International Journal of Industrial Engineering, 15(1), 122-131, 2008.

Time and Motion Study For Affordable Traffic Data Collection System For The State of Florida

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The Florida Department of Transportation initiated and funded development of electronic crash and citation reporting for the State of Florida using the TraCS (Traffic and Criminal Software) platform. Seven Florida law enforcement agencies were selected as a test-bed for electronic crash and citation reporting. The agencies were provided with required equipment and training to use the TraCS software for the data collection process. Ride-alongs were conducted with law enforcement personnel in two of those agencies and a time and motion study was used to compare the time to complete crash and citation forms both with and without the TraCS software. The time and motion study showed improvement in efficiency and accuracy of Florida traffic records using the electronic data collection system (TraCS). The efficiency of officer's using TraCS differed based on the learning curve, equipment provided, and mindset of officers.

Significance: This research applies the principles of time-motion study to the task of completing crash and traffic citation forms. Completing the forms with the TraCS software was found to be quicker than completing the forms without, although these differences were often not statistically significant.

Key words: Time and motion study; Law enforcement; TraCS software; Form filling task.

(Received 26 May 2006; Accepted in revised form 12 March 2007)

1. INTRODUCTION AND BACKGROUND

Traditional methods of traffic crash and citation reporting in the state of Florida involve a series of time-consuming and labor intensive procedures. The process begins with a law enforcement officer filling out forms by hand at the crash scene, and ends with entry of data into a state-wide computer repository. In an effort to improve the accuracy and timeliness of the process, a computerized system is being implemented on a pilot-study basis. The computerized process explored during this research begins with the use of customized Florida forms based on the TraCS (Traffic and Criminal Software) platform This paper examines potential time savings in completing the crash scene paperwork with the software versus performing the same tasks by hand. A discussion of system costs, as well as potential cost savings, is also included.

The objective of any work measurement system is to determine the time it should take an average, trained person to perform a task if he or she were doing that over an 8-hour day under usual working conditions and working at a normal pace. This time is called *standard time*. *Normal time* is defined as the time required for an average, trained operator to perform a task under usual working conditions and working at a normal pace. One of the possible methods of determining standard times is a direct time study (Turner et al., 2002). This is a work measurement technique in which a physical measurement is made of the actual time required to do a task using a stopwatch or other timing device. This measured time is then modified by considering the operator's pace, and finally, allowances are added to account for variations in the operator's pace.

2. SYSTEM DESIGN FOR TRACS-FLORIDA

In 1994, the Iowa Department of Transportation partnered with Iowa State University and other local government agencies to design and implement an accident reporting system to increase data accuracy while reducing the time allocated to processing accident reports. This software package was eventually named TraCS (Traffic and Criminal Software) (TraCS, 2004). In 1997, the state of Iowa was selected by the Federal Highway Administration (FHWA) as a partner for the National Model Project. The objective of the partnership was to expand on the existing accident reporting system to create a fully integrated safety management system that could meet the needs of other state and national agencies. The TraCS National Model software emulates paper reports, but makes use of machine-readable documents, provides electronic diagramming, and is capable of electronically capturing signatures, attaching image files, and locating events with Global Positioning Systems (GPS). A Software Development Kit (SDK) allows each state to develop customized crash, citation, and other motor vehicle reports. The TraCS system requires only a central server for data entry and storage, but maximum benefit comes with the use of laptop computers in patrol cars, peripherals such as magnetic stripe and/or bar code scanners for reading encoded driver license data, mobile printers for printing report copies in the field, and data communications to automatically transfer the data back to the server.

With the traditional method of crash reporting in the state of Florida, moving crash data into statewide databases follows a series of time-consuming and labor intensive procedures. Hence, as illustrated in Figure 1, adapted from (Iowa DOT, 2004), the duration between the time crash data are recorded to the time these data are made available for analysis is usually 12 to 18 months. In a typical non-automated law enforcement agency, an officer responding to a crash scene fills in a paper crash form either on-scene or at a later time based on hand written notes from the scene. The form is manually handed to a supervisor for approval; any changes or corrections require transfer back to the reporting officer before resubmission and approval. Then, the data is typed into a local database if available, and the form is mailed to the Department of Highway Safety and Motor Vehicles (DHSMV). Once it reaches DHSMV, the form is sent to PRIDE (Prison Industries, Inc.) to enter into a state-wide crash database known as CrashMaster. After data entry, any errors found by an edit check algorithm require the form to be returned to the agency for corrections before it is then archived in the mainframe database at the state DHSMV. Records for crashes occurring on state roads are transferred to the Florida Department of Transportation at regular intervals, where manual methods are used to identify crash locations and reference them to state GIS and Roadway Characteristics Inventory (RCI) data. This time delay is one of the major problems for the highway safety community. The lack of the most recent data for safety analysis prevents engineers and police from locating safety problem areas and taking necessary measures in a timely fashion.

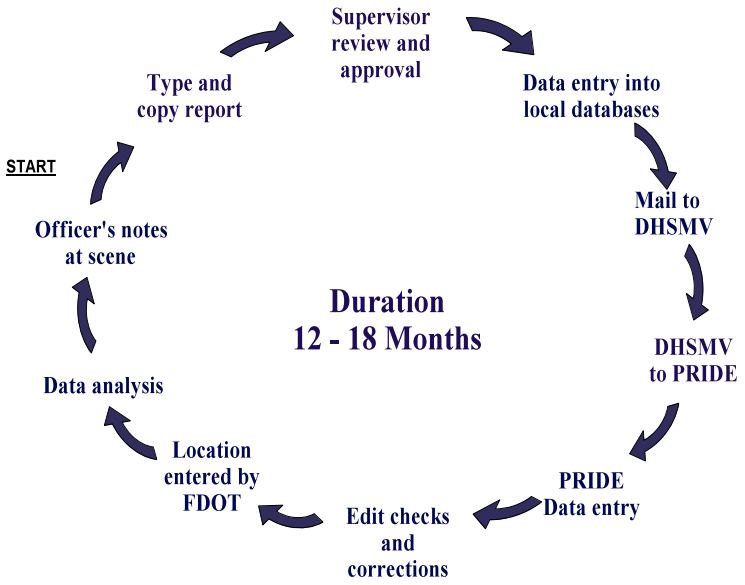


Figure 1: Present Crash Data Collection Process in Florida

The TraCS software was developed in response to the need for a well-designed information management tool for field officers that would simplify the data collection process and ease the administrative burden on officers. The information flow for the TraCS-Florida model is shown in the Figure 2. Capturing crash data electronically at the roadside eliminates

mailing paper forms and rekeying the data at the state level. Validation rules in the software reduce and eventually eliminate the need for state-level edit checks. Finally, the GPS enabled locator tool eliminates the need for adding supplemental location data by Florida Department of Transportation. DHSMV is currently working with the TraCS team and other commercial providers of traffic records software to develop a compatible standard to enable electronic transmission of the resulting data to the state repository. It is predicted that, when fully implemented, the TraCS-based system will reduce the time between the crash and state-wide availability of the data to eight hours.

3. METHODOLOGY

The Florida Department of Transportation initiated and funded development the electronic crash and citation reporting in Florida using the TraCS (Traffic and Criminal Software) platform; the customized Florida software is known as TraCS-Florida. The TraCS-Florida software is available to state and local agencies through a no-cost licensing program. The research is aimed at implementing an affordable automated traffic record management system based on the TraCS software platform in the State of Florida. A second focus was incorporating various features and functionalities of this software to obtain accurate and useful crash data. The ability to collect accident data when and where accidents occur reduces users' administrative duties and paperwork, while ensuring the availability of accurate and timely data. With TraCS-Florida, the process of crash reporting will be both streamlined and automated. It is important to note that this paper deals only with the roadside data capture aspects of the model, including validation.

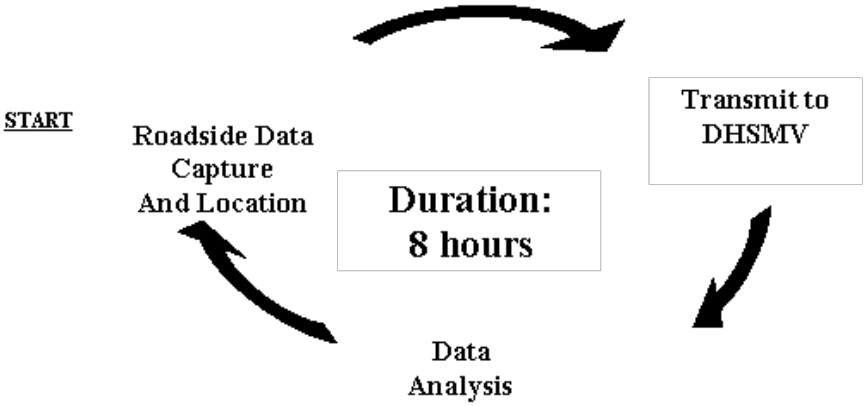


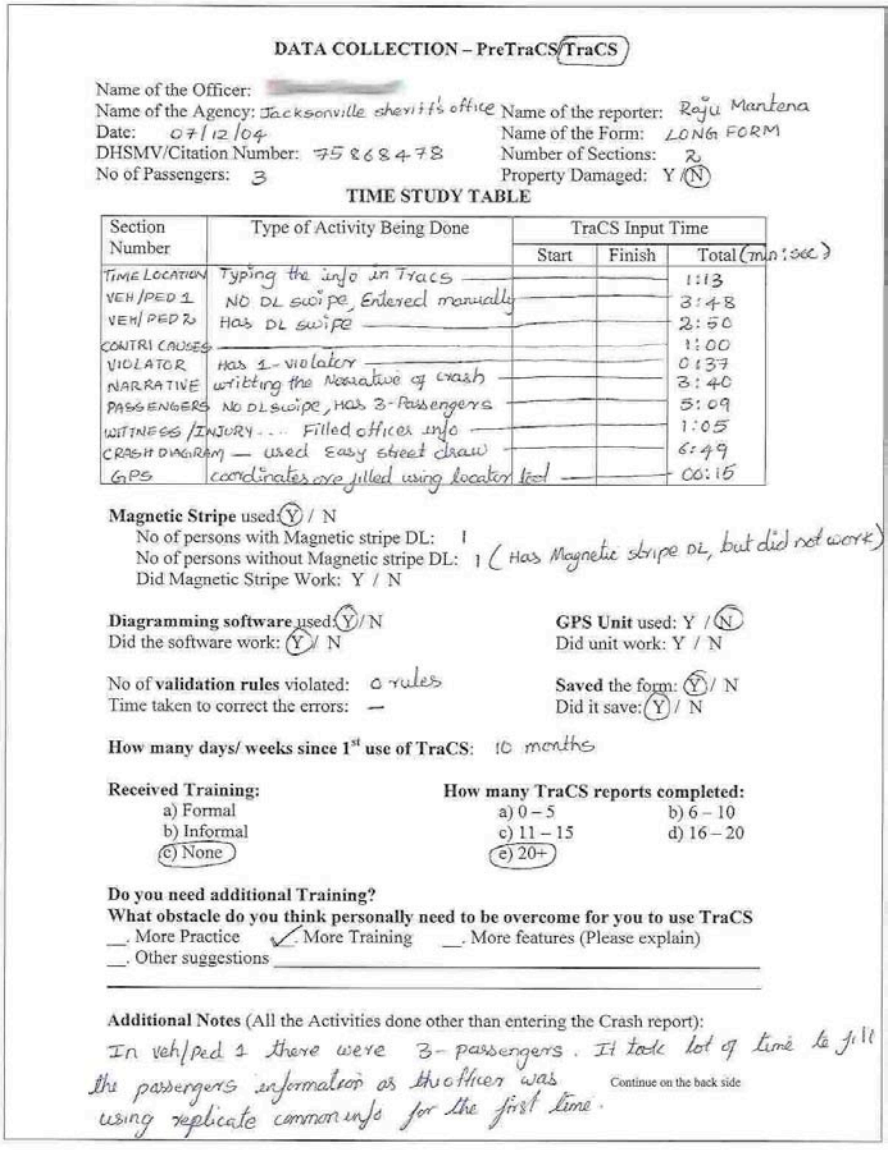
Figure 2: TraCS-Florida Model System

3.1 Data Collection and Sample Data

To compare the time involved in roadside data collection and form filling using traditional and software-based techniques, ride-alongs were conducted with law enforcement officers. A ride-along means that a member of the TraCS research team rode along with the police crew to crash scenes to observe the activities of the police officers and to collect the time measurement data. Among the seven pilot agencies, Jacksonville Sheriff's Office and Leon County Sheriff's Office were selected for conducting ride-alongs. Data collection was done in two phases, Phase I for pre-TraCS and Phase II for the actual TraCS operation. Phase I ride-alongs were performed before the pilot agencies started using TraCS-Florida and the data consisted of the time taken to fill various paper forms, including the Florida Uniform Traffic Citation, the Florida Traffic Crash Report (long and short versions), and the Driver Exchange form. In Phase II, ride-along data were collected while using TraCS-Florida to complete the forms on a laptop computer. When possible, officers used a magnetic stripe reader to scan the driver information from the Driver License. The data collection form completed for crash report # 75868478, which was a long form crash report completed using the TraCS software, is shown in Figure 3. The different types of information that were collected are shown in the data collection form. The information on a report is divided into sections known as groups (e.g. time/location group, vehicle/pedestrian group, etc.). The time taken to fill each group on section on the respective form was measured individually, other issues or difficulties were listed, and the experience of the officer filling out the form was noted. Table 1 shows the actual time measurements for this form.

Table 1: Time Taken to Fill Crash Report Number 75868478

Group Name	Time (sec)
Time Location	73
Section 1	228
Section 2	170
Contrib. Causes	60
Violator	37
Passenger	309
Witness	65
Narrative	220
Diagram	409
Total	1586



DATA COLLECTION – PreTraCS/TraCS

Name of the Officer: [redacted]
Name of the Agency: Jacksonville sheriff's office
Name of the reporter: Raju Mantena
Date: 07/12/04
Name of the Form: LONG FORM
DHSMV/Citation Number: 75868478
Number of Sections: 2
No of Passengers: 3
Property Damaged: Y / (N)

TIME STUDY TABLE

Section Number	Type of Activity Being Done	TraCS Input Time		
		Start	Finish	Total (min:sec)
TIME LOCATION	Typing the info in TraCS			1:13
VEH/PED 1	NO DL swipe, Entered manually			3:48
VEH/PED 2	Has DL swipe			2:50
CONTRI CAUSES				1:00
VIOLATOR	Has 1 - violator			0:37
NARRATIVE	writting the Narrative of crash			3:40
PASSENGERS	No DL swipe, Has 3 - Passengers			5:09
WITNESS /INJURY	Filled officer info			1:05
CRASH DIAGRAM	— used Easy street draw			6:49
GPS	coordinates are filled using locator tool			00:15

Magnetic Stripe used: (Y) / N
No of persons with Magnetic stripe DL: 1
No of persons without Magnetic stripe DL: 1 (Has Magnetic stripe DL, but did not work)
Did Magnetic Stripe Work: Y / N

Diagramming software used: (Y) / N
Did the software work: (Y) / N

GPS Unit used: Y / (N)
Did unit work: Y / N

No of **validation rules** violated: 0 rules
Time taken to correct the errors: —

Saved the form: (Y) / N
Did it save: (Y) / N

How many days/ weeks since 1st use of TraCS: 10 months

Received Training:
a) Formal
b) Informal
(c) None

How many TraCS reports completed:
a) 0 – 5
b) 6 – 10
c) 11 – 15
d) 16 – 20
(e) 20+

Do you need additional Training?
What obstacle do you think personally need to be overcome for you to use TraCS
__. More Practice ✓. More Training __. More features (Please explain)
__. Other suggestions _____

Additional Notes (All the Activities done other than entering the Crash report):
In veh/ped 1 there were 3 - passengers. It took lot of time to fill the passengers information as the officer was using replicate common info for the first time.

Continue on the back side

Figure 3: Sample Data Collection Form

An example to calculate the standard time for collecting data for this report is shown below. In this case, the performance rating is considered as 115% or 15% faster than would normally be expected. To obtain the normal time, the actual time is multiplied by the performance rating. The total allowances are equal to 12%, accounting for delays for

personal needs, fatigue, and other unavoidable circumstances. The standard time is calculated by adding the allowances to the normal time. If the operator had been performing at 90%, or 10% less than what normally would be expected, the *Normal Time* would be 1586(0.90) = 1427.4 sec = 23 min 47 sec.

Total Actual Time = $73 + 220 + 170 + 60 + 37 + 309 + 65 + 220 + 409 = 1586\,\text{sec} = 26\,\text{min}\,26\,\text{sec}$
Performance rating = 115%
Normal time = $1586 \times 1.15 = 1823.9$
Total Allowances = 4% (personal needs) + 5% (fatigue) + 3% (unavoidable delays) = 12%
Standard Time = $1823.9 \times 1.12 = 2042.76\,\text{sec} = 34\,\text{min}\,2\,\text{sec}$

3.2 Data Analysis and Results

This section includes the results of the data collection and the data analysis that was performed. Table 2 summarizes the data that were collected during the ride-alongs. All observed crashes had either 1, 2 or 3 vehicles, with most being two vehicle crashes. Magnetic stripe use was summarized as "Yes" if information on all drivers could be obtained from the mag stripe on the driver license, "No" if information on no drivers could be obtained from the mag stripe reader, and "Partial" if some but not all information could be obtained from the mag stripe reader. Driver licenses with magnetic stripes were also used to enter data on passengers when available. A total of 95 incidents were attended during ride-alongs in which TraCS was used in approximately two-thirds of the cases.

Table 2: Summary of the data collected

Form Type	TraCS				Pre-TraCS
	Magnetic Stripe Used			Total	
	Yes	No	Partial		
Long Form	6	2	7	15	6
Short Form	6	9	5	20	7
Driver Exchange	6	8	5	19	9
Citation	8	1	0	9	10
Total				**63**	**32**

In the statistical analysis, the response variable was the total time taken to fill out a crash report. Because of the large variation in completion time of certain groups, namely the narrative and diagram, these groups were excluded from the total report completion time. In addition, no driver exchange forms were completed using TraCS. Because all of the information on the driver exchange form is equivalent to what is on the first page of the short form, a comparison set was created by summing the time taken to fill the groups in the first page of short forms using TraCS.

To see the scatter or variability of the data, a dotplot was generated in Minitab as shown in Figure 4. This dotplot shows the total completion time for each form, grouped according to form type and whether or not TraCS was used. As the number of observations was small, it was difficult to identify any specific pattern in the variability. In general, for each form type, forms completed with TraCS took less time to fill out than those without TraCS. This plot also indicates that, other than some outliers, most of the completion times for each form fall very close to each other when the forms were filled using TraCS.

The boxplot of total time was generated by Minitab and shown in the Figure 5. The plot displays two sets of boxes for each form, starting with the long form. For each form, the first set of boxes on the left is for forms filled without using the TraCS software (Pre-TraCS); the second set of boxes for each form type is for forms filled using TraCS (TraCS). Each box or line within a set depicts the upper and lower bounds for a quartile (one-fourth) of the data points. The rectangular boxes identify the second and third quartiles, in which a total of 50% of the data fell. The line in the center of the rectangles is the median value. The vertical lines above and below the quartiles identify the first and fourth quartiles, which is the range of good data that are not considered as potentially outliers. The symbol "*" indicates an outlier, which is a point that is well outside of rest of the distribution. One outlier is identified for the long form, when the TraCS software was used. The plot in general showed that the forms filled using TraCS had an equal or smaller range and lower median compared with the forms filled without using TraCS (manually). As an example, consider the long form. When completed without TraCS, 50% of the completion times were between 1000 and 1400 seconds, with values as low as 800 and as high as 1600 seconds. When TraCS was used, 50% of the times were between 900 and 1100 seconds, with most of the remainder between 700 and 1400 seconds. A completion time of almost 1600 seconds was identified as an outlier case. Upon review of the data collection form, no justification for the extreme time measurement was noted. The median completion time dropped from

over 1200 seconds to around 1000 seconds. A large difference can also be seen in driver exchange form filled using TraCS and without using TraCS.

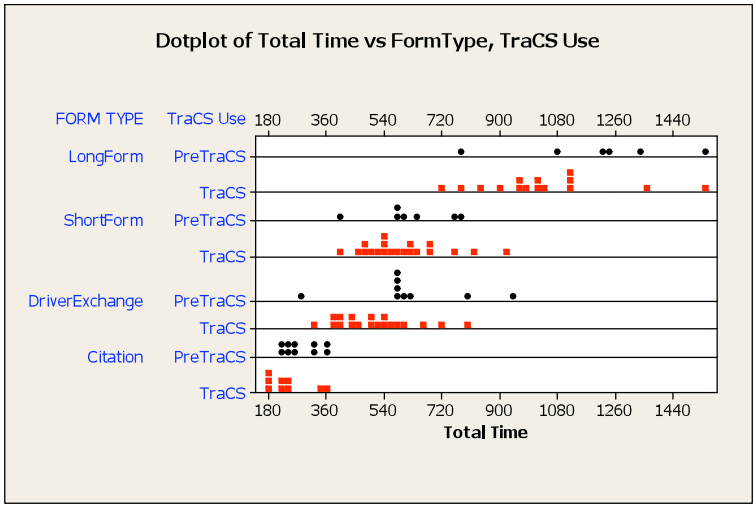


Figure 4: Dotplot of Total Time vs. FormType, TraCS_Use

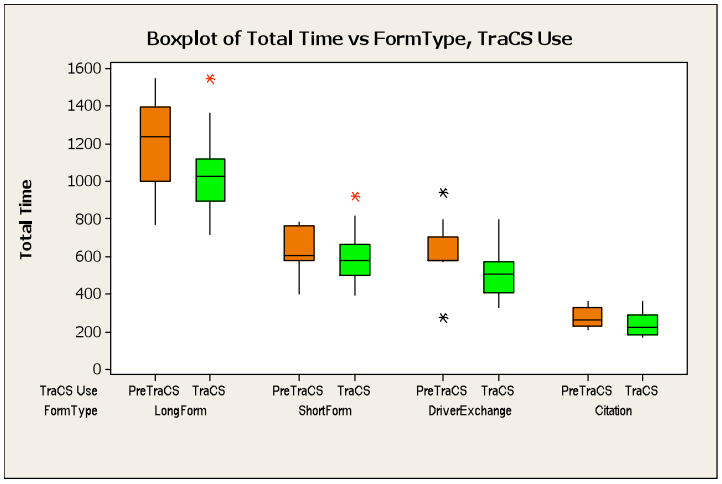


Figure 5: Boxplot of Total Time vs. FormType, TraCS_Use

The summary of descriptive statistics shown in Table 3 indicated that, in general, the mean for all the forms was less using the TraCS software than without TraCS. However, in a few cases when the sample size was equal to one, the mean was less without TraCS than with TraCS. For example, for long forms with one vehicle, it took more time to complete forms with TraCS than without TraCS. This probably implies that the benefits of computer-data entry were not realized when data was entered on only one vehicle. Table 4 further explores the difference in form completion time with and without TraCS using data generated from two-sample t-tests. As shown in Table 4, it took 3.9% less time to complete the short form with TraCS, and 16.6% less time to complete the driver exchange form with TraCS. However, the confidence intervals and p-values show that none of the differences are statistically significant at the 95% confidence interval.

As stated previously, the magnetic stripe reader was used to swipe the driver license and retrieve the information automatically into the forms. In total, 117 persons were involved in the incidents, of which the magnetic stripe was read 63 times, or 53% of the time. Table 5 shows the effectiveness of the mag-stripe reader in reducing form completion times. The data was generated using one-way analysis of variance (ANOVA) tests and Tukey's multiple comparison tests. The crash report data is based on two-vehicle crashes because there were an insufficient number of one- and three-vehicle crashes to be considered. For the Tukey's comparison tests, all comparisons were difference in completion time with respect to full mag-stripe use, that is, the "Yes" record in Table 5. As shown in Table 5, mag-stripe use resulted in significant time

differences (at a 95% confidence interval) in the short form with respect to both partial mag-stripe use and form completion without TraCS. The same trend is seen in the driver exchange form.

Table 3: Form Completion Time by Form Type and Number of Vehicles

Long Form						
NoOfVehicles	With TraCS			Without TraCS		
	Sample Size	Mean (sec)	StDev (sec)	Sample Size	Mean (sec)	StDev (sec)
1	3	865.3	133	1	772	N/A
2	12	1077.6	209.1	4	1221	109.5
3	0	N/A	N/A	1	1550	N/A
Short Form						
NoOfVehicles	With TraCS			Without TraCS		
	Sample Size	Mean (sec)	StDev (sec)	Sample Size	Mean (sec)	StDev
1	1	538	N/A	1	403	N/A
2	18	582.6	107.4	6	657	90.1
3	1	918	N/A	N/A	N/A	N/A
Driver Exchange						
NoOfVehicles	With TraCS			Without TraCS		
	Sample Size	Mean (sec)	StDev (sec)	Sample Size	Mean (sec)	StDev
2	18	497.4	100.9	7	542.6	118.9
3	1	498	N/A	2	867.5	102.5
Citation						
NoOfVehicles	With TraCS			Without TraCS		
	Sample Size	Mean (sec)	StDev (sec)	Sample Size	Mean (sec)	StDev
N/A	9	239.4	68.1	10	277.4	56.1

Table 4: Difference in Form Completion Time With and Without TraCS

Form Type	With TraCS			Without TraCS			Difference		95% Confidence Interval		p-value
	Sample Size	Mean (sec)	StDev (sec)	Sample Size	Mean (sec)	StDev (sec)	Seconds	Percent	Min (sec)	Max (sec)	
Long Form	15	1035	211	6	1201	262	166	13.8%	-62.306	394.039	0.145
Short Form	20	597	127	7	621	126	24	3.9%	-91.112	138.341	0.675
Driver Exchange	19	513	120	9	615	180	102	16.6%	-15.865	218.999	0.087
Citation	9	239	68	10	277	56	38	13.7%	-22.194	98.105	0.201

4. COST ESTIMATE OF CURRENT AND PROPOSED (TRACS-BASED) PRACTICES

Cost estimation was performed to look at costs to a typical agency and to the state, both with current procedures and with proposed TraCS-based procedures. Benefits of TraCS-based procedures are also presented. Where exact cost data were not available, approximate costs were discussed. Costs were considered for crash reports only, not for citations.

4.1 Cost Estimation Without TraCS (Current)

The present process, where the crash reports are filled manually on a paper by hand, results in minimal costs to a local agency including the cost of pens, postage, and incidental supplies. The crash reports are provided free of charge by Department of Highway Safety and Motor Vehicles (DHSMV) to the agencies. The labor cost is based on the salary of the police officers completing the crash reports and also reviewing and approving the completed reports by a supervisor. In addition, forms rejected either during the internal approval process or after submission to DHSMV have to be handled again by one of the police officers. The average salary of a police officer per hour is $25.00. The physical costs for the

agency are very low without using TraCS. However, the officer's time involved in the manual processing results in both high labor costs and in officer safety issues, due to the length of time an officer much remain on the roadside.

The cost estimation on the state (DHSMV) level is performed based on the information gathered from DHSMV (Horne, 2004). The cost estimations shown in Table 6 include some of the major costs for DHSMV. This cost estimate does not include additional time and expense at the state level in handling rejected reports. In the first ten months of 2004, a total of 229,432 long forms and 263,850 short forms were submitted, 3,907 of which were returned to the submitting agency for corrections. Three months later, 61% of these reports had been corrected and returned to DHSMV.

Table 5: Difference in Form Completion Time With and Without Mag-Stripe Reader

Long Form (p = 0.400)					
Mag Stripe Use	Sample Size	Completion Time (sec)		Difference WRT "Yes" 95% Confidence Interval	
		Mean	StDev	Min (sec)	Max (sec)
Yes	5	1118.4	276.7	N/A	N/A
Partial	7	1048.4	163.4	-233.7	373.6
Pre-TraCS	4	1221	109.5	-450.4	245.2
Short Form (p=0.005)					
Mag Stripe Use	Sample Size	Completion Time (sec)		Difference WRT "Yes" 95% Confidence Interval	
		Mean	StDev	Min (sec)	Max (sec)
Yes	6	488.5	55.36	N/A	N/A
Partial	4	685.25	131.88	-347.14	-46.36
No	8	601.75	65.87	-239.08	12.58
Pre-TraCS	6	657	90.1	-303.01	-33.99
Driver Exchange Form (p=0.011)					
Mag Stripe Use	Sample Size	Completion Time (sec)		Difference WRT "Yes" 95% Confidence Interval	
		Mean	StDev	Min (sec)	Max (sec)
Yes	6	401.83	42.85	N/A	N/A
Partial	4	596.25	111.69	-351.42	-37.42
No	8	519.63	63.91	-249.15	13.57
Pre-TraCS	7	542.57	118.93	-276.06	-5.42
Citation (p=0.086)					
Mag Stripe Use	Sample Size	Completion Time (sec)		Difference WRT "Yes" 95% Confidence Interval	
		Mean	StDev	Min (sec)	Max (sec)
Yes	8	226.88	60.65	N/A	N/A
Pre-TraCS	10	277.4	56.1	-108.98	7.93

Table 6: DHSMV Annual Cost Estimation

Expense Category	**Cost/year ($)**
Printing of Crash Report (all four forms, total of 2,905,000 forms printed)	5,6641.76
Shipping of Crash Reports to the Agencies Long form first 2 pages (Form#90003) Long form narrative/diagram page (Form#90005) Short form/Driver Exchange form (Form#90006) Update/Continuation form (Form#90004)	 698.57 768.58 3,225.25 713.02
Data Entry Data Entry by PRIDE, imaging, copies of CD's to DOT- $50,000 per month	600,000.00
Image Server by Hayes	23,040.00
Total Cost at DHSMV level	**685,087.18**

4.2 Cost Estimation With TraCS (Proposed)

The pilot agencies were provided with hardware and software resources to facilitate deployment of TraCS software. The agencies that had laptop computers in their police vehicles were provided with the required peripherals to use TraCS software, including USB GPS receivers, and magnetic stripe readers, thermal printers and USB flash drive. For those agencies that did not have computers in their patrol vehicles, new laptop computers were provided along with mounting brackets and peripherals. The cost estimation for an agency to start using TraCS software is shown in Table 7.

Table 7: Equipment Cost with TraCS

Equipment Type	Cost per Item ($)
Laptop computer (2.4 MHz, 40 GB hard drive, 256 MB RAM, etc.)	999.00
Mounting bracket	400.00
12 volt DC power supply	50.00
Magnetic stripe reader	69.00
USB GPS receiver	83.00
Thermal printer	280.00
USB flash drive	20.00
Total	**1901.00**

For an agency without laptop computers in their vehicles, it will cost $1901.00 to outfit each vehicle. If the agency does have computers in their police vehicles (e.g. for computer-aided dispatch), it will cost approximately $452.00 per vehicle to start using TraCS. This cost includes magnetic stripe readers, USB GPS receivers, thermal printers and USB flash drives. All peripherals are optional equipment used in conjunction with TraCS to improve the process. The equipment cost is a one time investment until the life of the equipment expires. From conversations with information technology (IT) staff at several pilot agencies, it was determined that most of the police agencies purchase new laptops once in three years, so it can be assumed that the cost shown is for approximately three years. It takes less time to fill a crash reports using TraCS software than manual process, therefore, the labor cost is reduced and officer's safety is increased by using TraCS software.

5. CONCLUDING REMARKS

The study has shown that the efficiency and accuracy of Florida traffic records can be improved by using a computerized and automated affordable traffic data collection system such as Traffic and Criminal Software (TraCS). The law enforcement agencies in the State of Florida can utilize the results of this study to obtain information that will be useful in making decisions, evaluating alternatives, and optimizing their processes. Based on the study, the following conclusions can be drawn.

Most of the data collected for long form, short form and driver exchange form was for two vehicle crashes. On average, for the two vehicle crashes, the time saved by using TraCS software to fill the long form, short form, and driver exchange form was 13.8%, 3.9%, and 16.6%, respectively. However, none of the results are statistically significant at the 95% confidence interval. Using the TraCS software, the time taken to fill a citation was reduced by 13.7% from the time taken without TraCS. The efficiency gains from using TraCS differs based on the learning curve, equipment provided and mindset of an officer. After suitable training and practice, the time taken to complete a report with TraCS should decrease even further. Because the officers are used to filling the reports with hand on a paper report from many years of experience, it takes some practice and interest to get used to the new technology (Yerdelen 2003).

The software has the best functionality when used in conjunction with the magnetic stripe reader for the Florida Driver License. Full use of the mag-stripe resulted in statistically significant differences in completion time on both short forms and driver exchange forms when compared to both partial mag-stripe use and form completion without TraCS. However, among the data collected, the magnetic stripe was only read on 53% of the driver licenses. Based on experience from the ride-alongs, the magnetic stripe reader worked in most of the cases when it was used and reduced the time to fill the reports. In some cases, the officers did not use the magnetic stripe reader, possibly because they are not completely accustomed to the new technology. Therefore, the agencies should focus on educating and training officers in using the magnetic stripe reader.

The cost for implementing TraCS at an agency is primarily an investment in laptop computers and/or peripheral equipment. The initial cost is expected to range from $500 to $2000 per vehicle, depending on needs and availability of equipment. There are many long term cost benefits to both the local law enforcement agencies and DHSMV by using TraCS software. Electronic submission of crash data, which TraCS makes possible, will result in cost savings to DHSMV

by eliminating manual data entry of the paper crash reports into the state database by Prison Industries (PRIDE). Money can also be saved in printing and distribution of the blank crash reports forms to the agencies. The DHSMV will be the prime beneficiary of implementing TraCS as a data collection system. Benefits to the local agencies include time saving in completing the form, as well as in review and approval processes. Benefits in officer safety will also result from decreased time on the roadside. The crash reports filled using TraCS are more legible and accurate than the paper forms, as the software has the facility to validate and cross-check against the rules provided by DHSMV before the forms are printed and sent to DHSMV. In addition, researchers have found that the pilot with TraCS has served as a motivation to the agencies for further automation within the agency.

In general, it can be stated that the TraCS software has improved the crash reporting process for the pilot agencies and has the potential to improve the data collection system for the state of Florida. However, in most cases, the improvement in the system and the time reduced using the TraCS software were not proved statistically.

6. REFERENCES

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