Scope of Service

Integrated Work Zone Safety Management System and Analysis Tools

Submitted to

The Florida Department of Transportation
Research Center
605 Suwannee Street, MS 30
Tallahassee, FL 32399

c/o Dr. Sastry Putcha, P.E.

Submitted by

Dr. Alaa K. Ashmawy, P.E.
Department of Civil and Environmental Engineering
University of South Florida
4202 E. Fowler Avenue, ENB 118
Tampa, FL 33620-5350

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PROBLEM STATEMENT

Despite recent efforts to improve work zone safety in Florida, the number of fatalities and injuries at work zones has increased dramatically over the past few years. A number of procedures have been adopted, with varying degrees of success, based on earlier FDOT research findings. Such procedures include the use of low-profile temporary barriers, better illumination, enhanced signage, and driver education programs. In parallel, a number of new technologies to improve safety at construction zones are currently being tested in Florida. However, the relative effectiveness of each of these technologies under given conditions is yet to be determined.

As the number of fatalities and injuries at work zones has climbed, so has the need for the Department to develop a comprehensive work zone management system. Such a system must be based on advanced accident data analysis tools and supported by numerous recent advances in pattern recognition and computer vision technologies. Patterns, causes, and temporal variations of accidents at work zones can also be minimized through advanced analysis and interpretation of data collected from real-time monitoring of construction zone traffic.

Other affected functional areas: Safety Office.

LITERATURE SEARCH SUMMARY

An extensive literature review has been conducted on this topic. A significant amount of work has been carried out in Florida by the State Construction Office and the State Safety Office. However, few efforts have been undertaken, in general, to examine work zone safety from a holistic perspective. Rather, the efforts seem to focus either on the analysis of specific aspects of work zone safety or the development of specific technologies to improve safety. For instance, Consolazio et al (2003) examined the effectiveness of temporary low-profile barriers as a roadside safety provision at construction zones. Ellis (2003) provided improved procedures and guidelines for pavement markings to minimize pavement damage and accordingly enhance safety. At the national level, a number of new technologies intended to promote safety at construction zones have hit the market recently. Examples include the SonoBlaster® and the Wireless Warning Shild (WWS), which are mounted on traffic cones to trigger a loud siren or produce a wireless chain reaction for warning upon impact. Such devices are targeted toward worker – not driver – safety.

From the data collection, analysis, and synthesis standpoint, a study has been conducted by the Safety Office (Turner 2001) to investigate the causes of fatal crashes in Florida. The study did not specifically focus on construction zone accidents, but data presented in the study sheds some light on the causative factors that could potentially be of relevance at construction zones. Spainhour and Mtenga (2002) developed an electronic database of MOT accident reports with a simple web-based interface. The database constitutes a positive step in collecting and analyzing accident data at work zone. However, neither an analysis tool nor post-processing procedures/algorithms are available to make use of the raw data.

OBJECTIVES/TASKS

The goal of the proposed work is to develop a comprehensive work zone safety management system through advanced analysis tools of crash data at construction zones. The system will feature a web-based interface for entering, processing, and analyzing the crash data. Real-time monitoring of selected construction sites coupled with pattern recognition analysis will aid in identifying the main causative factors and cause-outcome relationships of crashes. The specific project tasks are as follows:

Task 1: Literature search and information collection
A broad literature review has already been conducted. Because of the rapid evolution in the technologies, review of the literature will be updated periodically during the course of the project. In addition, a thorough survey of the technologies available in the market will be conducted.

Task 2: Development of web-based interface for data analysis
A web-based interface will be developed to store, retrieve, and analyze the data to generate cause-effect relationships between the various factors associated with crashes at construction zones. The interface will be built upon the database structure developed by Spainhour and Mtenga for FDOT, and will feature specific analysis modules that can be used to assist in Task 5 of this project. The interface will be XML-based and will also be compatible with GIS software used by the Department.

Task 3: Implementation of pattern recognition analysis tools
Real-time video monitoring devices will be mounted at selected construction sites to evaluate the onset, triggers, progression, and outcome of accidents at work zones. The video captures will be analyzed through pattern recognition algorithms developed in collaboration with researchers from the Computer Science department at the University of South Florida. A video database of accident progressions will be made available as part of the study. The pattern recognition algorithms will be immensely valuable in evaluating the mechanisms leading to the crash.

Task 4: Evaluation of new technologies
Data will be compiled from various work zones where new commercial technologies have been implemented. This will be done in coordination with other FDOT offices and personnel, including the Safety Office. Examples of safety improvement and warning systems include the SonoBlaster and WWS, beacon lights blinking at the driver's speed, and light beam pavement markings. The relative effectiveness of each of the techniques in relation to the work zone conditions will be analyzed.

Task 5: Final data synthesis and development of work zone safety management system
The collection of the tools and data from Tasks 2, 3, and 4 will be integrated into a single web-based software that can be used for work zone safety management. Examples of final data synthesis include an evaluation of the frequency and pattern of worker vs driver injury, nighttime vs daytime accident rates, and the relative success of new technologies in relation to particular work zone settings.

DELIVERABLES

The deliverables from this project consist of 12 hard copies of the final report, and electronic version of the final report, and an electronic version of the summary. In addition, a web-based software and graphic interface of the work zone management system will be made available. Quarterly progress reports will be submitted to the Research Center and will include the activities performed the current quarter, the activities planned for the next quarter, a summary of requested modifications if any, and the progress schedule.

BUDGET SHEET

The total cost for this project is estimated to be $150,291. A detailed budget is attached at the end of this document.

TRAVEL

Travel in conjunction with the project is limited to in-state travel. No out-of-state travel is planned. The travel includes two PM-PI meetings per year, as well as trips to install instrumentation and measurement devices at construction work zones.

EQUIPMENT

The equipment needed to conduct this research is available at the State Materials Office and the University of South Florida.

SCHEDULE

The proposed duration for this project is 24 months, including the three months needed to prepare, review, and submit the final report. A timeline (progress schedule) is shown in the chart below.

FLORIDA DEPARTMENT OF TRANSPORTATION
RESEARCH CENTER

PROGRESS SCHEDULE

Project Title: Work Zone Safety Management System and Analysis Tools
FDOT Project No. _____ FY _____ Month _____
Research Agency _____
Principal Investigator: Alaa Ashmawy, Ph.D., P.E.

RESEARCH TASK	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	ESTIMATED % COMPLETION
1. Literature Search																									
2. Web-based interface																									
3. Pattern recognition tools																									
4. New technologies																									
5. Work zone management system																									
6. Quarterly & final report preparation																									
OVERALL % COMPLETED																									

FIG. A -- OVERALL PROJECT SCHEDULE

FIG. B -- CONTRACT FUNDS

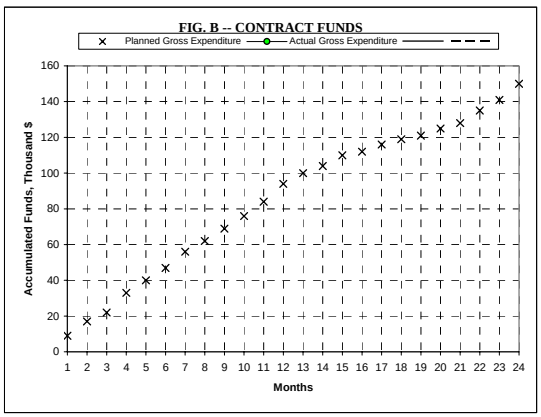
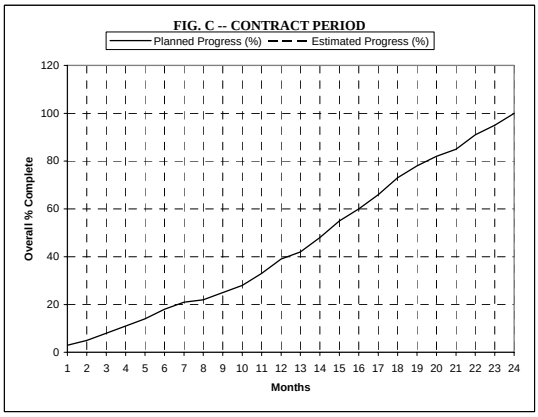


FIG. C -- CONTRACT PERIOD



Funds Expended %
Contract Amount $
Expended This Month $
Total Exp. to Date $
Balance $

Time Expended %
Starting Date
Completion Date

IMPLEMENTATION

Successful completion of this project will provide FDOT with an extremely valuable tool for work zone safety management. The work is crucial at a time when accident and fatality rates at construction zones are on the rise in Florida and nationwide. This project is also very timely in that the Department has already invested in various smaller efforts to enhance work zone safety. Development of final guidelines for selecting specific safety programs as a function of the construction zone conditions, as well as the implementation of the web-based software will immensely benefit the public as well as the District personnel. The information in the web-based software will be updated by FDOT, with the specific roles of the State Construction Office, Safety Office and OIS being coordinated by the project manager before the end of the project. Recommendations – both conceptual and specific – will be made with respect to the safety improvement tools and procedures that are available. Examples of tools include web-based software, illumination of flooring, electronic laser beams for pavement markings, or optical noise systems. The conditions warranting the use of one or more of these methods will be incorporated in the MOT design and others will be part of the construction zone operational procedures. Final recommendations to this regard will be made in the final project report.

CONTACT INFORMATION

The research will be conducted by Dr. Alaa Ashmawy, Associate Professor at the University of South Florida. The Project Manager is Dr. Sastry Putcha at the State Construction Office in Tallahassee.

Sastry Putcha, Ph.D., P.E.
State Construction Office
605 Suwannee St
Tallahassee, FL 32399
Tel: (850) 414-4148
Fax: (850)412-8021
E-mail: sastry.putcha@dot.state.fl.us

Alaa K. Ashmawy, Ph.D., P.E.
Department of Civil and Environmental Engineering
University of South Florida
Tampa, FL 33620-5350
Tel: (813) 974-5598
Fax: (813) 974-8832
E-mail: ashmawy@eng.usf.edu

Other Research Team Members: Patrick Brady, Lap Hoang, Stephanie Maxwell

PROPOSED BUDGET: **PRINCIPAL INVESTIGATOR:**
Year One Alaa K. Ashmawy

PROJECT LENGTH: 24 months

TITLE: Integrated Work Zone Safety Management System and Analysis Tools

1. **SALARIES:**	**Hourly Rate**	**# of Hours**	**Total**
PI Salaries – Ashmawy	$50.40	520	26,208
		TOTAL SALARIES	$26,208
2. OTHER PERSONNEL SERVICES (OPS):			
Graduate Student Salaries	$17.00	2088	35,496
		TOTAL OPS	$35,496
3. FRINGE BENEFITS:			
PI @ 16.5%			4,324
Graduate Student @ 1%			355
		TOTAL FRINGE	$4,679
4. PERMANENT EQUIPMENT (OCO)*:			
List Each Item or Provide a Breakdown with Prices in the Proposal			
		TOTAL OCO	_____
5. OPERATING EXPENSES:			
Travel (2 meeting with PM + 3 trips for data collection)			250
Expendable supplies			1,500
Software			12,000
Publication costs			100
Tuition			8,877
		TOTAL EXPENSE	$22,727
6. TOTAL DIRECT COSTS:			$89,110
7. INDIRECT COSTS: (5%)			$4,456
8. TOTAL PROJECT COSTS:			**$93,566**

***Equipment – Unit price greater than $1,000**

PROPOSED BUDGET: **PRINCIPAL INVESTIGATOR:**
Year Two Alaa K. Ashmawy

PROJECT LENGTH: 24 months

TITLE: Integrated Work Zone Safety Management System and Analysis Tools

1. **SALARIES:**	**Hourly Rate**	**# of Hours**	**Total**
PI Salaries – Ashmawy	$51.41	260	13,366
		TOTAL SALARIES	$13,366
2. OTHER PERSONNEL SERVICES (OPS):			
Graduate Student Salaries	$17.34	1566	27,254
		TOTAL OPS	$27,154
3. FRINGE BENEFITS:			
PI @ 16.5%			2,205
Graduate Student @ 1%			272
		TOTAL FRINGE	$2,477
4. PERMANENT EQUIPMENT (OCO)*:			
List Each Item or Provide a Breakdown with Prices in the Proposal			
		TOTAL OCO	_____
5. OPERATING EXPENSES:			
Travel (2 meetings with PM + 3 trips for data collection)			250
Expendable supplies			1,500
Software			0
Publication costs			400
Tuition			8,877
		TOTAL EXPENSE	$11,027
6. TOTAL DIRECT COSTS:			$54,024
7. INDIRECT COSTS: (5%)			$2,701
8. TOTAL PROJECT COSTS:			**$56,726**

***Equipment – Unit price greater than $1,000**

PROPOSED BUDGET: **PRINCIPAL INVESTIGATOR:**
Full Project Period Alaa K. Ashmawy

PROJECT LENGTH: 24 months

TITLE: Integrated Work Zone Safety Management System and Analysis Tools

1. **SALARIES:**	**Hourly Rate**	**# of Hours**	**Total**
PI Salaries – Year 1	$50.40	520	26,208
PI Salaries – Year 2	$51.41	260	13,366
		TOTAL SALARIES	$39,574
2. OTHER PERSONNEL SERVICES (OPS):			
Graduate Student Salaries	$17.00	2088	35,496
Graduate Student Salaries	$17.34	1566	27,154
		TOTAL OPS	$62,650
3. FRINGE BENEFITS:			
PI @ 16.5%			6,530
Graduate Student @ 1%			627
		TOTAL FRINGE	$7,156
4. PERMANENT EQUIPMENT (OCO)*:			
List Each Item or Provide a Breakdown with Prices in the Proposal			
		TOTAL OCO	_____
5. OPERATING EXPENSES:			
Travel (4 meetings with PM + 6 trips for data collection)			500
Expendable supplies			3,000
Software			12,000
Publication costs			500
Tuition			17,754
		TOTAL EXPENSE	$33,754
6. TOTAL DIRECT COSTS:			$143,135
7. INDIRECT COSTS: (5%)			$7,157
8. TOTAL PROJECT COSTS:			**$150,291**

***Equipment – Unit price greater than $1,000**