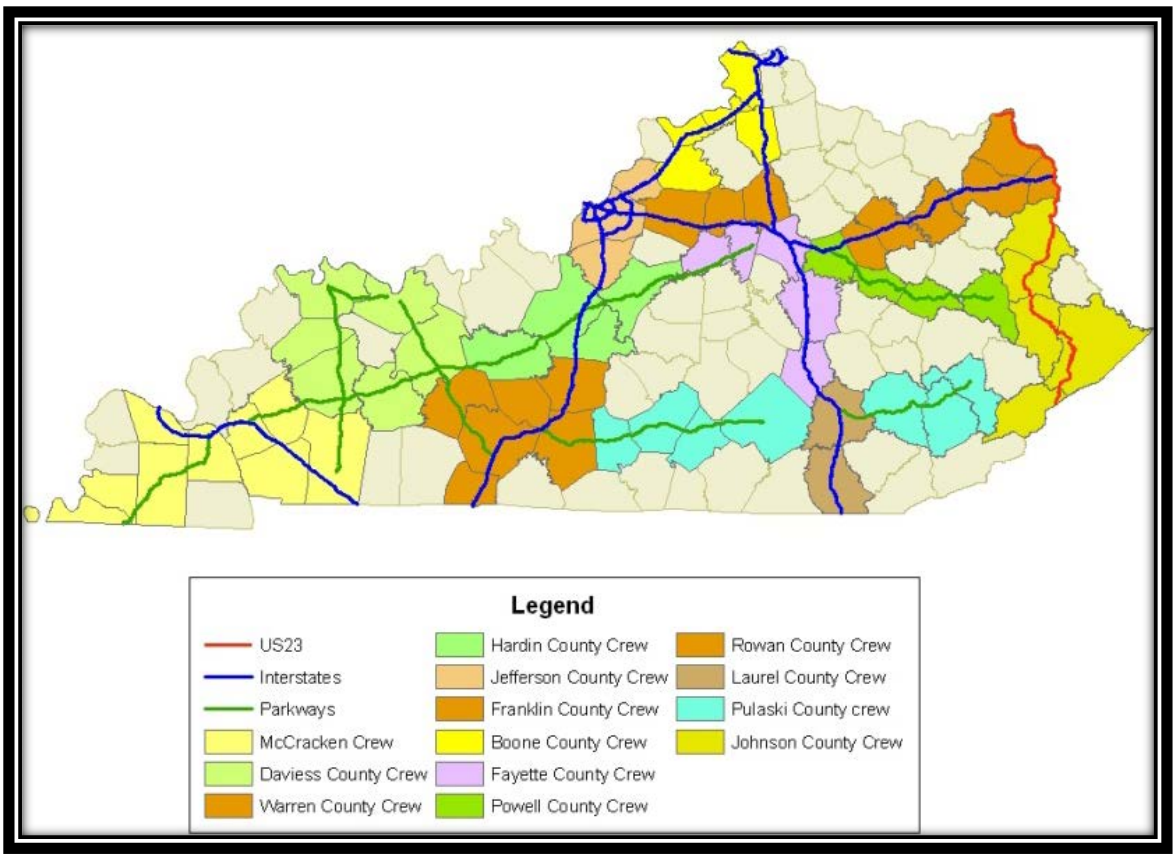


Figure 3: SAFE Patrol Coverage [2]

2.2.2 Organization of Management

The SAFE Patrol program is under management of the Roadway Assistance Branch of the Division of Incident Management. Figure 4 shows the organization of the SAFE Patrol management.

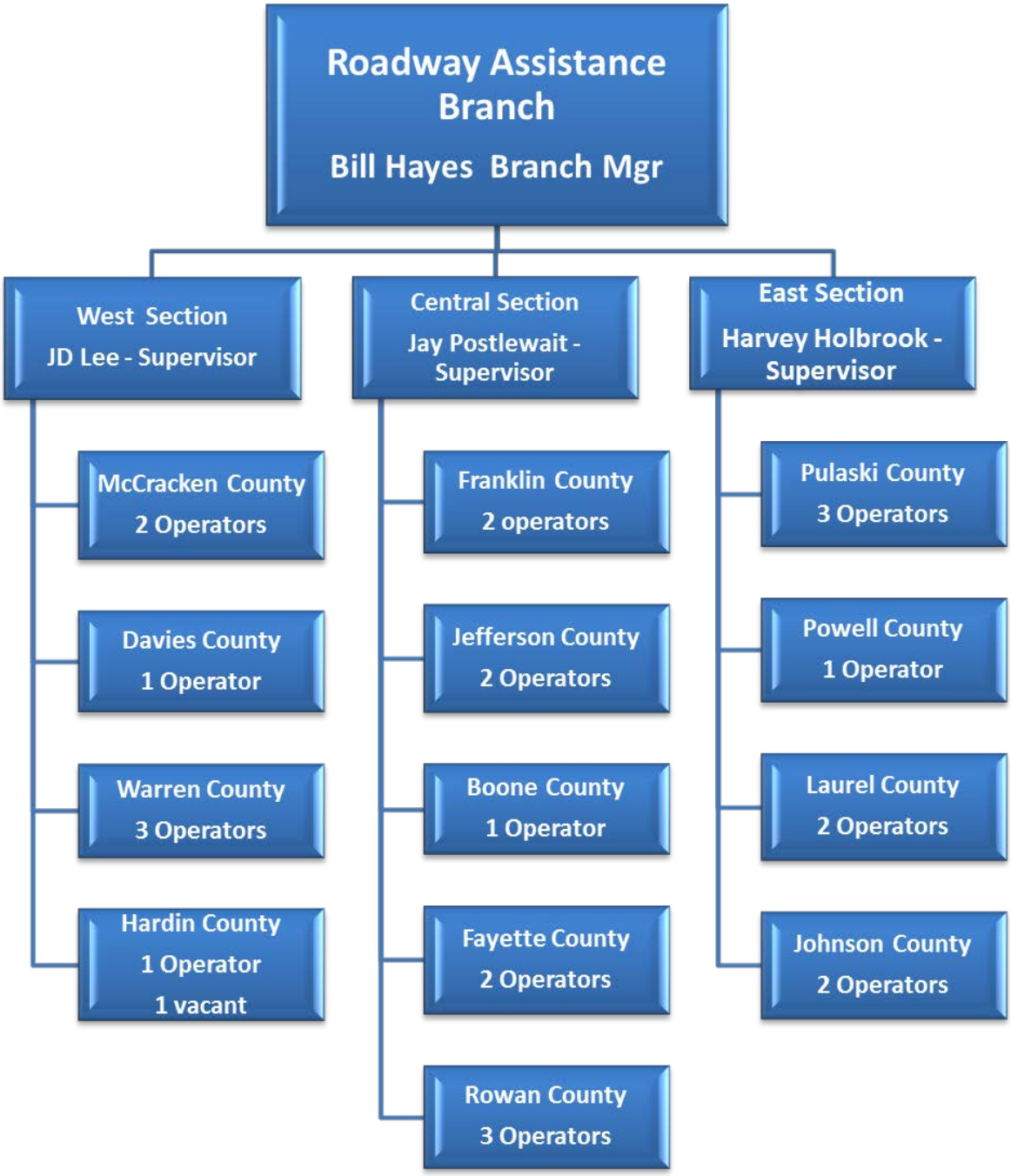


Figure 4: Organization of the SAFE Patrol Management[2]

In total, there are 26 operators, 3 supervisors and 1 branch manager with 30 trucks in the SAFE Patrol program. All of the SAFE Patrol staff is state employees and the trucks and equipment are owned and maintained by the Division of Incident Management. The distribution of staff is illustrated in Figure 5.

[2] Courtesy of Mr. William Hayes of Road Assistance Branch

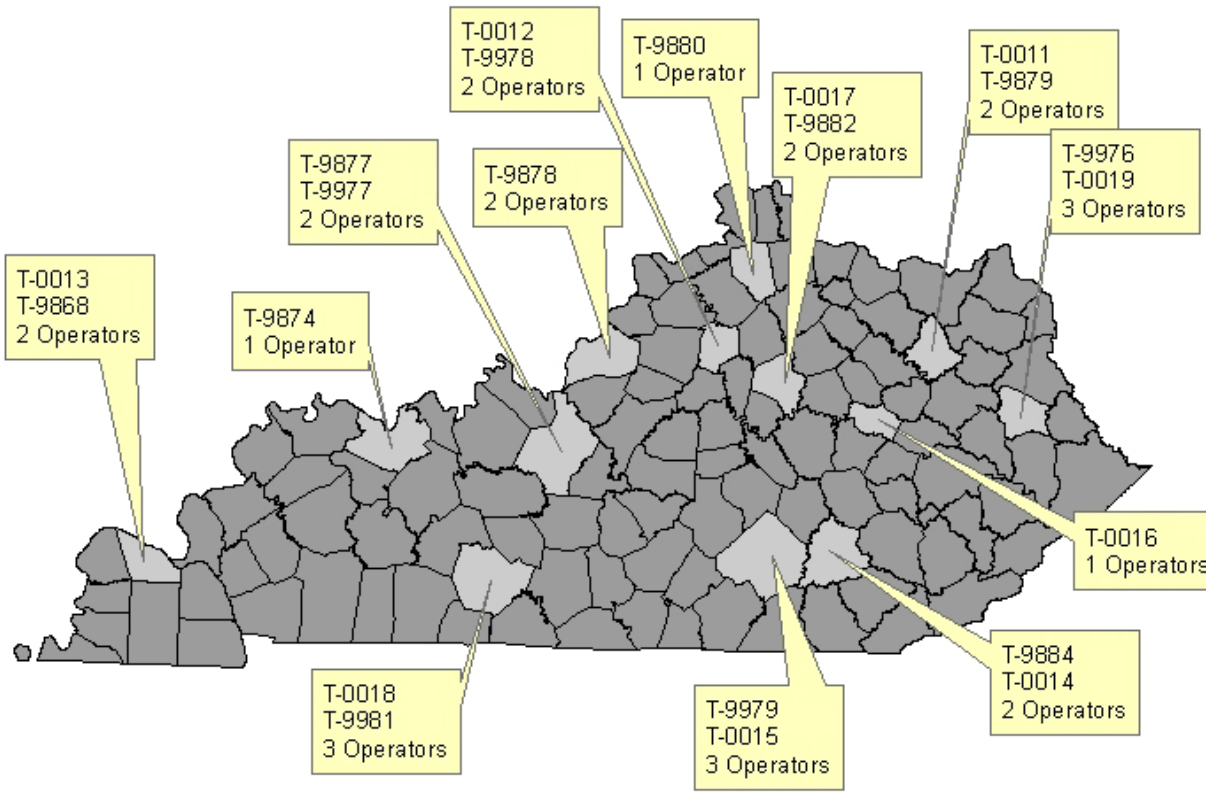


Figure 5: Locations of SAFE Patrol Operators[3]

2.2.3 Services Provided by SAFE Patrol

The SAFE Patrol currently provides the following services, all of which are free[1]:

- Provide gasoline or oil to help vehicles to leave the freeway
- Add air to flat tires or change flat tires
- Jump start dead batteries
- Make minor mechanical repairs
- Assist law enforcement by directing traffic at incident scenes
- Remove debris from the roadway
- Monitor infrastructure for suspicious devices, people, or activities
- Check and tag abandoned vehicles
- Monitor weather changes

A standard SAFE Patrol truck has tools as indicated in Table 2.

[3] Courtesy of Mr. William Hayes of Road Assistance Branch

Table 2: Tools in SAFE Patrol Trucks

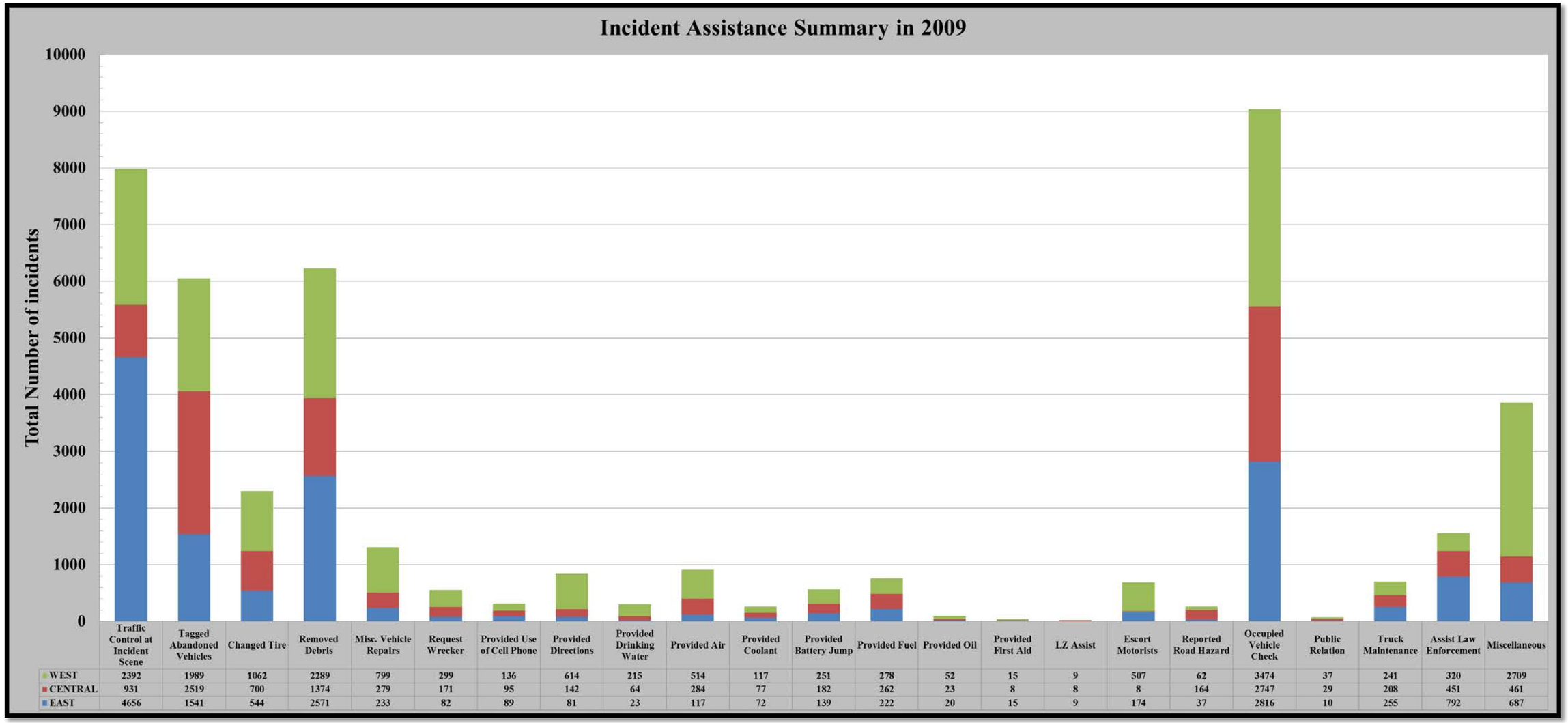
Equipment	Hand Tools	Hubcap Tool	Emergency Traffic Control Equipment
Inverter	Torque Wrench	4-way Lug Wrench (sm)	Emergency Sign Stands
Mobile Radio	Utility Knife	4-way Lug Wrench (lg)	Emergency Signs
CB Radio	SAE Comb. Wrenches	3# Shop Hammer	Traffic Cones
Defibrillator (AED)	Metric Comb. Wrenches	Wheel Protector Sockets	Hard Hat
12 volt Cooler	9 pc. Screwdriver set	Air Hose Reel	Reflective Vest
12 volt Compressor	24" bolt Cutters	Water Jug	Fire Extinguisher
Impact Wrench	10" Curved Jaw Pliers	Push Broom	Flashlight
Booster Pack	10" Adjustable Wrench	Square Point Shovel	First Aid Kits
Floor Jack	ATM Fuses	Round Point Shovel	Flares
Leaf Blower	ATC Fuses	Binoculars	Safety Flags
	Funnel	Blanket	Warning Triangles
	1/2" dr. Socket Set	Impact Set	Safety Glasses (Clear)
	18" Breaker Bar	Torque Wrench Socket Set	Safety Glasses (Smoke)
	4 pc. Pliers set	Jack Stands	Spot Light
	Pressure Gauge	Tire Hook	
	Air Line Inflator Gauge	Fuel Can	
	Battery Post Brush	Fuel Can (Blower)	
		Wheel Lock Removal Kit	
		Push Bumper/Tow Straps*	

*: The towing equipment of SAFE Patrol trucks are only intended to relocate disabled vehicles from travel lanes to road side.

2.2.4 Summary of Incidents Assistance by SAFE Patrol in 2009

Table 3 shows the summary of incident assistance by incident types and locations.

Table 3: Summary of Incident Assistance in 2009



	Traffic Control at Incident Scene	Tagged Abandoned Vehicles	Changed Tire	Removed Debris	Misc. Vehicle Repairs	Request Wrecker	Provided Use of Cell Phone	Provided Directions	Provided Drinking Water	Provided Air	Provided Coolant	Provided Battery Jump	Provided Fuel	Provided Oil	Provided First Aid	LZ Assist	Escort Motorists	Reported Road Hazard	Occupied Vehicle Check	Public Relation	Truck Maintenance	Assist Law Enforcement	Miscellaneous
WEST	2392	1989	1062	2289	799	299	136	614	215	514	117	251	278	52	15	9	507	62	3474	37	241	320	2709
CENTRAL	931	2519	700	1374	279	171	95	142	64	284	77	182	262	23	8	8	8	164	2747	29	208	451	461
EAST	4656	1541	544	2571	233	82	89	81	23	117	72	139	222	20	15	9	174	37	2816	10	255	792	687

2.3 Working Procedure during Incidents Processing

The SAFE Patrol operators work closely with the TOC and Kentucky State Police (KSP). According to the discussion with the members of the advisory committee, Mr. Jeff Bibb and Mr. Bill Hayes, if a minor incident is discovered by a SAFE Patrol operator and there is no need for KSP and other responders, the SAFE Patrol operator will handle the incident on his own. If a major incident is discovered by a SAFE Patrol operator, the SAFE Patrol operator will notify the TOC to dispatch KSP and other stakeholders to the incident scene.

If an incident is not reported or discovered by the SAFE Patrol staff, the dispatcher will first tell whether there is a need for law enforcement, fire trucks, or other stakeholders. If none of them are needed, the dispatcher will then inquire as to the availability of a nearby SAFE Patrol operator. If there is a SAFE Patrol operator available, that operator will be sent to the incident scene. If no SAFE Patrol operator is available, the KSP will be dispatched. If the TOC dispatcher considers a reported incident major, he will dispatch all necessary stakeholders to the scene including KSP, SAFE Patrol staff, fire trucks and/or first aid.

According to Jeff Bibb from Division of Incident Management, KYTC, whenever the KSP gets involved in an incident, a report describing the entire timeline of all activities in detail is generated and archived into the CAD database. The SAFE Patrol operators also summarize the activities on a daily basis. Later, the supervisors and branch manager compile these daily reports and send them to the TOC to put into the CAD database. Figure 6 illustrates the whole working procedure during incident processing.

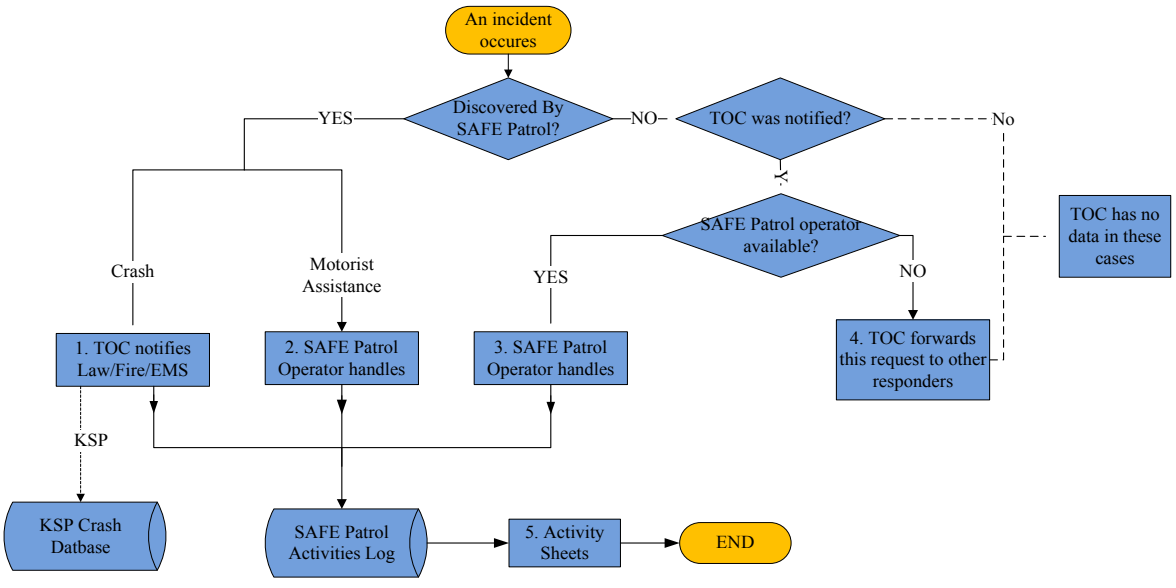


Figure 6: Working Procedure When an Incident Occurs

2.4 Comparison of Level of SAFE Patrol in Kentucky with the Recommendations by Federal Highway Administration

According to its *Service Patrol Handbook* the FHWA classifies the patrol services into three levels according to provided assistance, coverage, operating times, and interaction with Transportation Management Center (TMC) and other stakeholders[3]. Table 4 reveals the recommended services at various levels by FHWA and whether those services are being provided by the SAFE Patrol in Kentucky.

Table 4: Level of SAFE Patrol Service in Kentucky

Services recommended by FHWA	Services in Kentucky
Base Line Patrol Service	
Service on a peak hour basis, at least 5 days a week	YES
Operator is trained to provide limited emergency TTC at incident scenes	YES
Trained in the Incident Command Service, specifically IS-100/200 level	NO
Patrol vehicles able to push stalled or abandoned vehicle out of travel lanes	NO
Respond within 1 hour of notification	SOMETIMES
In contact with a regional TMC	YES
Incident debrief or after-action review	YES
Dispatchable by TMC or law enforcement	YES
Typical services (minor repair, remove debris, provide fuel, relocate vehicle out of travel lanes and assist emergency services)	YES
With traffic control items, gasoline, communications equipment and other basic tools	YES
Mid-Level Service Patrol	
Patrol on a peak hour basis, 5 days a week, plus on-call service 24 hours, 7 days a week.	NO
Operators are highly skilled in emergency TTC stands	NO
Respond within 30 minutes during peak hours and within one hour during on-call services.	NO
Direct communication with TMC and law enforcement	YES
Include First-aid items in addition to the baseline	YES
Supply basic tools	YES
Establish methods to quantify customer feedback	YES
Full-function Service Patrol	
24 hours, 7 days a week	NO
Operators are highly skilled with skills of NIMS, ATSSA, CPR and towing/recovery operations	NO
Patrol vehicles able to fully relocate vehicles from a highway to a safe location	NO
Fully integrated with TMC operations	NO

Ready to be dispatched to incident locations as needed	YES
Methods for quantifying costs and benefits, including customer feedback and operational information such as clearance times.	NO
Public Outreach.	YES

2.5 Cost and Funding Source

The Operating cost for the SAFE Patrol program for fiscal year (FY) 2010 was approximately $3.4 million. The program was completely funded by the state.

CHAPTER THREE

BEST PRACTICES IN SURROUNDING REGIONS

3.1 Florida

3.1.1 History

Florida has one of the most ambitious safety service patrol (SSP) programs in the U.S. It covers 1,262 centerline miles throughout the state as of 2010 and is often referred to as the Road Ranger [4].

The Road Ranger started in 1999 and was initially intended to manage traffic incidents in construction zones. The Road Ranger's mission is to "provide free highway assistance services during incidents to reduce delay and improve safety for the motoring public"[5]. The Florida Department of Transportation (FDOT) has seven districts plus the Florida Turnpike Enterprise. Each individual subdivision office manages its own Road Ranger program. Therefore, the types of services and operating hours vary from district to district.

Each district also has a Traffic Incident Management (TIM) team to better communicate, coordinate and cooperate between stakeholders. The TIM team is also a part of the TMC.

Figure 7: Seven Subdivisions of Florida DOT and Florida Turnpike

3.1.2 Current Safety Patrol in Florida

The operation of the Road Ranger is based on the cooperation/negotiation between the FDOT district offices and private contractors. The operating hours are as follows[4]:

- District 1:
  - Interstate 275 (including Manatee County and Sunshine Skyway Bridge): 7 AM -7 PM, Monday-Friday; 9 AM- 9 PM, Saturday and Sunday.
  - Interstate 75 (including Manatee, Sarasota, Charlotte, Lee Counties): 6 AM-6 PM, Monday-Friday, 9 AM-9 PM, Saturday and Sunday
  - Interstate 75 (Collier County): 5 AM-10 PM, Monday-Friday; 9 AM -9 PM Saturday and Sunday
  - Interstate 4 (Polk County): 6 AM-6 PM, Monday-Friday
- District 2:
  Operating hours are uniformly from 6:30 AM to 6:30 PM Monday-Friday
  - Interstate 95 (From San Marco Road north to Pecan Park Road and from Old Street Augustine Road north to College Street)
  - Interstate 295 (From I-95S to Pulaski Road)
  - Interstate 10 (From San Marco Blvd (Fuller Warren Bridge) to SR 200 (US301)
  - J. Turner Blvd (From I-95 to SR A1A)
  - Interstate 9 A (From Pulaski road to I-95 S)
- District 3: No Road Ranger currently
- District 4:
  - Interstate 95 (From Ives Dairy Road to Palmetto Park Road): 24 hours a day, 365 days a year
  - Interstate 74 (From Miami Gardens Drive north to Mile Marker 50): 24 hours a day, 365 days a year
  - Interstate 595 (From Interstate 95 to US-1): 24 hours a day, 365 days a year
  - Interstate 95 (From Hillsboro Road north to Indiantown Road): 24 hours a day, 365 days a year
  - Interstate 95 (From Donald Ross Road (Exit 83) north to Fellsmere Road (Exit 156) : 6:00 AM-10:00 PM, Monday-Friday
  - Interstate 595 Express (Interstate 75 Sawgrass Expressway Interchange to Interstate 95): 24 hours a day, 365 days a year
- District 5:
  - Interstate 4 [From County Rd. 532 (Polk/Osceola County Line) to I-95 (Volusia County)]: 6 AM to Midnight, Monday-Friday; 7:30 AM to 3:30 AM, Saturday - Sunday
- District 6 :
  Operating hours are 24 hours a day, 365 days a year
  - Interstate 75 (From SR 826 north to the Miami-Dade/Broward County Line)
  - Interstate 95 (From US 1 north to the Miami-Dade/Broward County Line)
  - Interstate 195 (From I-95 east to Alton Rd)
  - Interstate 395 / MacAuthur Causeway (From I-95 east to Alton Road)
  - State Road 826 (From US 1 north to the Golden Glades Interchange)
- District 7:

Operating hours are 24 hours a day, 365 days a year
    - Interstate 4 [From I-275 (MP# 0)] in Hillsborough County, East to milepost 25 (County Line Road) at the Polk County Line
    - Interstate 75 (From the Manatee County Line north to the Hernando County Line, including all of Hillsborough and Pasco Counties)
    - Suncoast Parkway
    - Interstate 275 (From the rest area north of the Sunshine Skyway Bridge (milepost 12.1) in St. Petersburg, Pinellas County, north to milepost 61 (I-75/I-275 apex) in Hillsborough County
    - Leroy Selmon Crosstown Expressway (Full length/14.2 miles)
- Miami-Dade Expressway Authority (MDX):
  Operating hours are 24 hours a day, 365 days a year
    - State Road 112 (From LeJeune Road east to I-95)
    - State Road 836 (From Florida's Turnpike east to I-95)
    - State Road 874 (From Florida's Turnpike north to SR 826)
    - State Road 878 (From SR 874 east to US 1)
    - State Road 924 (From SR 826 east to NW 27 Avenue)
- Florida's Turnpike Enterprise
    - Toll 869/Sawgrass Expressway: 14 hours a day, 365 days a year
    - Florida Turnpike Enterprise (in Miami-Dade, Broward, Palm Beach and Orange and Osceola counties): 24 hours a day, 365 days a year
- Joint Program of Florida Turnpike with Orlando Orange County Expressway Authority
    - East West Expressway/Toll 408 (From Florida's Turnpike to the State Road 50 exit): 6:00 AM-8:00 PM, 365 days a year
    - Central Florida Greeneway (Toll 417) (From I-4 east to international Drive) : 6:00 AM-8:00 PM, 365 days a year
    - Beachline Expressway (Toll 528) (From I-4 east to McCoy Road): 6:00 AM-8:00 PM, 365 days a year
    - Toll Road (429)/Western Beltway (From I-4 to Seidel Road): 6:00 AM-8:00 PM, 365 days a year
- Joint Program with FDOT District 7
    - Toll 589/Veterans Expressway (From mile post 0 to mile post 19/State Road 54 interchange): 6:00 AM-10:00 AM/4:00 PM-8:00 PM, Monday-Friday

3.1.3 Provided Services by the Road Ranger

Ever since the Road Ranger started in 1999, it has assisted with over 2.8 million incidents. Table 5 is a list of services by year[4]:

Table 5: Number of Assisted Incidents by Year in Florida

Year	Assisted Incidents
2009	296,041
2008	320,217
2007	383,584
2006	277,537
2005	298,776
2004	342,895
2003	316,883
2002	279,525
2001	198,372
2000	112,000

The standard services include:

- Helping reduce accidents
- Helping reduce incident duration by assisting the Florida Highway Patrol
- Helping disabled or stranded motorists
- Helping remove road debris
- Helping reduce congestion produced air pollutants
- Helping increase safety at incident scenes

Since the Road Ranger program is managed by the FDOT district offices, the equipment and services vary from district to district. Figure 8 shows the different trucks used in various districts.

The standard equipment includes:

- Two towing straps rated at three thousand (3,000) pounds minimum
- Rubber-faced push bumper
- Rear work lights and/or a 360 degree rotating spotlight
- Power outlets ("hot boxes," "booster outlets," or equivalent), front and rear-mounted, compatible with 12-volt booster cables
- Two (2) heavy-duty batteries, each with the minimum of 750 cold cranking amps (CCA)
- Functioning cab lighting
- A roof-mounted, light bar, front to rear controllable, utilizing white and/or amber colors. The use of red or blue flashing lights is prohibited
- Department-approved arrow board or truck mounted dynamic message sign. This unit shall be mounted atop the cab above the roof-mounted light bar and be free to pivot into place as needed
- Universal ball mount with 1⅞-inch, 2-inch ball and 2 5/16 inch balls
- One (1) Five (5) gallon trash can or heavy duty trash bags
- Two (2) multi-purpose funnels with flexible spouts
- Two (2) wood blocks, each measuring 4-inches by 6-inches by 12-inches
- Fifteen (15) Department approved 36-inch traffic cones, with reflective markings

- One hydraulic floor jack, capable of lifting passenger vehicles
- Air compressor capable of inflating tires of vehicles and operating an impact wrench
- Heavy duty flashlight/traffic wand with spare batteries
- One set of booster cables consisting of 3-gauge copper wire with heavy-duty clamps and one end adapted to the Road Ranger Vehicle's power outlets, minimum 25 feet in length
- Cell phone and Department approved radios

Other Tools include:

- Shovels (1 each)
  - Square-end
  - Round-end
- One (1) 24-inch street broom
- Lug wrenches to fit all vehicles (metric and standard)
- Pry bar, minimum 36 inches in length
- Air operated impact wrench with sockets to fit all vehicles (metric and standard)
- Each Road Ranger Vehicle shall have a toolbox containing the following tools:
  - Screw Drivers
    - Standard 1/8, 3/16, 1/4 and 5/16 inch
    - Phillips head #1 and #2
    - Star driver (Torx bit) 1 set
  - Pliers (1 pair each)
    - Needle nose
    - Adjustable rib joint, 2-inch minimum capacity
    - Wire cutter
  - Adjustable wrenches (1 each)
    - 8 inch
    - 12 inch
  - Five-pound hammer
  - Rubber mallet
  - Electrical tape (20 yards)
  - Duct tape (20 yards)
  - Tire pressure gauge
  - Mechanic's wire (25-foot roll)
  - Bolt cutters – 24 inch or larger
  - Complete set of open end and box wrenches (metric and standard)

Expendable Items include:

- Five (5) gallons of diesel fuel in labeled and approved container
- Five (5) gallons of unleaded gasoline in labeled and approved container
- First aid kit (First Responder Kit, fully stocked, including gloves)
- Two (2) fire extinguishers, 5-pound dry chemical ABC units meeting all safety requirements. If seal is broken, unit shall be tested, resealed and certified
- Five (5) gallons of radiator water in labeled container(s)
- Twenty four (24) highway wet flares, 30-minute burn

- Ten (10) gallons of absorbent material for liquid spills
- Twelve (12) bottles of drinking water in individually sealed bottles, minimum 16 ounces
- Fifty (50) DOT-approved comment cards, provided by the vendor.
- Twenty-Five (25) Move it Law Cards, provided by the district, for distribution to crash victims who have questions regarding the Move It Law

Figure 8: Different Trucks of the Road Ranger in Florida

The operators received training on temporary traffic control and basic first aid. Although many Road Ranger trucks are not equipped, the drivers are trained in quick clearance activities such as pushing a disabled vehicle out of travel lanes. In the areas where tow trucks are utilized, the operators also receive training on towing vehicles.

In addition to the Road Ranger, some subdivisions of FDOT also developed other local incident management programs to serve major incidents clearance. The Florida Turnpike Enterprise established the Roadway Incident Scene Clearance (RISC) program, whose contractors are

specially equipped with heavy duty recovery equipment for major incidents that need more resources to clear. District Four of the FDOT outfitted certain vehicles particularly for major freeway incidents, called the Severe Incident Response Vehicle (SIRV), to provide a higher level of assistance when major incidents occur[6].

3.1.4 Costs and Benefits

According to a study conducted by the University of South Florida, the operating cost for the Road Ranger was $1,133,085 in FY 2004-2005 and total benefits were $29,230,724. Therefore the benefit-cost ratio is approximately 26:1[7].

The Road Ranger funding was once cut during the 2008 fiscal year. Later the budget was increased back to the numbers before 2008. As of July 2010, there are 109 trucks with a total of 248 drivers and supervisors. The total budget for FY 2009-2010 was 16 million dollars.

3.1.5 Funding Sources

The Road Ranger is usually funded by the FDOT's local district offices. Therefore it competes with other highway projects. Due to the budget cuts in FY 2008-2009, the FDOT began to allow more private companies to participate in this program under the FDOT's oversight. The private companies sponsor the program and then can get compensated by advisements and other indirect benefits. For instance, the Florida Turnpike Enterprise got sponsorship from State Farm Insurance to enhance the Road Ranger service. By doing so, State Farm received less accident claims and therefore benefited from participation.

3.2 Georgia

3.2.1 History

In Georgia, the freeway service patrol is called Highway Emergency Response Operators (HERO) program. The HERO started in Atlanta in 1994 and later became a part of the transportation management center (the "NaviGAtor" system) in metro Atlanta after 1996. The HERO's primary mission is to clear wrecked or disabled vehicles to minimize traffic congestion and provide traffic control at incident scenes. Its secondary mission is to help stranded drivers replace flat tires, jump start weak batteries, provide courtesy use of a phone or provide gas, etc. In addition, the HERO also assists traffic control during special events or natural disasters, such as hurricane evacuation. All the HERO operators are Georgia DOT employees. The other stakeholders include the FHWA, the Georgia DOT, traffic reporters, emergency/ first-response agencies and private partners (e.g., the State Farm Insurance)

The NaviGAtor system in Georgia is a comprehensive program of incident management. The TMC is located in Atlanta, and operates 7 days a week and 365 days a year. The TMC also serves as an information clearinghouse and is connected with a number of other TMCs and smaller Transportation Control Centers (TCC) throughout the state. The TMC personnel keep

monitoring the traffic via cameras. Once an incident is discovered, they will notify the HERO truck operators to respond promptly[8].

3.2.2 Current Service Patrol in Georgia

The HERO is a key component of the Georgia DOT's TIM program. It has been proven capable of responding to incidents and clearing blocked lanes quickly. The HERO patrol currently covers the busiest metro Atlanta freeways (see Figure 9) with over 221 miles. The list of patrolled freeways includes:

- I-20 between Thornton Rd. (Exit 44) and SR20/SR138/Stockbridge Hwy. (Exit 82)
- I-75 between SR 155 (Exit 216) and Emerson-Allatoona Rd. (Exit 283)
- I-85 between SR 74/Senoia Rd. (Exit 61) and SR 20 (Exit 115)
- I-285 between Washington Rd. (Exit 1) and Old National Hwy (Exit 62)
- I-575 between Barrett Pkwy (Exit 1) and Townlake Pkwy (Exit 8)
- I-675 between I-75 and I-285
- I-985 between I-85 and Spout Springs Rd./Flowery Branch Rd. (Exit 12)
- SR 166/Langford Pkwy between I-285 and I-75/85
- US 78 between Valley Brook Rd./N. Druid Hills (Exit 1) and West Park Place Blvd. (Exit 9) and
- SR 400 between Sidney Marcus Blvd/Piedmont Rd. (Exit 1) and Windward Pkwy (Exit 11)

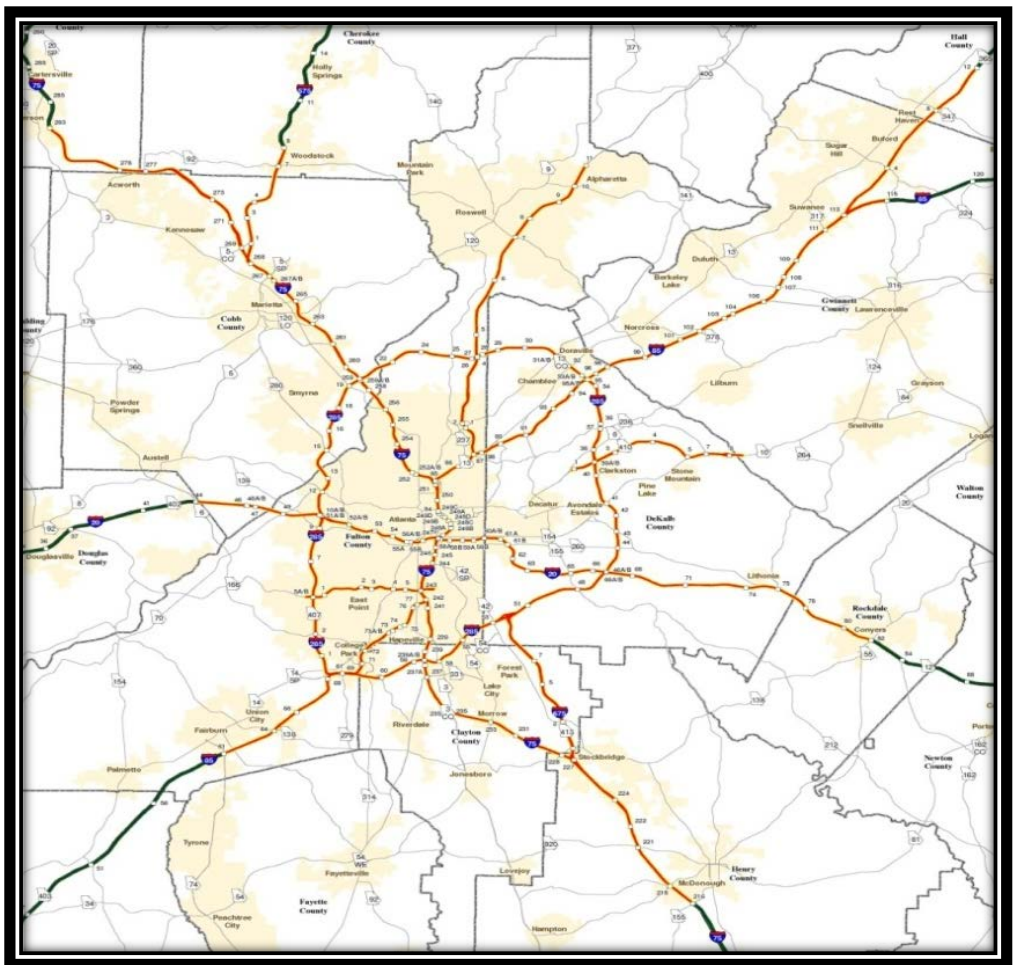


Figure 9: HERO Program Coverage in Atlanta[8]

As of 2008, the number of HERO staff members is approximately 75 (including 4 women) and 11 supervisors[9]. They were split into four shifts: morning, afternoon, weekend and overnight. The patrol service starts from 5:30 AM to 9:00 PM on weekdays and from 7:30 AM to 9:00 AM on weekends. During the rest of time, the HERO team is on call to respond to incidents.

3.2.3 Provided Services by HERO

During FY 2007-2008 the HERO unit's stops for incidents were 92,029. During FY 2008-2009, the stops were 85,111[10]. The average incident response time is 13 minutes and the average roadway clearance time is 9 minutes[9].

The services provided by the HERO program include:

- Clearing stalled vehicles from the travel lanes
- Changing flat tires
- Jump starting weak batteries
- Providing fuel, coolant, etc.
- Providing road and travel information

- Providing transportation to safer areas and
- Providing courtesy use of a telephone

Usually the HERO trucks do not tow wrecked or disabled vehicles to auto services or off the freeways because their primary mission is to clear the travel lanes and minimize the traffic congestion. Nonetheless, the HERO truck operators will provide a courtesy telephone to let the drivers call towing companies.

Figure 10: the State Farm HERO Truck

3.2.4 Costs and Benefits

According to a research conducted in 2003, with the TMC operations and Intelligent Transportation Systems (ITS) device maintenance combined, $16 million was spent on the entire Traffic Incident Management program, or the NaviGAtor™, in 2003.

3.2.5 Funding Sources

The HERO program has been funded by the Congestion Mitigation/Air Quality (CMAQ) program under the guidance of the Atlanta Regional Commission's Incident management Taskforce, an alliance of stakeholders[8].

3.3 Indiana

3.3.1 History

The freeway service patrol (FSP) in Indiana is called the Hoosier Helpers. It started on August 30, 1991 under the management of the Indiana Department of Transportation (INDOT). In the early stages, the Hoosier Helpers covered portions of Interstate 89, Interstate 94, and Interstate 65 in northwest Indiana. Later, the Hoosier Helpers program became a part of INDOT's ITS initiative, also known as TrafficWise, and expanded to the Indianapolis metropolitan area in 1997 and southern Indiana near Louisville, Kentucky in 1999.

The Hoosier Helpers program is a key component of TrafficWise. By continuously patrolling the interstates and communicating with the TMC. The patrollers can identify incidents and clear the blocked travel lanes quickly and therefore minimize the incurred traffic congestions[11].

3.3.2 Current Service Patrol in Indiana

Currently, the Hoosier Helpers primarily covers three regions: the northwest Indiana area with 34 freeway miles, the central Indiana (Indianapolis metropolitan) area with 95 freeway miles and the southern Indiana area (near Louisville, Kentucky) with 28 freeway miles. On average, each zone covers 18 to 20 miles (one way) and average time to finish one patrol is 40 minutes depending on traffic conditions and stops during patrols.

Figure 11 through Figure 13 illustrate the coverage[11]. The operating hours and shifts are as follows:

- Northwest Indiana: Monday-Friday 1st shift is from 6:00 am to 2:00 pm; 2nd shift is from 2:00 pm to 10:00 pm and Sunday from 12:00 pm to 8:00 pm
- Indianapolis metro area: Monday-Friday. 1st shift is from 6:00 am to 2:00 pm, 2nd shift 1:00 pm to 9:00 pm
- Southern Indiana: Monday-Friday 1st shift is from 5:00 am to 1:00 pm; 2nd shift is from 12:00 pm to 8:00 pm

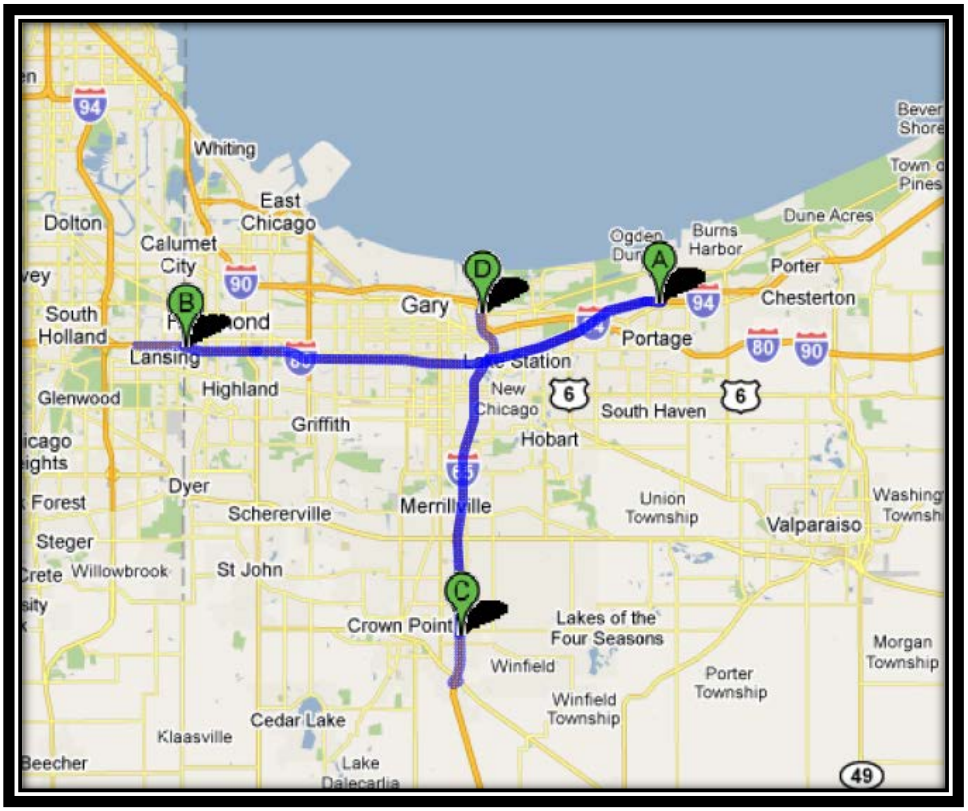


Figure 11: Coverage of the Hoosier Helpers Program in the Northwest Indiana

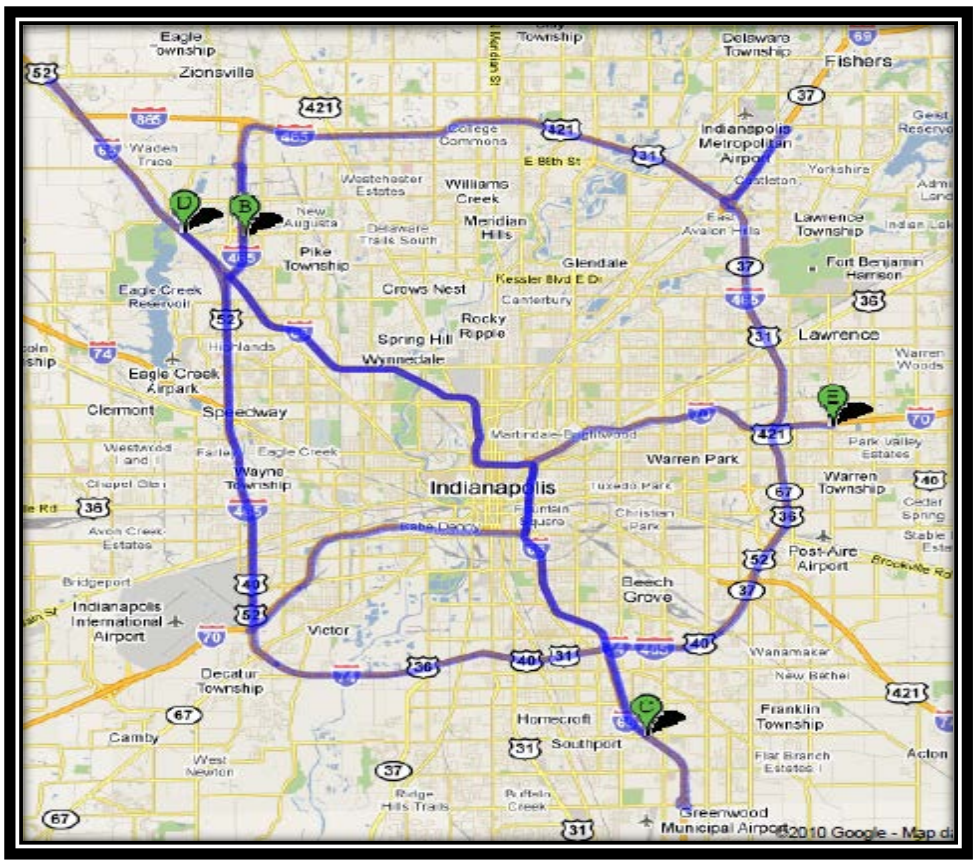


Figure 12: Coverage of the Hoosier Helpers Program in Metro Indianapolis

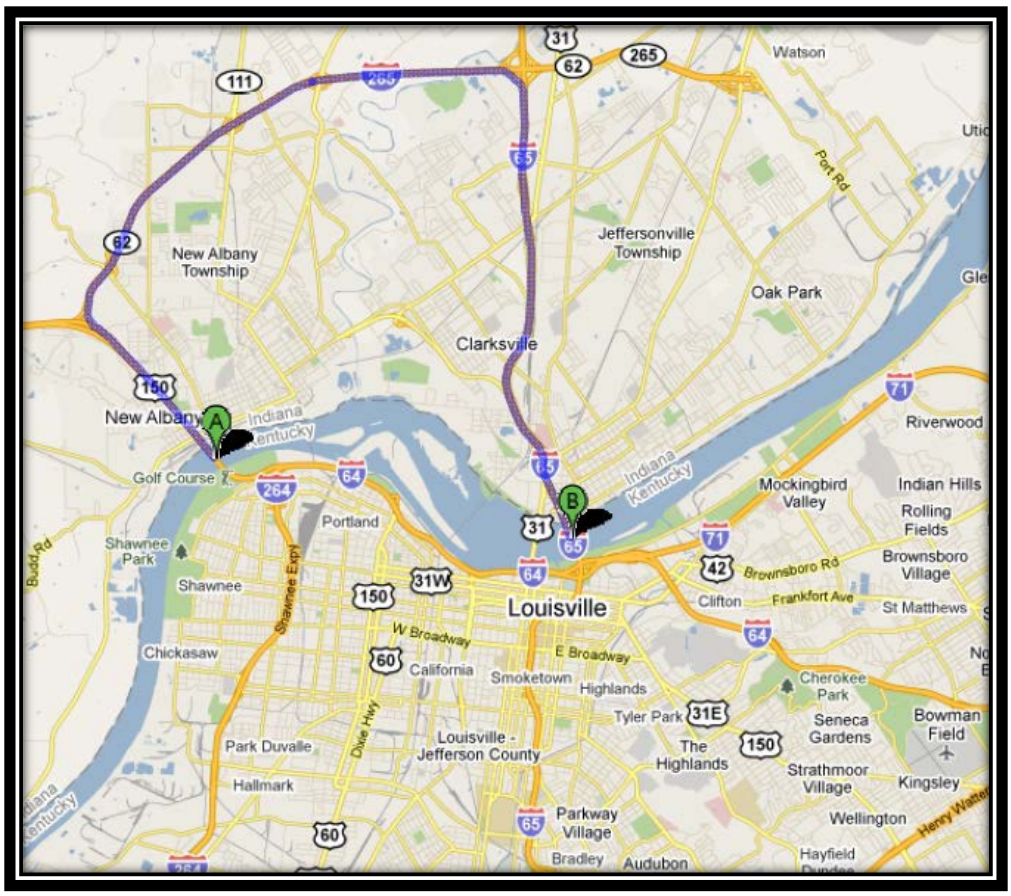


Figure 13: Coverage of the Hoosier Helpers Program in Southern Indianapolis

3.3.3 Services Provided by the Hoosier Helpers

According to the website of INDOT, since the program started in 1991, the Hoosier Helpers operators have assisted over 350,000 motorists on Indiana's busiest interstates. The provided services include changing a flat tire, jump starting vehicles, providing water for overheated vehicles, providing enough fuel to a motorist to make it to a service station or perhaps helping with a minor mechanical problem. Their goal is to help drivers in 20 minutes or less; and if that timeframe is not possible, they will call a wrecker or transport a stranded motorist to a safe location off the roadway. The Hoosier Helpers operators also assist the Indiana State Police at incident scenes. The INDOT conducts in-house training utilizing its own Standard Operating Guideline and the Temporary Traffic Control Guideline of Manual on Uniform Traffic Control Devices (MUTCD). The operators also receive training for first responders including first aid, Cardiopulmonary Resuscitation (CPR), and Automated external defibrillator (AED). The operators also receive training from local tow services as they have winches. The Hoosier Helpers program has no partnership from private sectors.

Figure 14: A Hoosier Helpers Van

In northwest Indiana, there are 11 trucks, one supervisor, and 10 truck operators. In metro Indianapolis, there are 12 trucks, one manager, one supervisor and 10 truck operators. Southern Indiana has two trucks, one shift leader, and one truck driver.

3.3.4 Costs and Benefits

The Hoosier Helpers program was just reorganized after July 1, 2010. Therefore the annual data is being captured currently. However, according to the cost from July to November, salaries expenditure has been $394,189 and the vehicle maintenance has been $394,189. If we extrapolate these numbers into the entire year, the total operational cost will be about $1 million dollars plus approximately $500,000 fuel cost.

According to the information provided by Mr. Donald Holder from INDOT, the benefit to cost ratio is about 4.8:1.

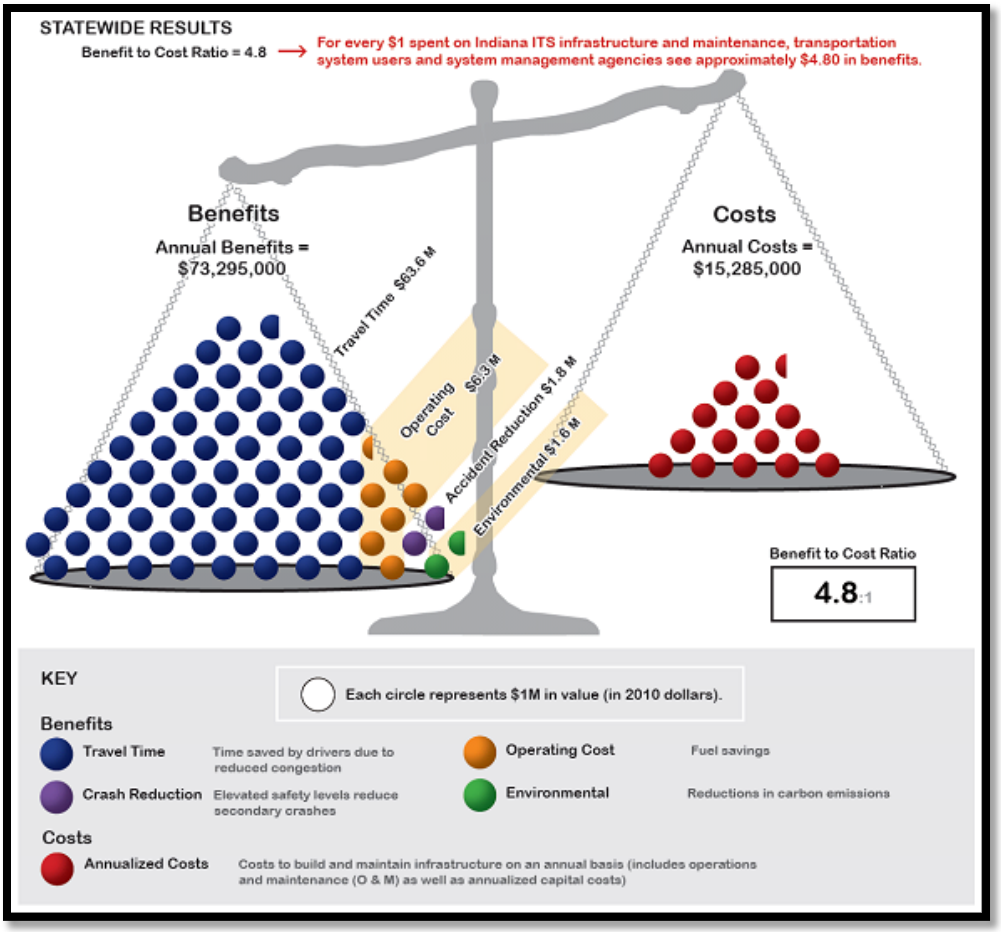


Figure 15: Benefit-Cost Ratio of the Hoosier Helpers Program in Indiana

3.3.5 Funding Sources

A majority of funding is federal funding (90 percent) under the CMAQ program and other programs. The remaining 10 percent is from state funds.

3.4 Tennessee

3.4.1 History

The freeway patrol service in Tennessee is named HELP and it is also part of the incident management program and ITS initiatives of the Tennessee Department of Transportation (TDOT). The mission of HELP is to minimize traffic congestion caused by incidents and promote safer movement of people and products. Before the staged implementation, a freeway patrol service task force was created to concentrate all necessary resources within TDOT and promote common understandings and expectations among stakeholders. The intended stakeholders include motorists, law enforcement officers, fire and emergency medical services personnel, tow truck operators, and local transportation officials.

TDOT first launched the HELP program in Knoxville and Nashville in 1999 and started the patrols in Chattanooga and Memphis in 2000. Initially, the operating hours on weekdays were from early morning to about 8:00 PM. In September 2001, the HELP program in all four cities extended the service to seven days a week with longer hours.

HELP has been closely coordinating with other stakeholders, including law enforcement agencies, fire and emergency medical services, towing and recovery operations and other incident responders. The Tennessee Highway Patrol (THP) only responds to the incidents outside the major cities' boundaries. When an incident occurs within the major city boundaries, the HELP operators work closely with local law enforcement agencies [12].

3.4.2 Current Service Patrol in Tennessee

The HELP program has become a core component of TDOT's ITS initiative, or "SmartWay." HELP operates on the busiest routes in Chattanooga, Knoxville, Memphis and Nashville with 144 served miles in total. The HELP program has three shifts of operators, supervisors, and dispatchers. The operating hours are 6:00 AM to 8:30 PM on Monday, 5:00 AM to 10:30 PM from Tuesday through Friday, 8:30 AM to 8:30 PM on Saturday, and 9:30 AM to 8:30 PM on Sunday. In other words, it operates seven days a week except four holidays (Thanksgiving, Christmas, New Year's Day and the Fourth of July). As of 2009, there are a total of 52 truck drivers, 4 supervisors, 4 dispatchers, and 1 regional coordinator equipped with 80 trucks in the HELP program [13].

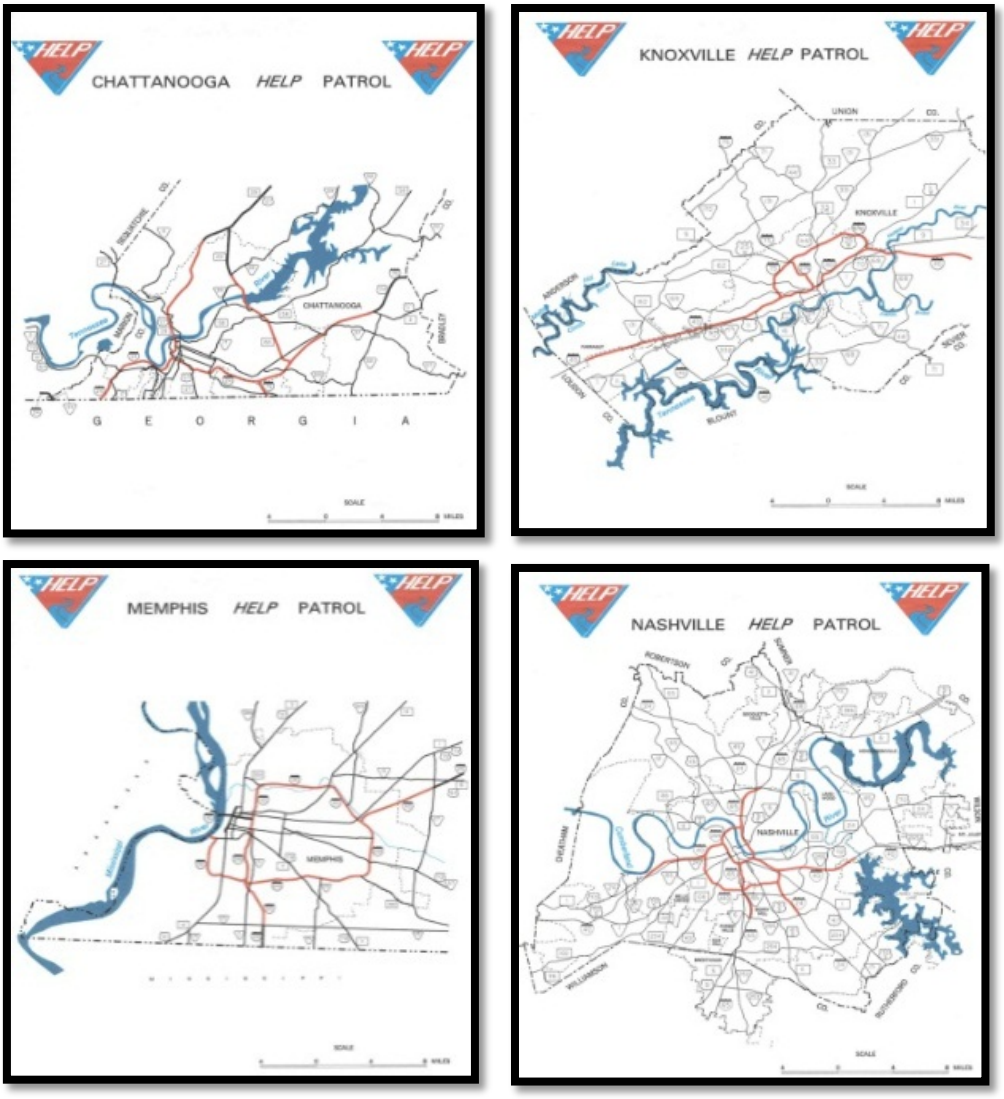


Figure 16: HELP Routes of Major Cities in Tennessee[13]

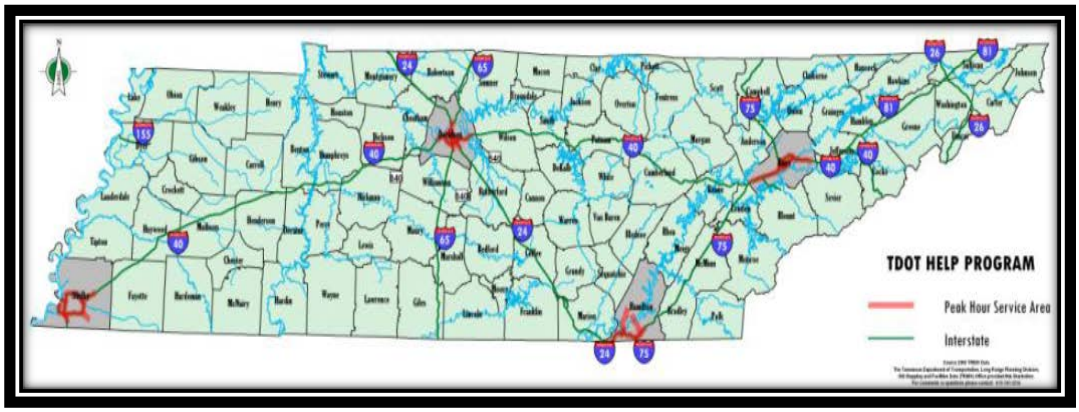


Figure 17: Tennessee Statewide HELP Routes[13]

3.4.3 Provided Services by HELP

According to the HELP program homepage[14] and the 2008-2009 annual report of the HELP program operations[13], the types of service and frequencies are listed in Table 6.

Table 6: Service Type and Frequencies During FY 2008-2009[13]

Service Type	Number of Services	Percentage
Provide traffic control	22,744	22.92%
Tagged Abandoned Vehicle	12,881	12.98%
Provide directions	11,212	11.30%
Change tire	11,058	11.14%
No service – check well being	9,933	10.01%
Provide fuel	8,795	8.86%
Mechanical assistance	7,889	7.95%
Remove debris from roadway	5,502	5.54%
Relocate vehicle from traffic lane	3,080	3.10%
Provide fluids	1,990	2.01%
Notify law enforcement	1,393	1.40%
Provide use of cell phone	1,248	1.26%
Transport motorist	422	0.43%
Apply absorbent	385	0.39%
Secure load	362	0.36%
Perform first aid	273	0.28%
Extinguish fire	80	0.08%

Figure 18: Highway Incident Response Unit with Supplies Displayed

3.4.4 Costs and Benefits

According to the FY 2008-2009 annual report of the HELP program, the total expenditures during FY 2008-2009 were approximately $7.0 million, covering staff salaries and benefits, vehicle operation and maintenance fuel, supplies and other operational costs. Amortization of the trucks and equipment adds approximately another $0.8 million per year to costs of the program. Therefore the annual cost in total was about $7.8 million during FY 2008-2009.

As for the benefits, not all the benefits categories could be clearly quantified. Nonetheless, according to the 2007 Urban Mobility Report by the Texas Transportation Institute (TTI), approximately $35 million was saved in Nashville and Memphis due to reduced delay and fuel consumption.

3.4.5 Funding Sources

Most of the capital and operating expenses for the first three years of the HELP program (from 1999 to 2002) were paid by the FHWA and matched by the state under either the CMAQ Program or the Surface Transportation Program (STP). Specifically, the expenditures in Knoxville, Memphis, and Nashville were paid under CMAQ due to these cities' inability to meet certain federal air quality standards. Chattanooga was in compliance with the federal air quality standards and therefore the expenditures were paid under STP.

During FY 2008-2009, the operational cost of HELP was covered with the state and federal STP funds and TDOT plans to pay all the operational costs with highway user taxes in the future.

3.5 Virginia

3.5.1 History

Virginia is one of the earliest states with the freeway patrol service. There are two major areas where the freeway patrol service is provided, the northern Virginia (NOVA) district and the Hampton Roads district.

Back to 1968, several freeway segments were selected to assign a freeway patroller during holiday weekends in NOVA. The early patrollers used a superintendent's vehicle with a sign signifying the vehicle's purpose. This early patrol program experienced several expansions as northern Virginia became more urbanized. Taken as an example, the service patrol hours were extended to 16 hours a day, 5 days a week. In 1987, the Safety Service Patrol (SSP) was formally established as a separate section in NOVA and began to provide the patrol service to all covered areas[15].

The Hampton Roads SSP is located at the Hampton Roads Smart Traffic Center (STC) in Virginia Beach. The Hampton Roads SSP provides traffic control and roadside assistance for motorists and covers ten routes. Eight of the ten routes are continuously patrolled 24 hours a day, 7 days a week. The other two are on call to respond.

The SSP program had been expanding state wide until the recession that started in 2008. Virginia Department of Transportation (VDOT) determined to reduce the SSP budget and scale back to the levels of 2001 during FY 2009-2010. As a result, only the NOVA area and Hampton Roads area reserve the patrol service now. The other areas throughout Virginia are only on call to respond to incidents[16].

3.5.2 Current Service in Virginia

Given that the SSP program in Virginia has been considerably down sized in the latest fiscal year, it may be questionable if the SSP information in 2010 is used to represent the best practice. As such the research team decided to investigate the SSP information in Virginia before the budget cuts.

In 2006, the NOVA SSP had 28 patrollers and supervisors and covered 198 miles of freeways. The operating hours were 24 hours a day, 365 days a year. Figure 19 illustrates the SSP's coverage in NOVA. The old SSP incident management software was updated as well in 2006. The new software allows the Smart Transportation Center (STC) in NOVA to monitor real-time incident database entries from the field. A new public safety transportation operations center was built later to jointly house SSP, STC, and Virginia State Police (VSP)[15]. Due to the budgetary constraints in the last two years, the operating hours were adjusted as patrolling 20 hours per day, 7 days per week. During non-rush hours, it takes approximately 30 minutes to complete a designated patrol route and the time could be significantly lengthened during rush hours. After the budget cut in 2008, there are 26 operators, 4 supervisors and 22 trucks in NOVA. One third of the staff is currently contracted.

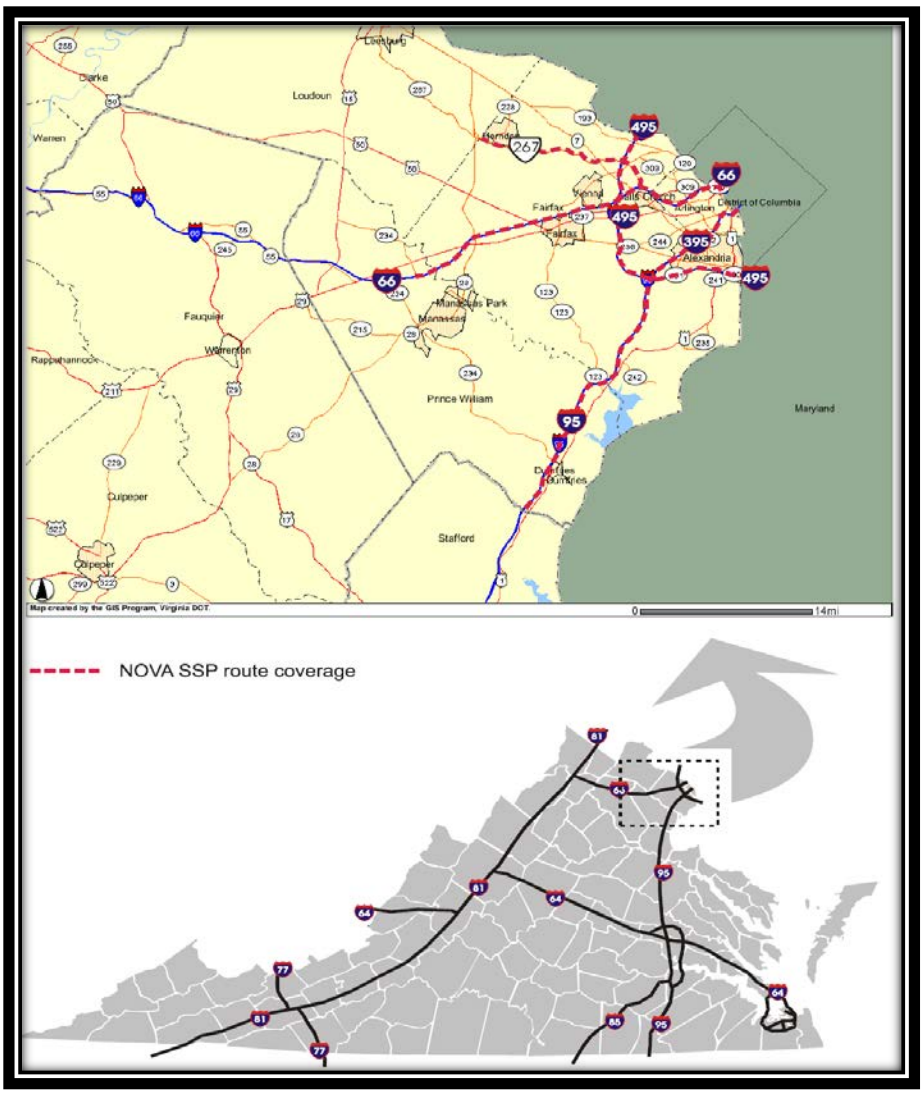


Figure 19: SSP Coverage in the Northern Virginia Area[15]

The coverage of Hampton Roads in Virginia Beach includes 10 routes with approximately 80 interstate miles. Eight of the ten routes are patrolled continuously with three shifts: morning shift from 4:00 AM to 12:00 PM; afternoon shift from 12:00 PM to 8:00 PM, and evening shift from 8:00 PM to 4:00 AM (next day). In other words, the service is 24 hours a day, 365 days a year. In 2007, a private partner, the URS group, provided the SSP personnel for VDOT, including 1 manager, 6 forepersons (i.e., dispatchers), and 51 patrollers. In addition, URS also provided VDOT with 16 pick-up trucks for $0.22 per mile. The Hampton Roads District Equipment Section supplied the rest with trucks at a charge rate of $10.08 per truck-hour[17].

Since fiscal year 2009, the Hampton Roads stopped cooperating with private sectors as above. Currently there are 30 operators, 3 supervisors, 1 manager and 40 trucks. There are other backup trucks for supervisors which are used when the regular trucks are being serviced or are in need of maintenance. The SSP staffs are 100 percent contractors. There are only 4 VDOT employees in the Hampton Roads TOC: a manager, a maintenance engineer, an administrator assistant, and a contract administrator.

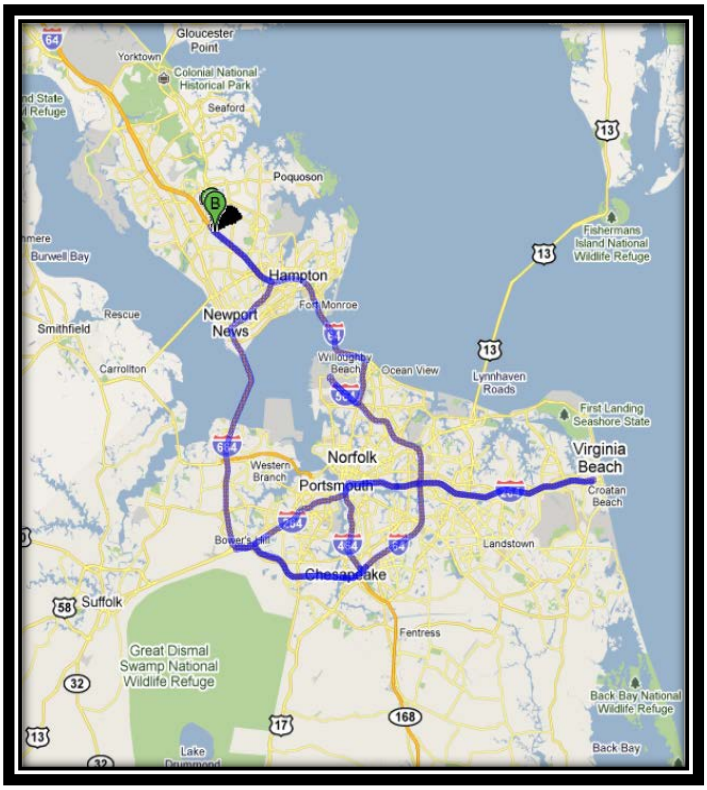


Figure 20: the SSP Coverage of Hampton Roads in Virginia Beach

3.5.3 Services Provided by SSP

The SSP's primary mission is to respond to unexpected incidents and unplanned events and provide congestion management during major interstate construction projects. The SSP's responsibilities include[15]:

- Stopping and assisting every stopped vehicle on the interstate system
- Providing jump starts to any disabled vehicle requiring it
- Removing debris from the travel lanes and shoulders safely
- Providing gasoline to any motorist needing it
- Notifying the state police of any abandoned vehicle that is creating a hazard
- Initiating maintenance action reports when needed
- Providing personal assistance including first aid, CPR, and transports
- Changing or assisting in the changing of a tire on a motorist's vehicle requiring such a service
- Performing minor mechanical repairs such as tightening battery terminals, duct taping leaky hoses, reconnecting spark plugs, wires, etc.

Figure 21: SSP Truck with Crew Members

In FY 2006-2007, the SSP of Hampton Roads stopped 33,877 times for incidents, 7 percent of which were caused by accidents, 87 percent were caused by breakdowns, and 6 percent were caused by debris[17]. The operators received training on temporary traffic control and emergency medical treatment. SSP received assistance from a contractor if towing services were needed.

In NOVA, there were 44,255 incidents reported in Fiscal Year 2004-2005, 50.2 percent of which were assisted by SSP. The top three types of assistance were wreck clearance, tire replacement and gasoline supplies[15]. The operators received training on temporary traffic control and emergency medical treatment. Most patrolling trucks were pickups but the SSP in NOVA also retains a small quantity of heavy-duty vehicles that have "push bumpers". If there is a need for towing, it is usually done by private contract under the administration of state or local police.

3.5.4 Costs and Benefits

According to a report by Virginia Transportation Research Center, in FY 2004-2005, the total delay reducing and fuel saving benefits for all routes in NOVA were $5,027,838 and total annual operational costs in NOVA were $805,897[15]. In FY 2005-2006, the total benefits for all routes in the Hampton Roads were $11.1 million and total operational costs in the Hampton Roads were $2.4 million, $90,000 of which were paid to the private partner, the URS, in fleet costs[17].

3.5.5 Funding Sources

In NOVA, the funding sources are composed of three parts: the federal funds under the National Highway Safety and Surface Transportation Progress (STP), VDOT funds, and the Dulles Toll Road facility (for the toll road only). In the Hampton Roads, the funding sources are 80 percent from the federal and 20 percent for the state.

3.6 West Virginia and Alabama

West Virginia and Alabama were suggested as states of interest by the Study Advisory Committee. The Courtesy Patrol service in West Virginia covers 8 interstates and 5 corridors in 30 counties throughout the rural area of West Virginia. Therefore, the Courtesy Patrol in West Virginia shares many similarities with the SAFE Patrol in Kentucky. Alabama does not have safety patrol service but a similar service is provided by other law enforcement agencies. Limited information was collected despite of the best efforts and is summarized in section 3.6.1 and section 3.6.2.

3.6.1 Courtesy Patrol in West Virginia

The Courtesy Patrol in West Virginia is operated by a non-profit Citizens Conservation Corps (CCC) of West Virginia through a contract with the West Virginia Division of Highway (DOH). This business mode provides two equally important benefits to the state. First, it reduces the number of individuals on welfare in the state of West Virginia through the employment and continuing education of former welfare recipients as Courtesy Patrol drivers. Secondly, this program benefits the traveling public using the interstate highways and corridors in West Virginia for tourism and local commerce[18].

The operators patrol 25 assigned zones with approximately 786 highway miles in total, 16 hours a day, 7 days a week, 365 days a year. The provided services include:

- Assisting stranded motorists
- Removing hazards from the roadways
- Providing gas or directions
- Changing flat tires, and
- Enhancing safety on the state's highways in general

25 well-marked white F-150s patrol the 25 assigned areas of patrol. The West Virginia Courtesy Patrol is on duty 7 days a week from 3:00 PM to 7:00 AM (next day). Table 7 reveals the statistics since it launched in 1998.

The operators are closely connected with the information center and also play a vital role in Homeland Security initiatives statewide. The Courtesy Patrol staff received FBI-style training to respond to various levels of alerts. They also continually monitor suspicious activities while patrolling bridges, overlooks and interchanges and assist other law enforcement with freeway incident management.

Table 7: Statistics of the Courtesy Patrol in West Virginia from 11/21/1998 to 05/15/2010

Total Mileage Logged:	**64,000,250**
Total Telephone Calls Received at Call Center:	2,553,496
Total Vehicles Assisted:	256,063
Total Debris Removed from Highways:	15,564
Total Deer Removed from Highways:	7,533
Total Bear Removed From Highways:	129
Total Other Animals Removed from Highways:	3,896
Total Routine Procedural Checks:	13,284
Total Abandoned Vehicles Checked:	73,867
Total # of Times First-Aid was Administered:	127
Total # of Times CPR was Administered:	8

3.6.2 Highway Patrol of the Alabama Department of Public Safety

There is no safety patrol program under the Alabama department of transportation. The Highway Patrol of the Alabama Department of Public Safety plays a similar role. Since the Highway Patrol is performed by law enforcement, it also takes other responsibilities besides the incident management, such as speed enforcement, tag abandoned vehicle and Driver under Influence (DUI) conviction. In 2009, the Highway Patrol processed 123,690 incidents and accidents in both urban and rural areas[19].

3.7 Summary

The practices of safety patrol services in the states of interest are summarized in Table 8.

Table 8: Summaries of Safety Patrol Services in the States of Interest

State	Starting year	Coverage	Miles	Hours	Services	Personnel	Operation Cost
Florida	1999	Statewide and Florida Turnpike	1262	From 24x7 to on-call service	Various services from adding air to towing	109 persons (2010)	$16M (FY09-10)
Indiana	1991	Northwest, metro Indianapolis and southern Indiana	157	24x7	Identify incidents, clear travel lanes and assist at incidents scenes	21 operators, 3 supervisors and 1 manager (2010)	$1.5 M (Projected FY 10-11)
Northern Virginia	1987	Northern Virginia	198	20x7	Identify incidents, clear travel lanes and assist at incidents scenes	26 operators, 4 supervisors and 22 trucks (2010)	$3.5 million (FY09-10)
Virginia Beach	1987	The Hampton roads	113	24x7 plus on call	Assist disabled vehicles and manage incidents.	30 operators, 3 supervisors and one manager (2010)	$4.9 million (FY08-09); $2.9 million (FY 09-10)
Tennessee	1999	Chattanooga, Knoxville, Memphis and Nashville	144	Peak hours, 7 days a week except 4 holidays	Assist disabled vehicles and manage incidents.	52 operators, 4 supervisors, 4 dispatchers and 1 regional coordinator (2009)	$7.8 million (FY 08-09)
Georgia	1994	Metro Atlanta	221	24x7	Move disabled vehicles Out of travel lanes	75 operators and 11 supervisors(2008)	$16M combined with TMC operations and ITS device maintenance in 2003

* Alabama and West Virginia are not listed in the table because the research team was unable to collect the desired data.

CHAPTER FOUR

STAKEHOLDERS IDENTITIES AND INTERVIEWS

It is desired to understand stakeholders' opinions in order to improve the performance of SAFE Patrol service in the future. As such, a comprehensive survey was conducted among the stakeholders. (Please refer to the Appendix for the survey questions.)

4.1 List of Stakeholders and Their Participation in the Survey

Based on the researchers' judgments as well as the suggestions from the advisory committee, the following agencies were invited to participate in the survey:

- Emergency Management
- Emergency Medical Service
- Fire Department
- Law Enforcement
- Towing companies
- Kentucky Transportation Cabinet

Other than the above agencies, other related agencies and individuals were also allowed to participate in this survey.

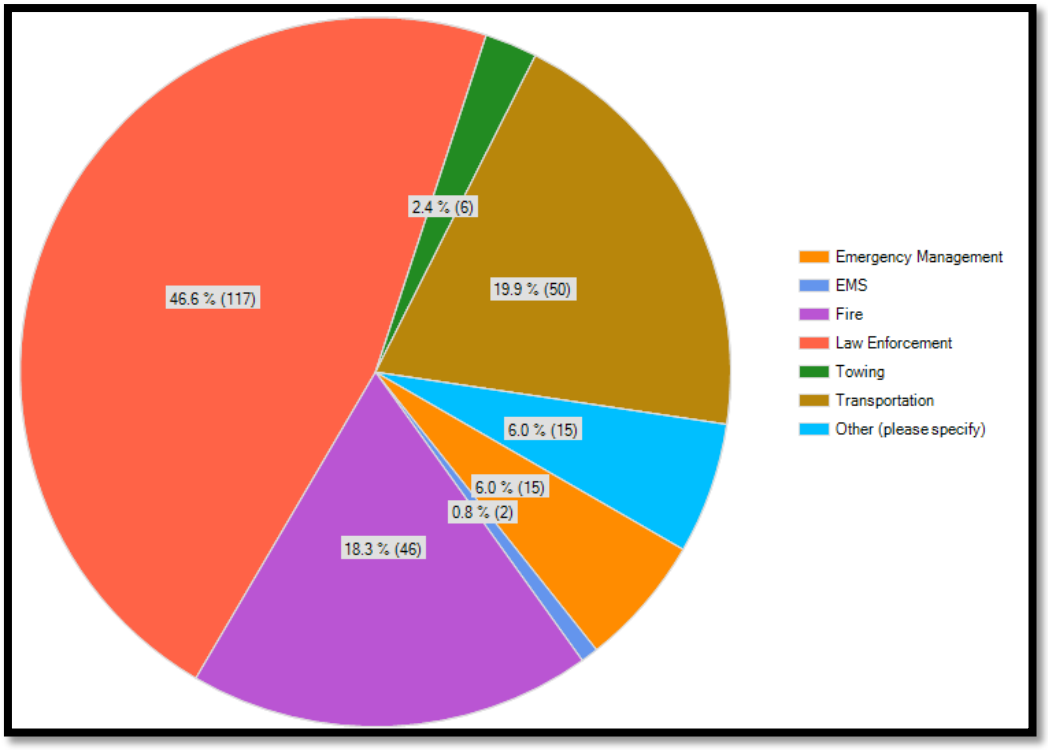


Figure 22: Agencies' Participation of the Survey

Figure 22 reveals that the top three responding agencies in the number of responses are the law enforcement agencies, Kentucky Transportation Cabinet, and fire departments. It is also worthwhile noting that, although the number of responses was low, many other agencies also participated in the survey. The responding agencies cover the health department, insurance investigation unit, environmental protection agency (EPA) and education.

4.2 Survey Results and Recommendations

4.2.1 Interactions between SAFE Patrol Operators and Other Stakeholders

The SAFE Patrol operators were trained to assist other stakeholders during the incidents processing. A question was therefore asked to examine how much interaction between the SAFE Patrol operators and the other agencies (e.g., the law enforcement agency). Figure 23 reveals that when other stakeholders went to incident sites, most of time, they did not get assistance from the SAFE Patrol operators

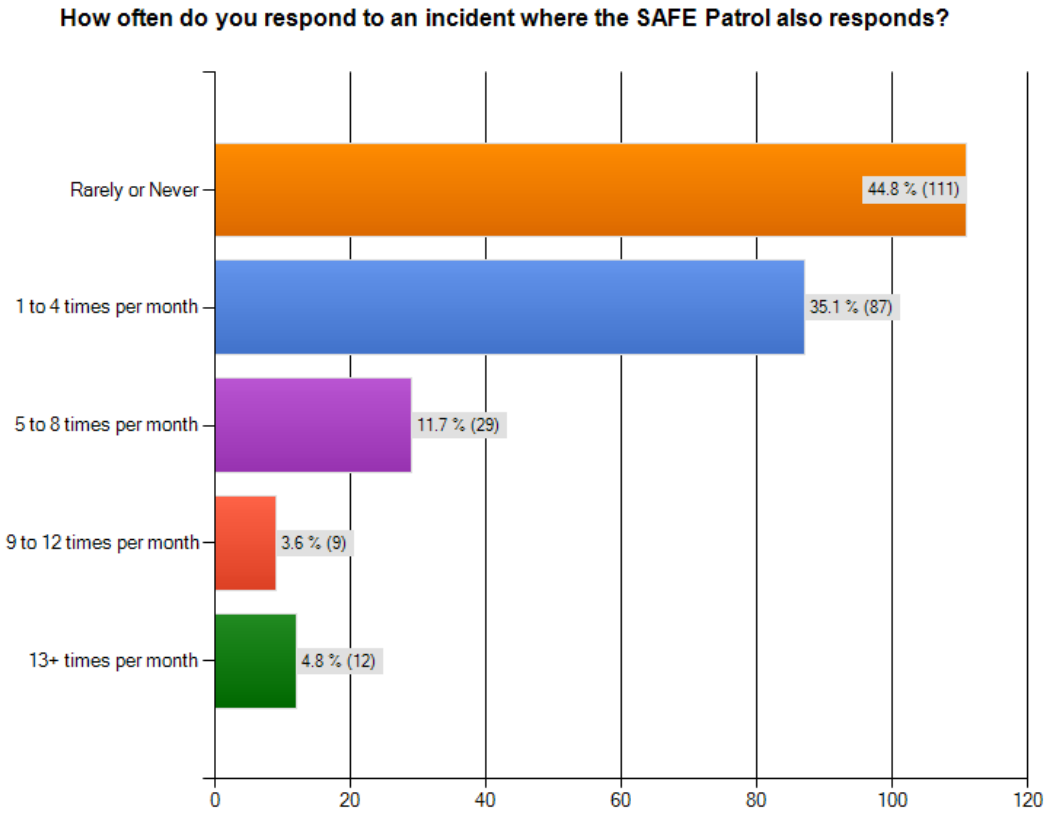


Figure 23: Other Agencies' Interactions with the SAFE Patrol Operators

4.2.2 Opinions on Response of SAFE Patrol to Major Incidents and Accidents

Another mission of the SAFE Patrol service is to assist the other agencies at the scenes of major accidents. A question was therefore designed to ascertain how quickly the SAFE Patrol service could respond to the major incidents. From Figure 24, the response of SAFE Patrol service to major incidents appears to need some improvement because only about 13 percent of the interviewees had positive feedbacks ("Mostly"+"Always"). Other feedbacks are mixed. Nevertheless, 91.1 percent of the interviewees considered the SAFE Patrol service helpful at incidents scenes and nearly all of the interviewees thought the SAFE Patrol Service at incident scenes was very effective to close and control traffic (the survey results of Question 4)

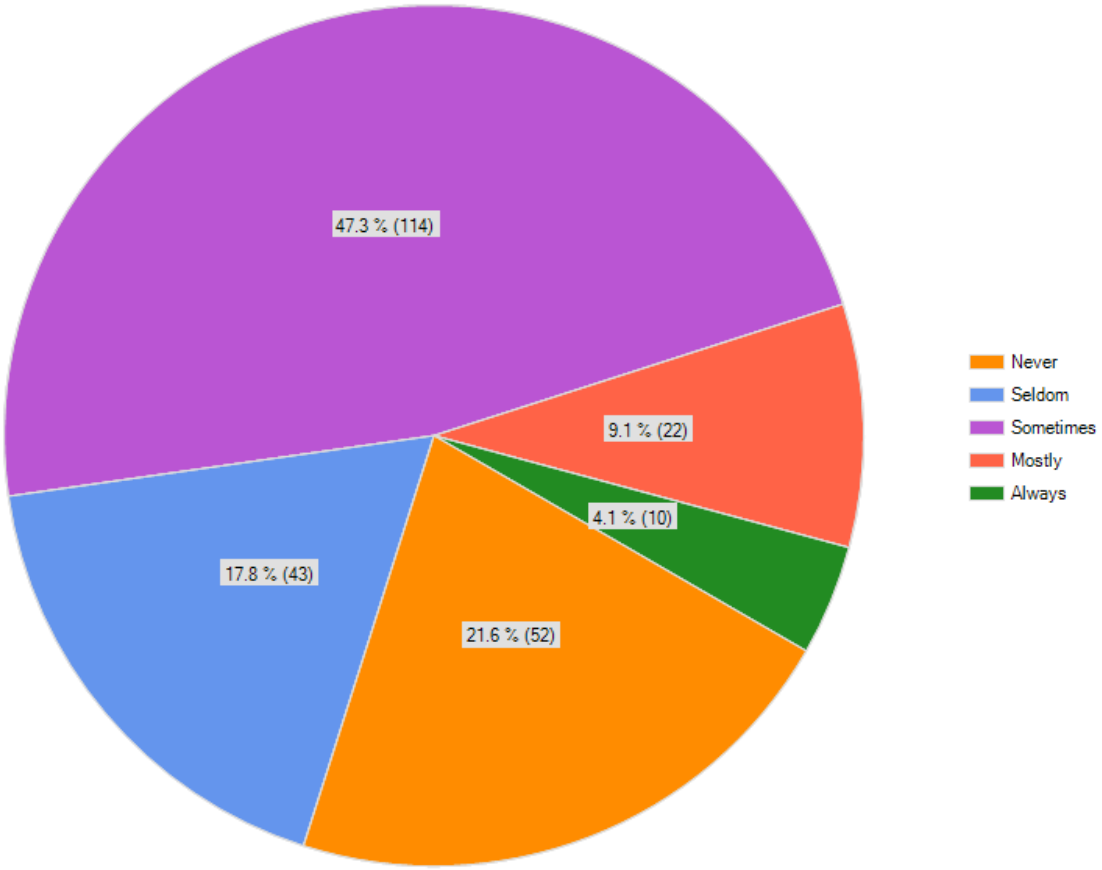


Figure **24: Promptness of SAFE Patrol Services in Major Accidents**

4.2.3 Assessment of SAFE Patrol and Recommendations for Future Services

The interviewees were asked to rank the services provided by the SAFE Patrol service according to their importance with score from 1 (very unimportant) to 5 (very important). Figure 26 and Figure 26 reveal that the other agencies think the most important services that the SAFE Patrol program provides are assisting the stranded motorists and assisting at the scenes of major incidents. It is also clear that most of the interviewees have a positive opinion to the SAFE Patrol service.

Another question was asked about the suggestions to future services and what tools in the patrolling trucks are desired most. Among the responses with text descriptions, some suggested assisting to control and detour traffic at construction and maintenance site. Expanding the service time and coverage is another popular suggestion. As for the most desired tools, the opinions are very scattered and ranged from shovels and cones to state police scanners and laptops. Many interviewees also thought the current tools in the trucks are already sufficient. (Question 7 and Question 8 in Appendix B)

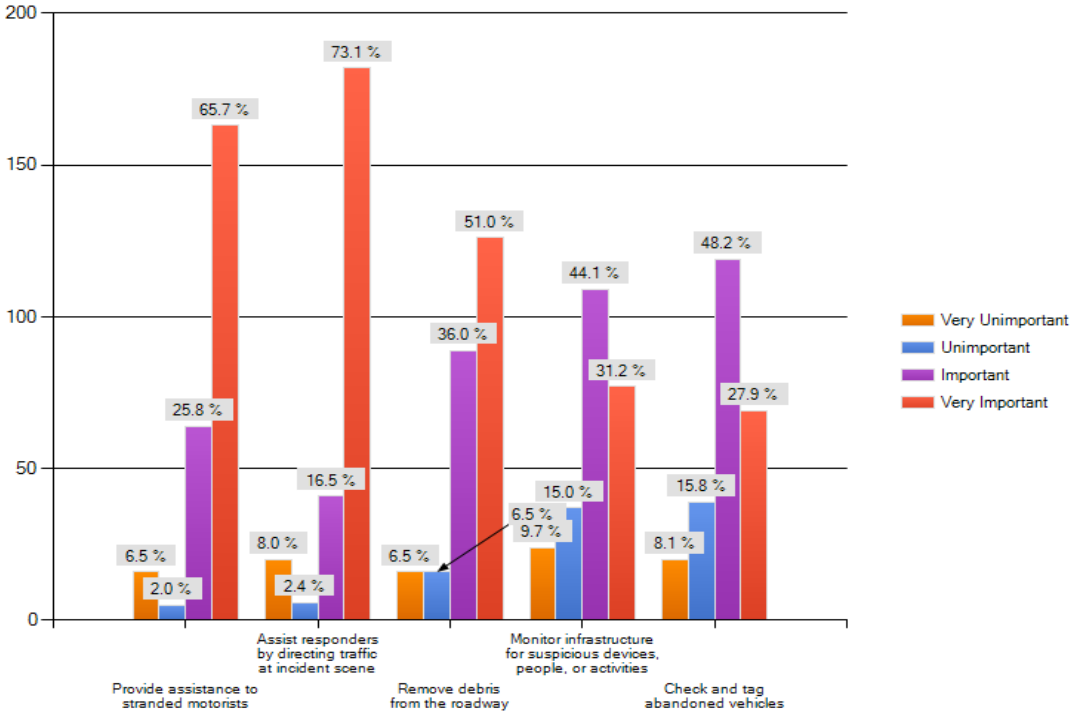


Figure 25: Importance Ranking by Service Types

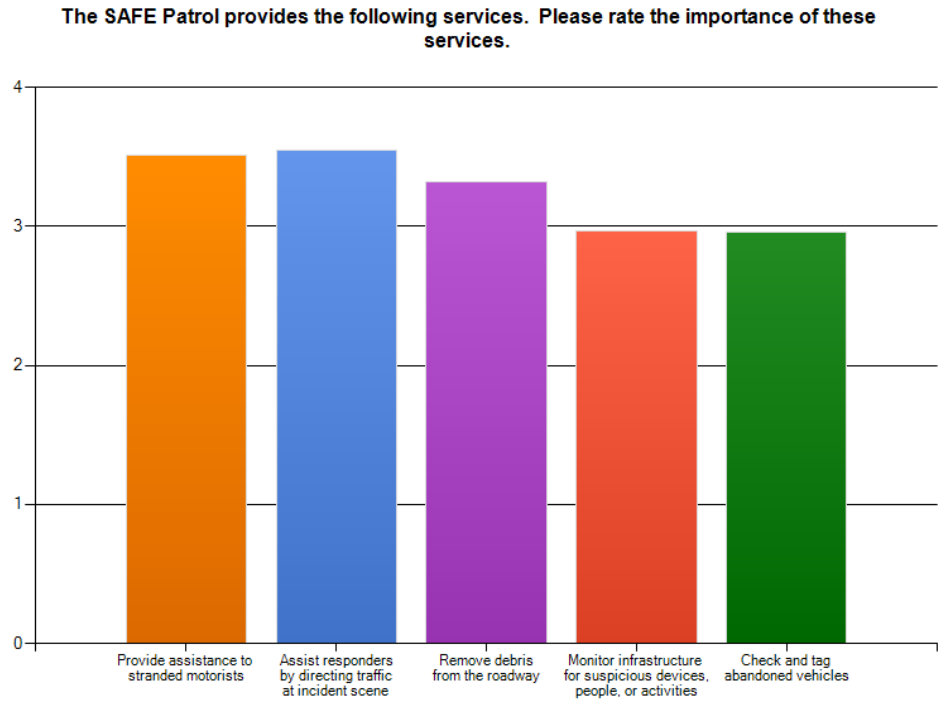


Figure 26: Importance Ranking of the SAFE Patrol Service by the Other Agencies

4.2.4 Opinions on Timeliness and Professionalism of SAFE Patrol

According to Figure 27, most of the interviewees considered that SAFE Patrol operators are timely as well as professional.

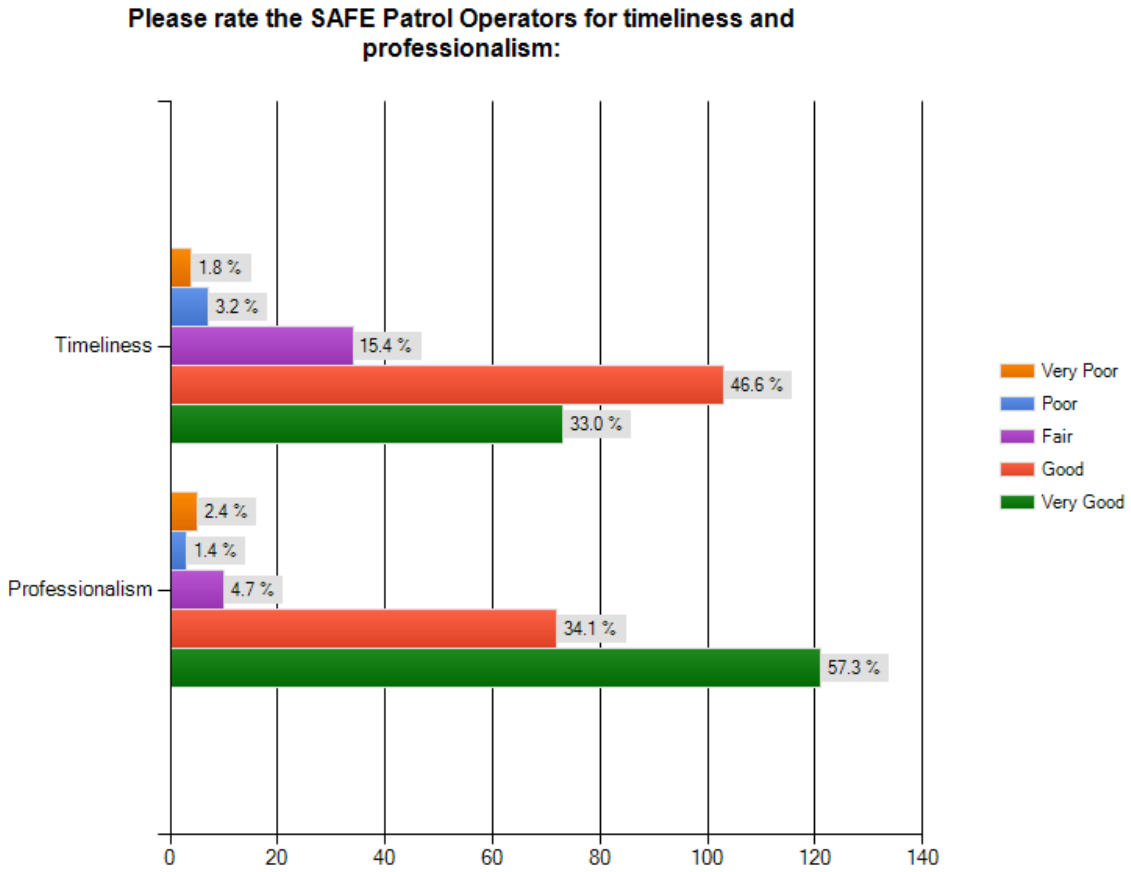


Figure 27: Timeliness and Professionalism of SAFE Patrol Service by the Other Agencies

4.2.5 Opinions on the Major Benefit of SAFE Patrol

Most of interviewees considered the largest benefits of the SAFE Patrol service are to improve the safety for both motorists and responders. This makes sense because the coverage of SAFE Patrol service is primarily in low-traffic areas and therefore the congestions and delays are not as outstanding as in metro areas unless all lanes are closed. Please refer to Figure 28 for more information.

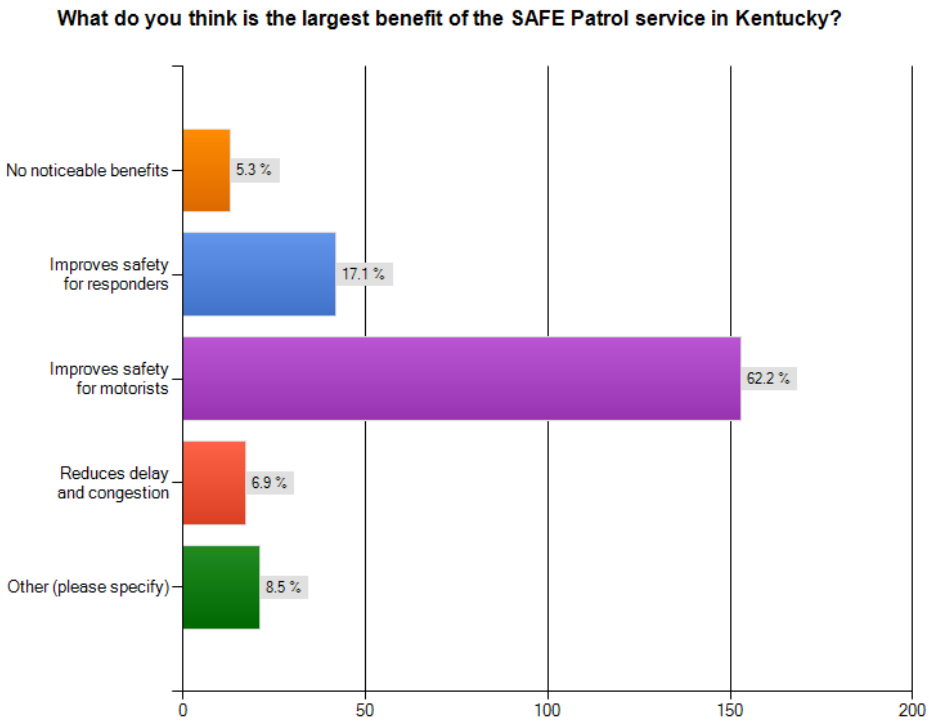


Figure 28: Benefits of the SAFE Patrol Service According to the Other Agencies

4.2.6 Opinions on the Current Coverage and Service Time of SAFE Patrol

The interviewees were also asked about their options on the current coverage of service hours of the SAFE Patrol service. According to Figure 29, the current coverage and service time are satisfactory. However, it would be better if the coverage was expanded and the more on-call service time was added.

At the end of the survey, the research team also provided the interviewees with an opportunity to write down their own comments anonymously (Questions 13 in Appendix B). While most of the opinions expressed a satisfaction with the SAFE Patrol service, some suggestions are also worth pointing out. The suggestions include that the SAFE Patrol operators should provide more assistance besides the traffic closure at incident sides; the SAFE Patrol operators should be equipped with better communication tools to contact the TMC at Frankfort and the SAFE Patrol operators should better coordinate with highway and bridge maintenance staff, law enforcement and other stakeholders in certain districts.

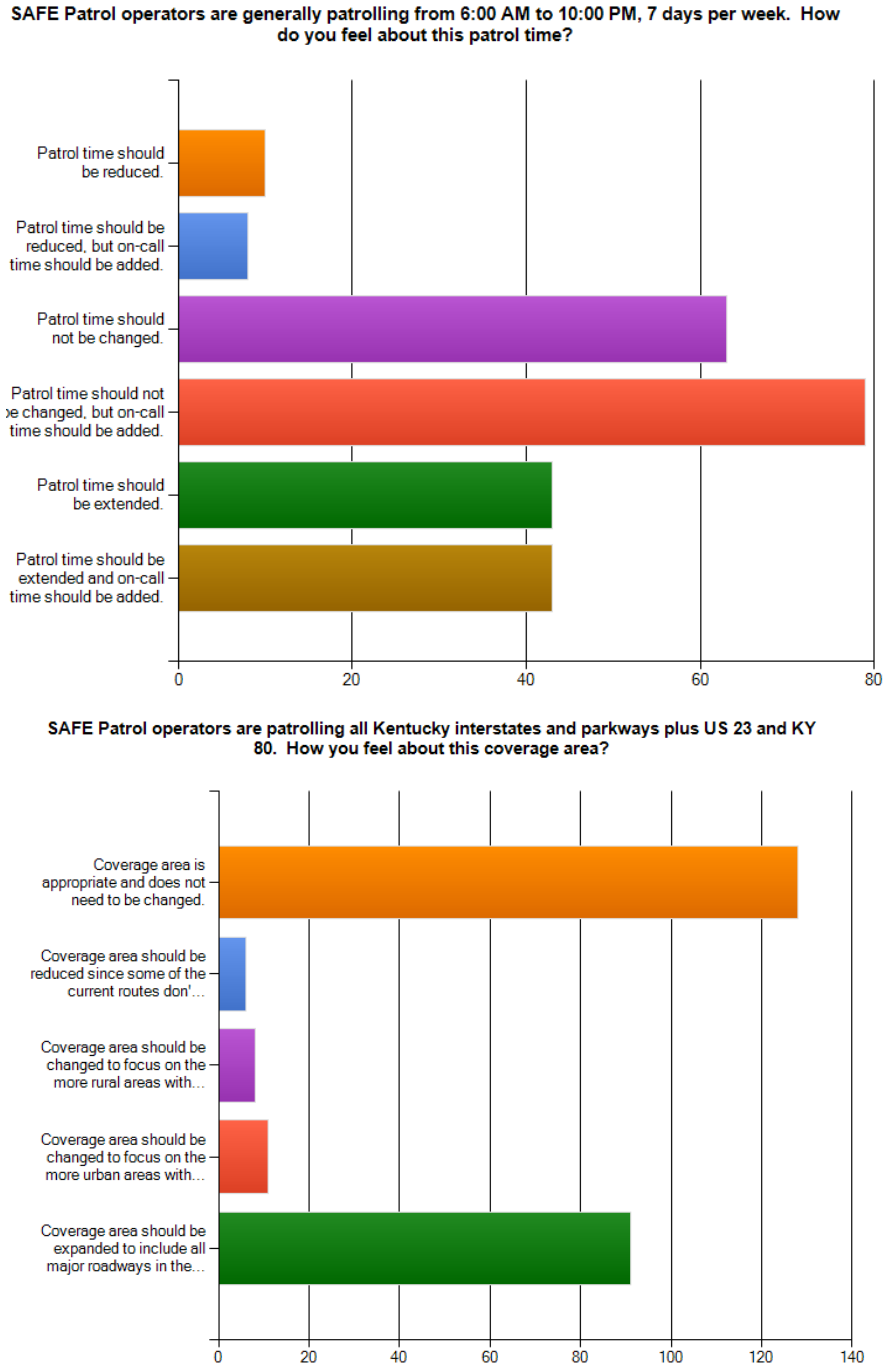


Figure 29: Options on the Coverage and Service Time of SAFE Patrol Service

4.2.7 Summary

According to the survey results, most stakeholders are satisfied with the performance of the SAFE Patrol Service. It would be better if the SAFE Patrol operators could respond to the major incidents more quickly; the coverage and service time could be expanded.

CHAPTER FIVE

EVALUATION OF SAFE PATROL WITH DISCRETE-EVENT SIMULATION

5.1 Introduction

5.1.1 Literature Review of Similar Research

Patrolling on freeways like the SAFE Patrol Program is often called freeway patrol service. As a low-cost approach to incident management, the freeway patrol service has been adopted in over 40 states. Many states also conducted extensive evaluations of their freeway patrol services. Cuciti and Janson conducted a benefit-cost analysis with six months of service patrol data along approximately 28 miles of freeway in Denver. Cuciti and Janson applied a deterministic queuing model and a $1 per hour travel time value, calculated the delay savings due to quicker responses and concluded that the freeway patrol service benefit-cost ratios vary from 10.5:1 to 16.0:1[20]. Minnesota Department of Transportation (MnDOT) conducted a similar research. MnDOT based their research on a previous finding that one minute of incident duration caused five vehicle-hours of total delay in the twin-cities area and concluded that the freeway service patrol, or the Highway Helper, could yield 2.3:1 benefit/cost ratio with the travel time valued at $5 per hour. Hawkins completed a similar evaluation of freeway patrol service in Houston in 1991. In Hawkins' research, incident delay as well as the reduction of road capacity was taken into account and the benefit-cost ratio was concluded as 19:1 with travel time value 10.47 per hour. Latoski et al conducted a cost-effective evaluation of the freeway patrol in Indiana, namely Hoosier Helpers[21]. Unlike other similar research, Latoski adopted a high-level simulation model, namely XXEXQ[22], to simulate patrolling policies, reduction of road capacity by incidents, environment (e.g., winter factor) impact on the freeway patrol and concluded that the benefit would be $1,241,300 (1995 dollar value) and $3,708,100 (1996 dollar value) respectively under daytime-only operation and 24-hour operation.

More recently, Skabardonis and Mauch developed a macroscopic model specifically for the freeway service patrol evaluation. The model takes into account, hourly traffic volumes, traffic directionality factors, queuing issues, and roadway capacity reduction due to incidents as well as fuel consumptions to calculate savings brought by the freeway patrol service [23]. Various variants of UC Berkeley model were later adopted by Virginia, Missouri and Florida in their efforts of evaluating the freeway patrol service in those three states. The reported information includes that the benefit-to-cost ratios from district to district in Florida will be from 2:1 to 41.5:1[5]; the incident duration reduction by freeway patrol service in northern Virginia could be up to 70 percent and the benefit-to-cost ratios in northern Virginia and Hampton Road were 5.4:1 and 4.7:1 respectively[24]. In Georgia, Guin et al considered the benefits of faster emergency response are composed of three parts, delay saving, secondary crashes reduction and emission reduction. Guin concluded that the benefits brought by freeway patrol service were $187.2 million in Atlanta area[25]. Sun et al conducted an evaluation of freeway motorist assist program in the St. Louis region with the UC Berkeley model and estimated a benefit-to-cost ratio of 38.25:1[26].

5.1.2 Problem Statement and Significance of the Research

In many states, the freeway patrol services are provided only in metro areas where the congestion and travel delay are the major issues. As such, in metro areas, the majority of benefits out of the freeway patrol services are the delay reduction. Previous evaluations of the freeway patrol service mostly focused on comparing the delay cost with and without the patrol services. Although such benefits still exist in low-traffic rural areas, they are less important than the safety benefits such as transporting quickly stranded passengers to safe areas. Meanwhile, the management may care more about questions like how quickly and in what ratio the stalled vehicles or stranded passengers can be taken care of if the existing service pattern is changed. For example, what the level of service would be if the coverage is extended or service time is lengthened while the size of operators stays unchanged? Such operational issues in the previous patrol service evaluations were seldom addressed. In this project, the research team designed a simulation-based model to evaluate the SAFE Patrol service in Kentucky from the operational perspective as well as predict the possible impact if the service pattern is adjusted. Challenges during modeling included:

- Commercial simulation software packages have no modules for the freeway patrol services. Some experimental software packages could evaluate the freeway patrol services but none of them can address the operational issues as discussed above.
- The archived operational records in Kentucky do not have all the information needed for the simulation and therefore the sophistication of simulation model had to be compromised due to lack of detailed information.
- When the simulation model was setup, the model had to be validated first. Some macroscopic measurements had to be selected appropriately and compared between the simulation outputs and the archived data.

The research team adopted a discrete-event simulation software package, named Arena, to simulate/evaluate the operations of SAFE Patrol program. This software is being used widely in many fields and it provides much flexibility for researchers to model and tailor systems in detail.

5.1.3 Discrete-event Simulation Tool: ARENA

Arena is a discrete-event simulation software package. With the Arena, the research team built incident process models that can simulate each step of SAFE Patrol services. Connector lines in Arena were used to join these modules together and specify the time and location of generated incidents and service procedure. Each module was interpreted to reflect a particular activity of the SAFE Patrol service.

Specifically, a whole calendar year was simulated with five repetitions. While the clock is ticking, incidents are first generated according to the distribution of time intervals between the reported incidents (Figure 35). Each generated incident has a time stamp indicating time, day of week and date. According to the temporal analysis of incidents occurrences (Figure 32, Figure 33 and Figure 34), it appeared that the hour-by-hour pattern of incidents occurrences during the weekdays was different from that during the weekends. As such, the model was designed to simulate the weekdays and weekends separately.

It was also needed to assign a location (west region, central region or east region) to each incident according to the probability where the incidents occurred in reality (Figure 31). The locations were divided into three regions because an incident can be assisted only if there is an available SAFE Patrol operator around the incident location. “Being around” was defined as “being in the same patrolling region” in the project. It makes sense since, for instance, it is unlikely that an operator in the east region can quickly assist a stalled vehicle in the central or west region. In that case, the dispatcher will have to forward this assistance request to other stakeholders, such as Kentucky State Police.

Once the time, date and location of an incident are assigned, the simulation model will first determine whether there is at least one available operator around. If so, an operator will be assigned to process this incident. The processing, or clearance, time for each incident is calculated according to the distribution of the recorded incident clearance time in 2010 (Figure 36). If all the nearby operators are busy, this incident will be ignored.

After a whole calendar year is simulated, the results will be automatically collected and saved into summary forms.

Figure 30 illustrates the flowchart of the simulation model.

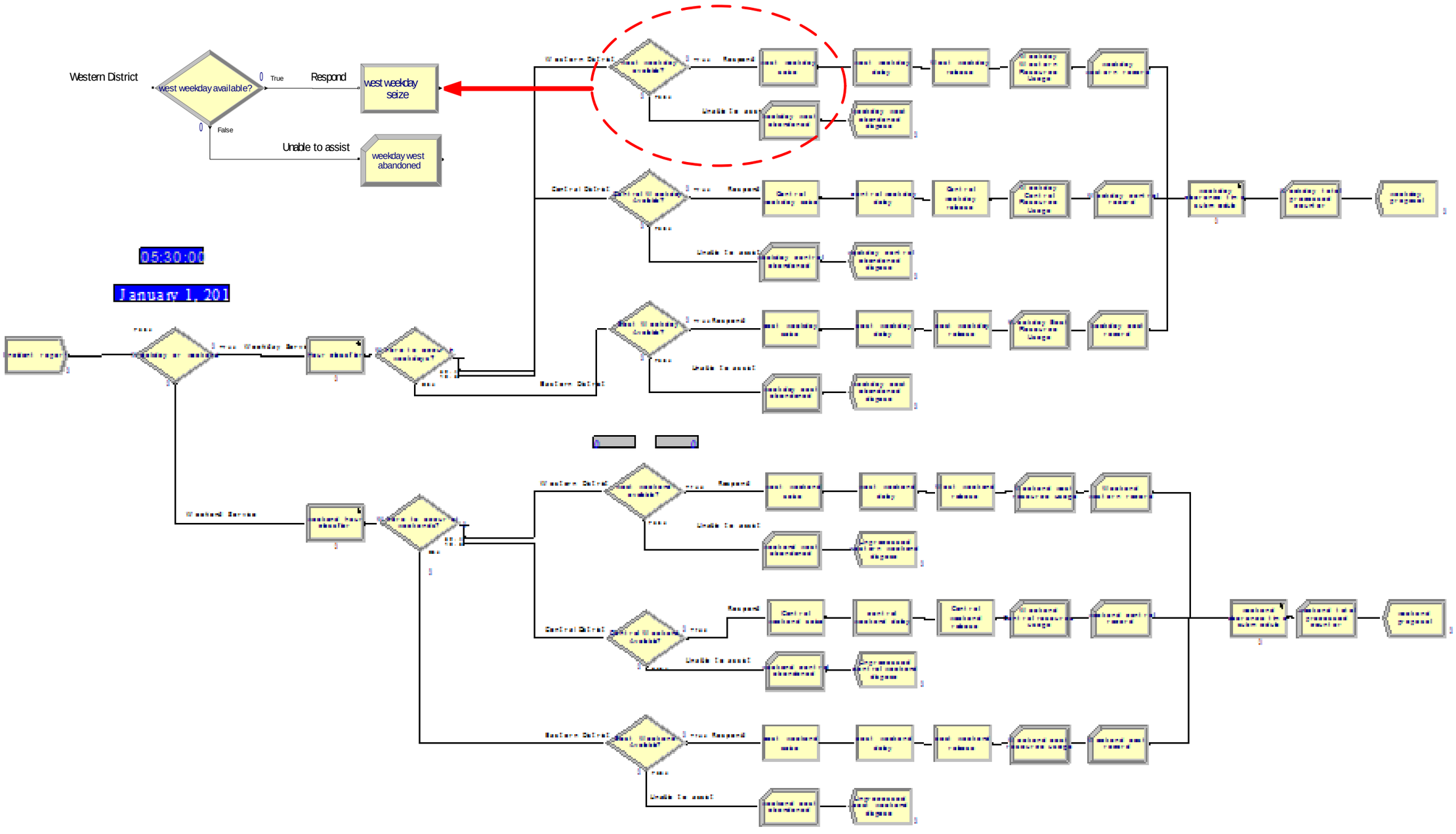


Figure 30: Simulation Flow in ARENA

5.1.4 Simulation Inputs Derived From the Historical Records of 2010

The research team utilized the historical records of 2010 to derive the necessary inputs for the simulation. The derived distributions are shown as follows.

5.1.4.1 Spatial Distribution of SAFE Patrol Road Assistance in 2010 (West, Central and East Region)

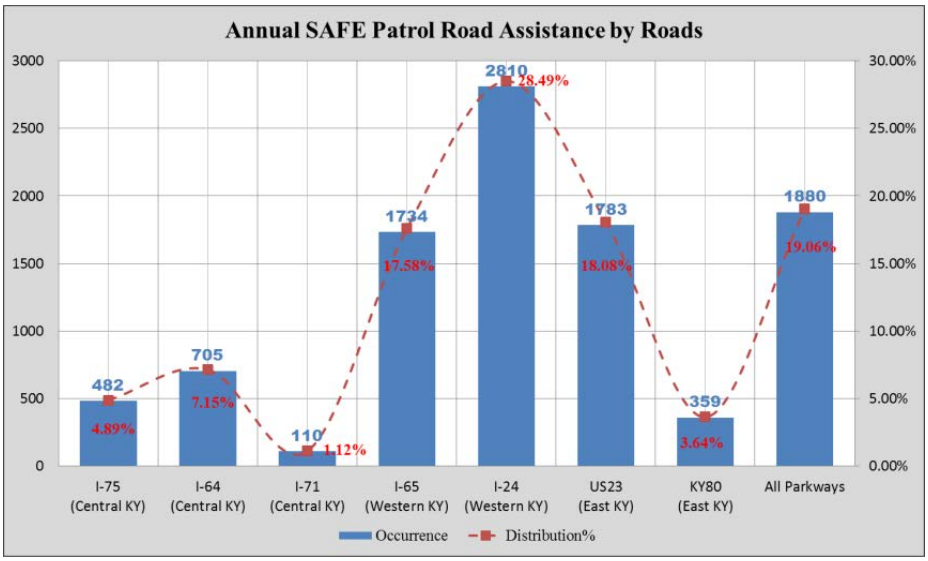


Figure 31: SAFE Patrol Road Assistance by Region

From Figure 31**,** it appears that the west district has the most served incidents by the SAFE Patrol and the central district has the lowest incidents.

5.1.4.2 Daily, Weekly and Monthly incidents Distributions

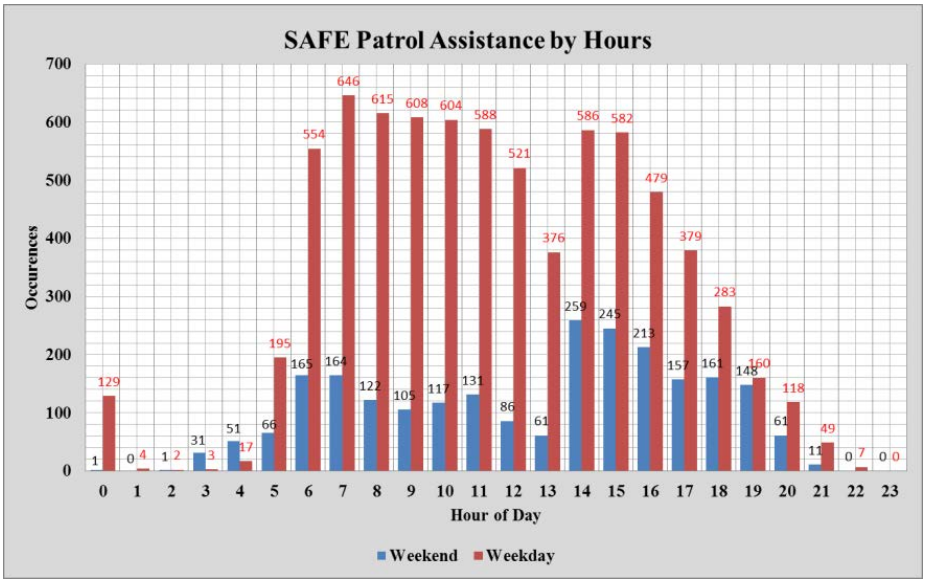


Figure 32: Incident Distributions by Hour

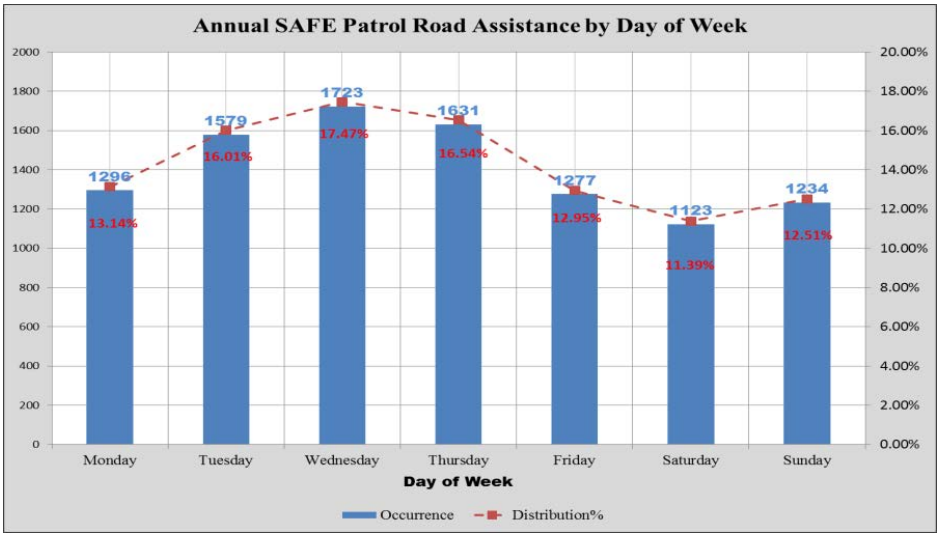


Figure 33: Incident Distribution by Day of Week

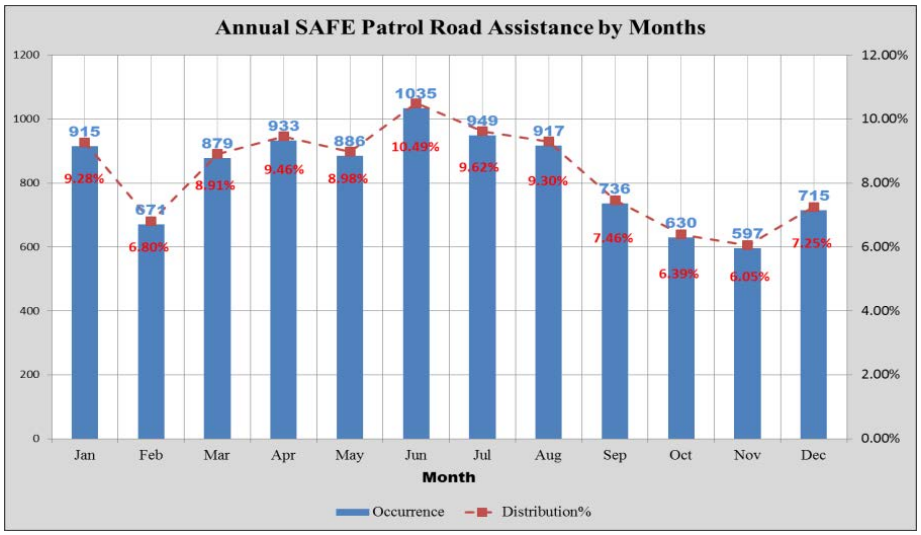


Figure 34: Incident Distribution by Month

From Figure 32 and Figure 33, it appears that the reported incidents during weekends are less than those during weekdays and the hour-by-hour distributions of incidents are considerably different between weekends and weekdays. From Figure 34, the difference by month is at most 5 percent. Since the crew schedule does not take into account seasonal changes and the difference of reported incidents between months is really negligible, the research team decided to only distinguish between weekdays and weekends.

5.1.4.3 Distribution of Time Intervals between Road Assistances

From Figure 35, it appears that the distribution of time intervals between road assistances is an exponential distribution and therefore the occurrence of incidents is estimated as a Poisson process. In addition, there is little difference between the weekdays and weekends in terms of time intervals between incidents, according to Figure 36.

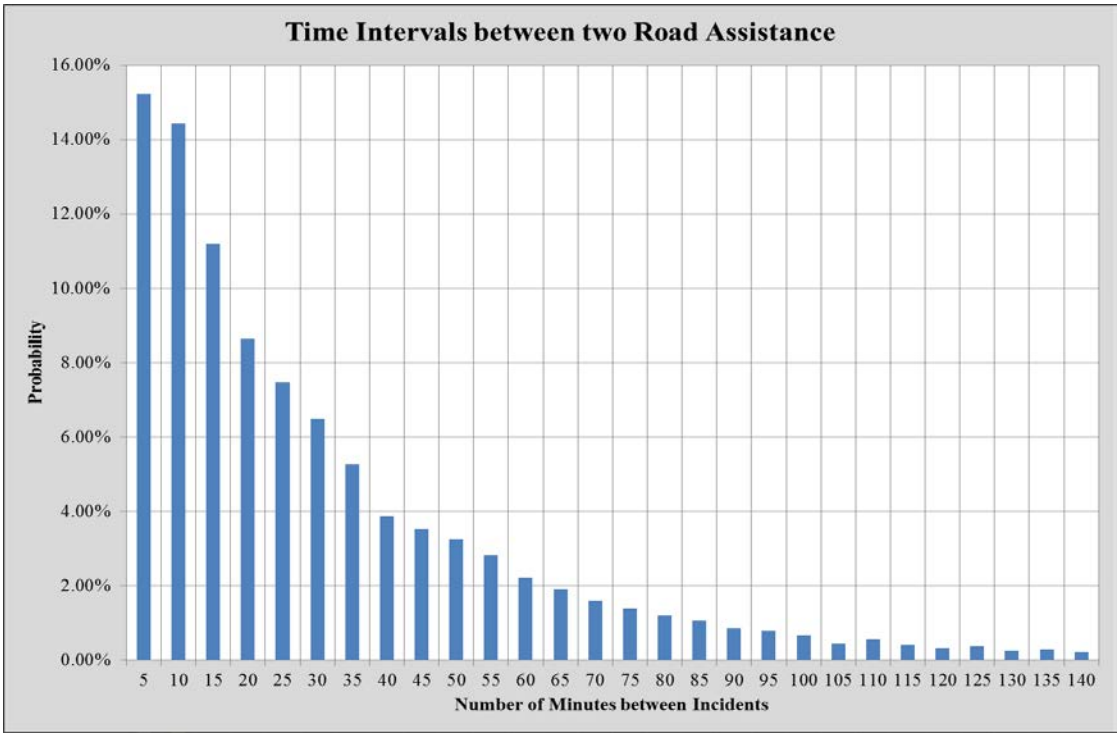


Figure 35: Distribution of Incident Intervals

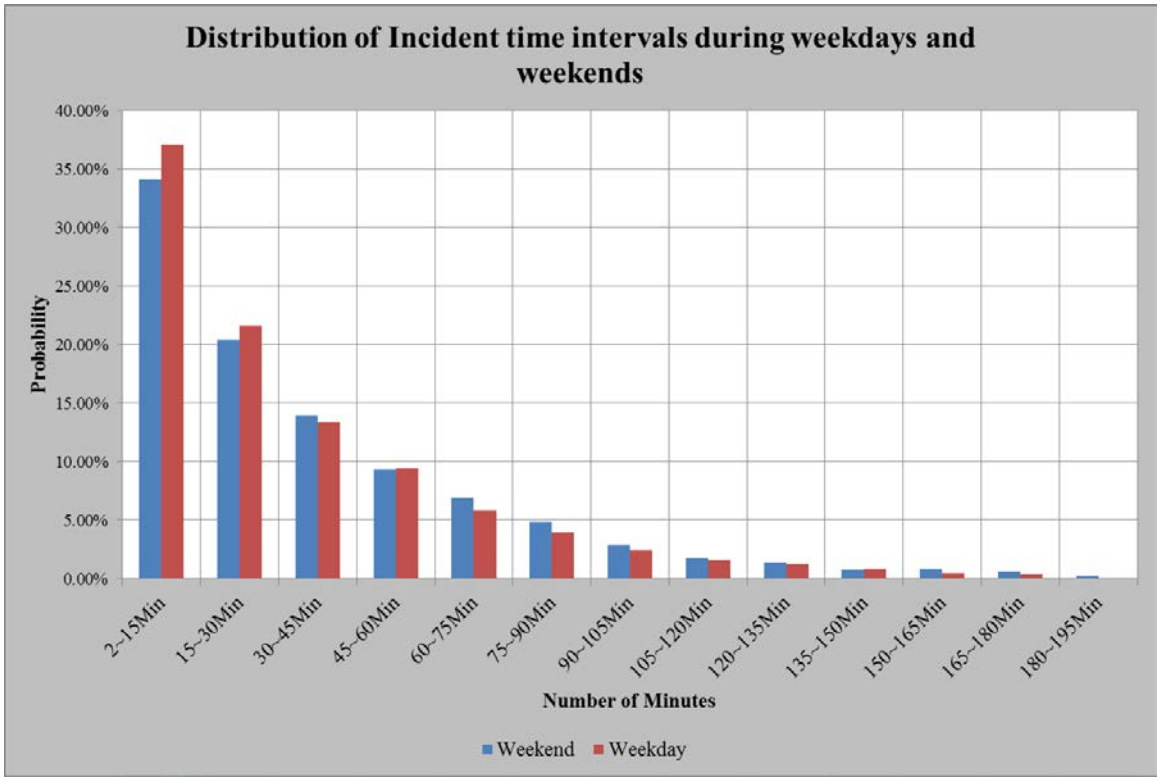


Figure 36: Distributions of Incident Intervals during Weekdays and Weekends

5.1.3.4 Distribution of Incident Clearance Time

From the histogram of the incident clearance times, it appears that there are no distributions able to reflect the true distribution of incidents clearance time. Therefore, the empirical distribution was used in the simulation according to Figure 37.

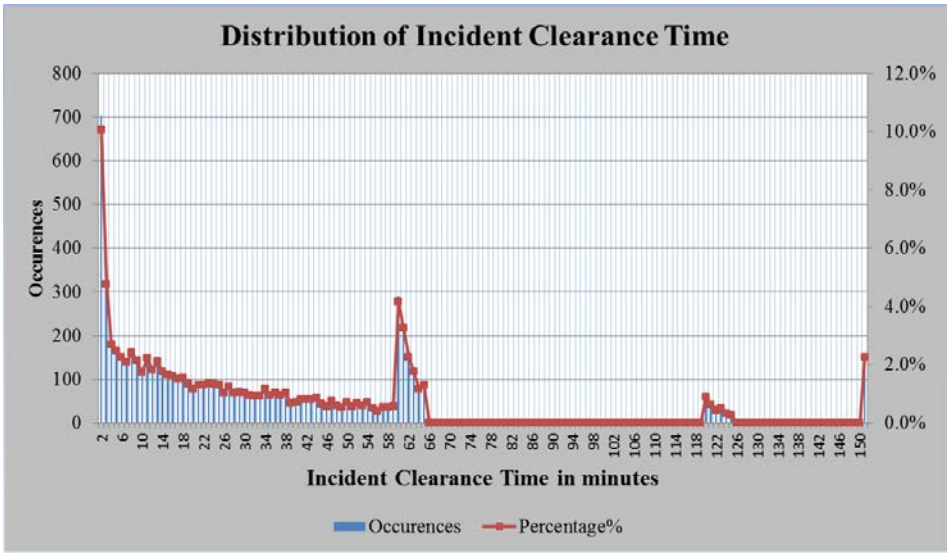


Figure 37: Distribution of Incident Clearance Time

5.1.4.5 Service Time and Crew Schedule

The time-variant maximum number of available operators by area was input into the simulation model according to the current crew schedule. When an incident is reported, one of the available operators will be randomly selected to process the incident for a certain account of time T. T is generated according to the empirical distribution derived above. After the incident is cleared the operator will again become available for new incidents. In the event that all the available operators are busy, this incident will be ignored by simulation[4]. The numbers are the number in Table 9 of operators.

Table 9: Crew Schedule

West	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
Day Shift	3	8	8	8	8	8	3
Night Shift	7	0	0	7	7	7	7

Central	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
Day Shift	7	8	8	10	8	8	7
Night Shift	5	2	2	9	7	7	3

East	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
Day Shift	4	7	7	8	8	8	4
Night Shift	7	3	3	7	7	7	7

[4] In practice, the Kentucky state or local police will go to the incident scene to process the incident instead.

5.2 Validation of the Simulation Model

Before conducting an extensive analysis, the simulation model must first be validated. The task in this section is to compare the simulation outputs and the historical records to ensure the simulation model is consistent with the reality.

The simulation model was run with five replications and the results revealed that the simulation outputs were highly consistent with the historical data and therefore this model could be used for operational analysis and prediction. Figure 38 through Figure 40 show the details.

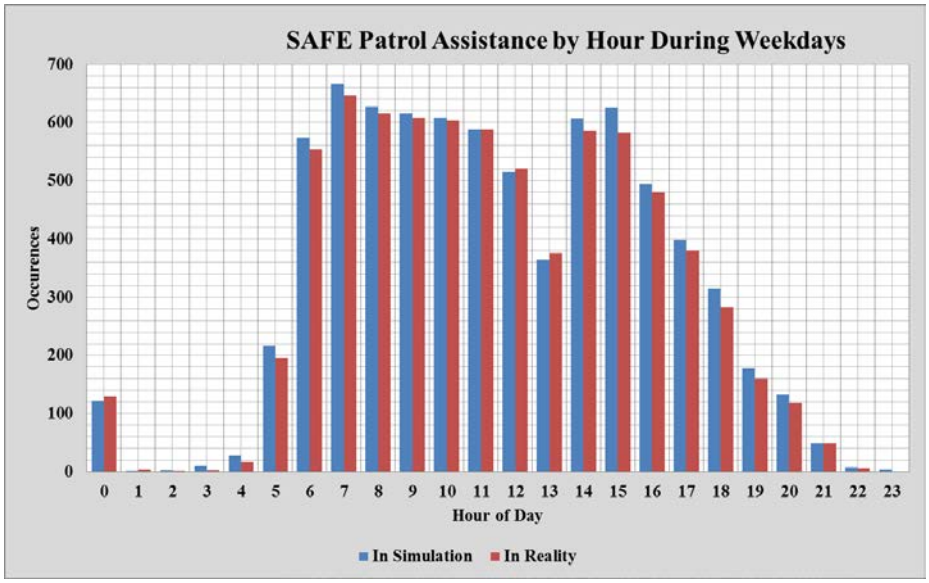


Figure 38: Annual Processed Incidents by hour during Weekdays in Simulation and in Reality

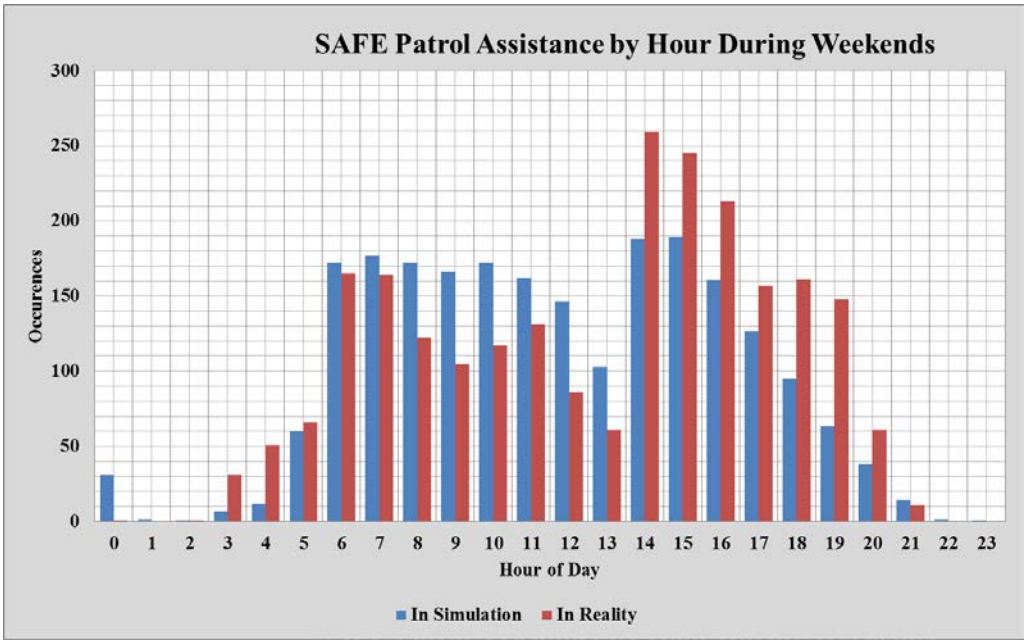


Figure 39: Annual Processed Incidents by Hour during Weekends in Simulation and in Reality

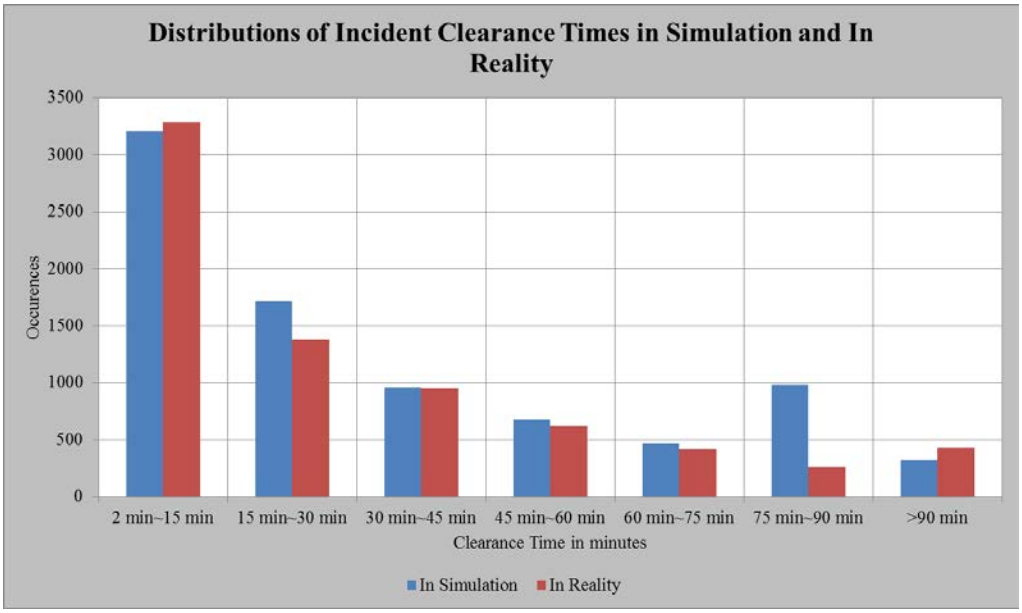


Figure 40: Comparison of Incident Clearance Time between Simulation and Reality

5.3 Sensitivity Analysis of the SAFE Patrol Service

The primary performance measurement of the SAFE Patrol service in Kentucky is the rejection rate. A rejection occurs when an incident cannot be responded to due to a lack of available operators. The sensitivity analysis in this section aims to predict the possible changes to this measurement if the service coverage or the operational time is adjusted.

5.3.1 The Rejection Rates if the Coverage is Extended

It is desired to understand how many incidents will be ignored due to the lack of available operators if the current service coverage is extended whereas the crew schedule stays unchanged.

Set "γ" as the current rejection rate, which is unknown since only assisted incidents were recorded. Therefore, if the same assisted incidents are generated in simulation, all of them are supposed to be responded to. In other words, the rejection rates in the three areas should be around zero. This speculation was supported by the simulation model in Table 1.

It is assumed that the number of incidents will increase proportionally when the service coverage is extended. As in Figure 35, the incident arrivals were approximated as a Poisson process and extending the coverage would increase the arrival rate λ proportionally. Meanwhile, if the coverage is extended, the incident clearance time may also be longer because each operator will patrol a larger range and it may take an operator longer to reach the incident scene. These considerations were reflected in the simulation model.

Table 10: Rejection Rate When the Coverage is Extended

	Rejection Rate		
Coverage Extension	East	Central	West
100%	1.8%	0.0%	2.0%
110%	2.0%	0.0%	2.5%
120%	2.9%	0.0%	3.4%
130%	3.3%	0.0%	3.8%
140%	3.8%	0.0%	5.3%
150%	4.5%	0.0%	5.9%

From Table 10, it appears that the patrol team in the central area will be able to respond to all the incidents even if the service coverage is significant. However, the rejection rates in the east and west areas would increase if the service coverage is extended. Therefore, it will make sense to have more operators in the east and west areas to keep the current rejection rate when the service coverage is extended.

5.3.2 The Rejection Rates under a New Service Time

From Figure 39, it appears that most of the incidents occurred from 6:00 AM to 8:00 PM. However, the current service is from 6:00 AM to 10:00 PM. As such, it might be possible to shorten the daily service time without increasing the rejection rates. Such adjustments were made in the simulation model. The results shows that changing the service ending time from 10:00 PM to 8:00 PM will not change the rejection rates and therefore it is recommended to switch the service type from patrol to on call from 8:00 PM to 10:00 PM.

5.4 Summaries

The primary goal of the SAFE Patrol in Kentucky is to assist stranded motorists and stalled vehicles quickly and safely. Therefore the performance measure of the SAFE Patrol service is the incident rejection rate. A rejection occurs when an incident is reported but there are no available operators nearby. In that case, the request for help will have to be addressed by state or local police. There are some concerns about how the SAFE Patrol service would perform if the service coverage or crew schedule were adjusted. In this chapter, a discrete-event-simulation model was developed in *Arena*® to simulate the working procedure of the SAFE Patrol service in Kentucky. The report of those incidents assisted by the SAFE Patrol in 2010 was used to tailor and calibrate the simulation model. Before conducting an extensive analysis, this simulation model was first validated by comparing the simulation outputs and actual incidents reports. After that, the simulation model was used to predict the possible rejection rates under various scenarios. Each scenario is composed of a particular service coverage and service time. The simulated results reveal that the service in the central area will not deteriorate if the coverage is extended under the same crew team size, whereas the patrol service in the west and east areas may have to add more operators to keep the level of service when the coverage is extended. Meanwhile, it is recommended to change the service type between 8:00 PM to 10:00 PM from patrol to on call. From incidents hour-by-hour

distributions, the incidents occurrences considerably decreased after 8:00 PM. The simulation results also supported this suggestion.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

In this project, the research team first investigated the SAFE Patrol service in Kentucky. The collected information includes: the history of the SAFE Patrol service in Kentucky, the divisions of the SAFE Patrol program, the summary of incidents assisted by SAFE Patrol operators in 2010 by district and by type respectively, the working procedure of how the SAFE Patrol program works, the types of service provided by the SAFE Patrol service and a comparison between the freeway patrol services provided in Kentucky and the fully functional freeway patrol service recommended by FHWA.

The research team also conducted a survey of the best practices in the states of interest. The purpose of this task is to better understand the similar practices in other states and seek experiences/lessons out of them. The investigated states include: Florida, Georgia, Tennessee, Indiana, Virginia, West Virginia and Alabama (where the freeway patrol service is being performed by the state police). These states are providing successful but rather different freeway patrol services. For instance, the service patrol system in Florida is under the oversight of district offices and utilizes the private sector extensively; the freeway patrol service in West Virginia is managed by a private company whereas the other states sponsor the services using the state budget or partially the FHWA funds (e.g., CMAQ or STP). The freeway patrol services provided in most states are around metro areas but the exceptions are Kentucky and West Virginia. The freeway patrol services in Kentucky and West Virginia are primarily in rural areas and therefore the major benefits of the freeway patrol services in Kentucky and West Virginia are to assist stranded passengers and stalled vehicles more safely and promptly rather than to reduce the delay due to shorter incident clearance time. This is in response to extensive sections of freeways and interstates in rural and semi-isolated areas.

Not all the stakeholders are fully aware of the SAFE Patrol service in Kentucky. To address this issue the research team also conducted a survey for the stakeholders. The purpose of this task is twofold: (1) to understand the awareness and opinion on the SAFE Patrol service among the stakeholders and adjust the SAFE Patrol operations accordingly; (2) to promote the stakeholders to better understand the freeway safety patrol service in Kentucky.

The survey results revealed that most stakeholders were satisfied with the performance of SAFE Patrol service. However, in the last survey question which allowed the participants to write down their own comments, some participants provided suggestions to the SAFE Patrol program. The research team collected and summarized the following suggestions:

- Provide more assistance beyond the traffic closure at incident sides
- Employ better communication tools to coordinate with the TMC at Frankfort and other stakeholders
- Improve coordination with highway and bridge maintenance personnel and law enforcement officers in certain districts

The research team designed a simulation model using the discrete-event-simulation software, the Arena, to evaluate the performance of the SAFE Patrol service. As mentioned above, the coverage of the SAFE Patrol service in Kentucky is mainly in rural areas and so the measure of effectiveness (MOE) for the service is how many reported incidents can be provided with assistance rather than the delay reduction due to quicker incident clearance. There is no

commercial software able to provide such evaluations directly. As such the research developed the simulation model according to the archived data of the SAFE Patrol. The simulation model was first validated by comparing the outputs of simulation and historical data. Then various scenarios were simulated and evaluated. The simulation results revealed that the patrol team in the central area would have sufficient staffing level if the service be expanded, whereas the east and west districts might be under staffed if the service is extended. The research team observed that most of reported incidents occurred from 6:00 AM to 8:00 PM while the patrol time is from 6:00 AM to 10:00 PM. According to the simulation results, the performance might not be affected if the patrol time ends two hours earlier at 8:00 PM.

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APPENDIX: SURVEY QUESTIONNAIRE FOR THE STAKEHOLDERS

Exit this survey

Survey of the SAFE Patrol Service in Kentucky for the stakeholders

1.

The purpose of this survey is to better understand stakeholders' impressions of the SAFE Patrol service and identify possible enhancements.

1. What type of agency do you represent?

- ☐ Emergency Management
- ☐ EMS
- ☐ Fire
- ☐ Law Enforcement
- ☐ Towing
- ☐ Transportation
- ☐ Other (please specify)

2. How often do you respond to an incident where the SAFE Patrol also responds?

- ☐ Rarely or Never
- ☐ 1 to 4 times per month
- ☐ 5 to 8 times per month
- ☐ 9 to 12 times per month
- ☐ 13+ times per month

3. When you arrive on scene, do you find the SAFE Patrol is already there?

- ☐ Never
- ☐ Seldom
- ☐ Sometimes
- ☐ Mostly
- ☐ Always

4. Would you find it beneficial to have the SAFE Patrol available at more incident scenes?

☐	Yes
☐	No

5. What is or what would be the single most beneficial thing the SAFE Patrol could do at the scene of an incident?

6. The SAFE Patrol provides the following services. Please rate the importance of these services.

	Very Unimportant	Unimportant	Important	Very Important
Provide assistance to stranded motorists	☐	☐	☐	☐
Assist responders by directing traffic at incident scene	☐	☐	☐	☐
Remove debris from the roadway	☐	☐	☐	☐
Monitor infrastructure for suspicious devices, people, or activities	☐	☐	☐	☐
Check and tag abandoned vehicles	☐	☐	☐	☐

7. What, if any, other services should the SAFE Patrol provide?

8. What equipment should the SAFE Patrol have available to assist responding agencies at the scene of an incident?

9. Please rate the SAFE Patrol Operators for timeliness and professionalism:

	Very Poor	Poor	Fair	Good	Very Good
Timeliness	☐	☐	☐	☐	☐
Professionalism	☐	☐	☐	☐	☐

10. What do you think is the largest benefit of the SAFE Patrol service in Kentucky?

- ☐ No noticeable benefits
- ☐ Improves safety for responders
- ☐ Improves safety for motorists
- ☐ Reduces delay and congestion
- ☐ Other (please specify)

11. SAFE Patrol operators are generally patrolling from 6:00 AM to 10:00 PM, 7 days per week. How do you feel about this patrol time?

- ☐ Patrol time should be reduced.
- ☐ Patrol time should be reduced, but on-call time should be added.
- ☐ Patrol time should not be changed.
- ☐ Patrol time should not be changed, but on-call time should be added.
- ☐ Patrol time should be extended.
- ☐ Patrol time should be extended and on-call time should be added.

12. SAFE Patrol operators are patrolling all Kentucky interstates and parkways plus US 23 and KY 80. How you feel about this coverage area?

- ☐ Coverage area is appropriate and does not need to be changed.
- ☐ Coverage area should be reduced since some of the current routes don't need to be patrolled.
- ☐ Coverage area should be changed to focus on the more rural areas within the state.
- ☐ Coverage area should be changed to focus on the more urban areas within the state.
- ☐ Coverage area should be expanded to include all major roadways in the urban and rural areas of the state.

13. Please note here any other suggestions to help improve the SAFE patrol service:

Done

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