Florida Department of Transportation
VIDEOLOG PROGRAM

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16. Abstract

The Florida Department of Transportation (FDOT) has an active program that calls for videologging the 11, 927 centerline miles of state maintained roadways. Concurrent with field video logging, various data on the highway network are obtained by separate groups. In other states, images and data thus obtained have proven very cost-effective in the various managerial functions of an operating DOT. In Florida, it is perceived that additional application of videolog technology will enhance customer satisfaction and provide operational efficiencies. In like fashion, public and private sector professionals have found great utility and satisfaction with videolog images and data. This study surveys the existing state-of-the-practice in Florida and presents recommendations to improve internal and external use of the FDOT videolog. Benefit/cost analyses are performed to estimate cost effectiveness.

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I. EXECUTIVE SUMMARY

The Florida Department of Transportation (FDOT) has responsibility for nearly 12,000 centerline miles of state roads, over 7,000 classified as rural and close to 5,000 as urban. To manage this system within Florida's 45,477 square miles, FDOT is divided into nine major managerial components: central office eight district offices. Given this large area and roadway system, and the significant differences in geometry and traffic volume encountered, it is easy to understand why FDOT opted to enhance its existing videolog program to assist in the planning, design, operation, maintenance, and asset management of the roadway network under its jurisdiction.

Based on effective use of image technology by other transportation agencies, FDOT staff saw a need to increase the user base of available videolog images within the Department. To this end, FDOT contracted with the Connecticut Transportation Institute (CTI) to provide guidance in this area. A project was developed subsequently with the following objectives:

1 - To report on the state-of-the-practice of the collection, processing, distribution, and use of video images and data required within FDOT, and other transportation agencies throughout the country;

2 - To assess the cost effectiveness of: current and possible future equipment and methods employed to collect, process, distribute, and make use of roadway images and physical data; and,

3 - To develop a comprehensive set of recommendations addressing various scenarios through which FDOT could apply this technology, and make the results available to its employees.

Questionnaires were designed and distributed to appropriate personnel not only within FDOT, but also twelve other transportation agencies employing this same technology. CTI staff reviewed the responses and then conducted personal interviews with some of the responders or their representatives to gain more detail and define more precisely the thoughts and responses that had been provided. Personal visits were concentrated within FDOT, while follow-up with other transportation agencies was via telephone.

Of the 79 FDOT staff persons responding to the questionnaire, the majority were of the opinion that the FDOT videolog images were useful in performing their tasks, and saved many person-hours by eliminating or reducing the number of field trips required. Eleven functional areas within FDOT reported the following uses:

documentation for various studies, damage assessments, various design, planning, and maintenance functions, and the location of roadway and roadside culture (physical assets). Many of the responders were of the opinion that the three-year image-acquisition cycle was too long. Others stressed the need for side views to complement the windshield perspective, the need for refinement of the current image-viewing system and its maintenance, and the need for physical data on roadway condition and geometry.

On-site, one-on-one, visits were conducted in three District Offices (Districts 3, 4, and 5) and the Central Office in Tallahassee. These visits focused on user issues and related technical strategies that could be implemented in addressing these issues. The interviews provided insights as to how subsequent use of video images and related data sets could aid in the delivery of services by FDOT.

Results of the survey of other transportation agencies revealed that a wide variety of equipment for collecting roadway images and physical data is being used. Use of the information includes safety and engineering studies, documentation of existing conditions, as well as concise input for public hearings, legal issues and claims.

Study Conclusions are summarized below:

1. FDOT's existing videolog effort does not address the current needs of FDOT staff. Issues ranged from lack of knowledge of the existing system to problems with obtaining needed data and information from the existing systems.
2. FDOT staff conduct duplicate field data-acquisition activities in some areas. FDOT should examine combination of these activities.
3. The existing Infonet provides an excellent means of distributing images and related roadway data. An application upgrade and substantial training in the use of the Infonet are required to address staff needs.

Recommendations to improve FDOT's videolog program are presented in three distinct areas.

1. (a) Improve existing image retrieval operations by: accelerating access to and the refresh rate of the Infonet; implementing an awareness and training program on Infonet usage;installing an invisible tracking system to document system useage; and, installing software to allow measurements in the plane of the roadway, and also developing software to link video-image mileages with actual mile markers.

(b) Improve image acquisition by: providing a camera to obtain right-of-way data from the outer lane, making added passes on multilane freeways or providing another camera to obtain median data; providing camera systems to automate pavement distress-data collection; reducing the image collection interval from 0.010 to 0.005 per mile; and, shortening the 3-year image-acquisition cycle, preferably to 1 year.

2. FDOT should upgrade its field data acquisition to address the needs of its central office and district staff. Significant cost savings can accrue if done in-house or on a contract basis.

3. FDOT should create a unit to manage the consolidated image- and related field data-acquisition, -processing, -storage, and –retrieval operations. The unit should be charged with department-wide responsibilities, and placed adequately within the administration of FDOT to accomplish this charge.

II. INTRODUCTION

The Florida Department of Transportation (FDOT) has responsibility for approximately 11,927 centerline miles of state roads, 7,007 classified as rural and 4, 920 as urban (See Figure 1). To manage this system within Florida's 45,477 square miles, FDOT is divided into managerial components: Central Office; and eight district offices. Given this large area and the significant differences in geometry and traffic volumes encountered, it is easy to understand why FDOT has opted to enhance its existing roadway videolog program to assist in the planning, design, operation, maintenance, and asset management of the roadway network in Florida.

From a managerial perspective, video images provide essential data, primarily with respect to inventory and asset management of the visible roadway expanse.

Substantial time and effort are required to collect, process and distribute the processed data in various forms and formats. More and more departments of transportation are seeking to automate and streamline these processes with the provision that data quality be maintained or improved over data collected by traditional manual means.

It has been primarily in past decades that states had begun to employ commercial ground-based imaging and data acquisition systems to eliminate or reduce appreciably their traditional labor-intensive methods. These automated systems travel the roadway network, simultaneously collecting images taken from many different roadway perspectives, and as much data as possible in a single pass. Data obtained may include such items of roadway geometry as horizontal and vertical curvature, grade, and transverse profile, and other items of interest such as bridge clearances, pavement condition (distress), rutting, cross fall, and pavement texture.

Many state DOTs have expanded use of video images and data to other state and local agencies, as well as the private sector. Some examples of other users are transit (bus) authorities, local and state police, and local public works, planning, and zoning organizations. The legal and judicial professions have utilized videolog images and their corresponding data sets with much success. As an example, videolog images presented in a court of action have saved the State of Connecticut several million dollars in unsubstantiated claims.

Recently, the Government Accounting Standards Board issued a guide for state agencies to report the value of their assets (Rule 34). It sets forth procedures for state and other transportation agencies to evaluate the worth of the roads and bridges under their jurisdictions. AASHTO has established a task force to study Rule 34, and to address and assess the impacts of this rule on operating DOTs. It is recognized that the images and data from videolog operations will be a key element used to establish the value of existing roads, bridges, and other appurtenances on highway systems throughout the nation.

III. BACKGROUND

Given the large state-maintained highway system in Florida, there is a continuing need


Escambia
Santa Rosa
Okaloosa
Walton
Holmes
Jackson
Washington
Bay
Calhoun
Gulf
Liberty
Franklin
Gadsden
Leon
Wakulla
Jefferson
Madison
Hamilton
Taylor
Suwannee
Lafayette
Columbia
Baker
Union
Bradford
Nassau
Duval
Clay
St. Johns
Gilchrist
Alachua
Putnam
Dixie
Levy
Marion
Flagler
Volusia
Citrus
Sumter
Lake
Seminole
Hernando
Orange
Pasco
Brevard
Pinellas
Hillsborough
Polk
Osceola
Indian River
Manatee
Hardee
Okeechobee
Highlands
St. Lucie
Sarasota
Desoto
Martin
Charlotte
Glades
Hendry
Palm Beach
Lee
Broward
Collier
Dade
Monroe
1
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for data and information on the status of this network. Current practice in FDOT separates the data needs of several operating divisions or units. The Transportation Statistics Office contracts with a private corporation to supply video images of the state maintained network. For this purpose, the contractor produces a video image at 0.01-mile intervals over approximately one-third of the network annually. The Pavement Management group contracts with another private corporation to supply ride-quality information (smoothness data in the form of an International Roughness Index (IRI)), cross fall, horizontal curvature, and a crack analysis for 8,000 lane-miles including the entire Interstate System and the Turnpike District in both directions (outer travel lane only) on an annual basis.

Simultaneously, and on an annual basis, FDOT's State Materials Office conducts pavement condition (distress) surveys on the entire state-maintained system. These data are obtained by four two-man (urban) and one-man (rural) FDOT crews and, in turn, provided to Pavement Management. Annual surveys of each roadway are conducted by district personal to provide various data to the Transportation Statistics Office. These data are entered into FDOT's Roadway Characteristics Inventory (RCI), a database of inventory items of Florida's roadway assets.

Based on recent emphasis on asset-management concepts and the need to more effectively undertake the activities outlined above, FDOT staff sought assistance to increase use of existing image technology in the Department. This need to address more effectively the field information needs of FDOT led to a contract with the Connecticut Transportation Institute (CTI) in 1999. The thrust of this work was to provide guidance in assessing FDOT's current videolog situation and to provide recommendations by which FDOT could increase the use of the current system (see project objectives set forth below). This report is a summary of the work performed and conclusions drawn by the CTI research team.

IV. PROJECT OBJECTIVES

1. Determine the state-of-the-practice of the collection, processing, distribution and use of videolog images and data acquired within the Florida DOT and other transportation agencies throughout the country. Survey customer and focus on better dissemination of FDOT videolog data.

2. Estimate the cost effectiveness of current and possible future equipment and the means employed to collect, process, distribute, and make use of roadway images and physical data.

3. Develop a comprehensive set of recommendations addressing various scenarios, which FDOT could adopt to apply the relatively new technology, and make the results readily available to its employees

V. PROJECT METHODOLOGY

Two types of questionnaires were developed to survey current practice associated with the collection, processing, distribution, and use of roadway images and data within not only the FDOT, but also several other transportation agencies. One questionnaire was designed to gain understanding of the needs of FDOT staff working in various functional areas (see Appendix 1), and the other specifically for the person(s) charged with the responsibility of overseeing image-and-data collection, processing, distribution in FDOT, and in the other states (see Appendix 2). They were developed jointly by the CTI research Team and FDOT staff. Distribution of the questionnaires to personnel working in various functional areas of the FDOT was the responsibility of the latter.

Following receipt of the completed questionnaires, one-on-one visits (interviews) were scheduled between CTI personnel and the respondents, or their representatives to gain greater detail and define more precisely the thoughts and responses provided. The personal visits were concentrated on FDOT, while follow-up with other transportation agencies was via telephone.

The data provided via the questionnaires and subsequent interviews served as the basis for benefit/cost analyses. These analyses were instrumental in formulating recommendations and suggestions to improve the effectiveness and acceptance of image and data logging in FDOT.

VI. IN-HOUSE SURVEY and INTERVIEWS

A. Results of In-House Survey

Information from the in-house questionnaires submitted to FDOT personnel was condensed into a spreadsheet format for review and analysis. Of the 100 questionnaires distributed, 79 were returned. Table 1 lists the number of responses from the various functional areas. All Districts and the Central Office were represented in some, but not necessarily all the functional areas existing under their authority.

TABLE 1 - Units Responding to Questionnaire

Functional Area	No. of Responses
Safety	2
Systems Planning	10
Program Development	2
Traffic	15
Public Transportation	3
Pavement Management	1
Transportation Operations	3
Design	25
Maintenance	11
Environmental Management	4
Project Management	1
Materials	1
Production	1

Responses in the questionnaire were generally informative. Some major findings are cited below:

1. Usage

Seventy (70) of those who responded to the questionnaire are aware, and make current use of the videolog images. The other nine (9), who do not currently make use of the images, reside in the Central Office (1), Turnpike District (2), District 3 (2), District 5 (2), and District 6 (1).

2. Method of Viewing

Within the FDOT, there are currently three means by which users can view videolog images: department-wide Infonet (server-based, digitized images available at any desktop with the appropriate computer and monitor), CD ROMs (copies of CD-based videolog images are currently reproduced for distribution), and videotape (original video tape goes to the Safety Office only). Results indicate that 63 of the respondents view the images on the Infonet, 18 from the CDs, and 7 from the videotape copies. Obviously, some personnel have the ability to view the images via more than one medium.

3. Use by Functional Area

Personnel involved with Design, Traffic, and Planning are the heaviest videolog-image users. Safety, programming, pavement management, environmental management, maintenance, public transportation, and project management are some of the other disciplines where considerable use is made of the videolog images.

4. Reasons for Viewing Images

According to the responses in the questionnaires, familiarization, documentation, and feature verification were the three basic reasons for viewing the videolog images. Other uses cited include QC/QA, simple linear measurements, selection of location for traffic-monitoring systems, and various forms of reference and/or benchmarking for damage assessment. Numerous other job-specific uses include: verification of conditions for legal and permit applications, public-hearing presentations, responses to questions raised by public and private individuals, inclusion of images in reports, and in-office collection of roadway data for the RCI, and inspection of sites prior to and after construction. It was also ascertained that videolog images obtained at regular intervals are helpful in providing useful historical data for damage assessment, and to facilitate various engineering evaluations, i.e., railroad crossings, accident studies, and in defining work loads.

5. Use of Other Image Sources

It was ascertained that 58 of the 79 respondents use other sources of imaging in their work assignments. They include individual hand-held film, digital, and video cameras, cameras installed aboard aircraft, etc. 61 respondents use either Polaroid or digital hand-held cameras, while the other 22 employ individual hand-held video cameras. Aerial photographs and photogrammetry are being utilized primarily for design.

6. Personal Comments from Users

The questionnaires provided insight from the user's perspective as to deficiencies within the current system. These are as follows:

- The current 3-year videologging cycle is too long, especially when one considers the time required to edit the images and perform QA/QC for the final product that is eventually distributed on the Infonet. By the time the new images are made available, some of those acquired from the previous videolog run may actually be four years old, rendering questionable any information they may contain.

- The only perspective provided by the current images (windshield view of ahead of the vehicle) does not make it possible to obtain a close view of roadway culture to the right side, and particularly to the left side on multilane divided highways. Many items in these, so-to-speak, restricted areas cannot be discerned, or if they can, are usually too far in the distance to permit accurate judgements.

- In many cases, the mileage locations shown on the video images do not correspond to the mile markers viewed. This may present a problem when a user wants to return to the same point on a roadway in different years. (i. e., a before-and-after accident study). The fact is known to FDOT staff, and is being addressed through education and training.

- Access to the Infonet for the viewing of images is often impossible for whatever reasons that have yet to be determined, e.g., server malfunction, overload, etc. System downtime is a definite "turnoff."

- When operational, access to the desired county, route, and milepost is very confusing, and also time-consuming.

- When the desired image or viewing location is ultimately arrived at, the "refresh rate", or the rate at which images can be updated in simulating a drive over is too slow (approximately one frame per second), and thereby time-consuming.

- The current inter-image distance of 0.01 mile is, in many cases, too long, whereby an item too far in the distance to be observed in one image, may be out of the field of view in the next one.

- There is currently no relatively accurate means of taking measurements of items either on, or alongside the road.

B. Results of Follow-up Interviews

Based on initial analysis of the questionnaires returned from FDOT employees, a series of meetings were jointly arranged by CTI researchers and FDOT staff. The meetings were held the week of October 16-20, 2000: two days in Tallahassee with Central Office personnel, and three days with personnel in separate FDOT district offices - Chipley (D3), Fort Lauderdale (D4), and Orlando (D5). Appendix 3 summarizes the daily schedule of these activities.

The personal interviews confirmed much of the information contained in the questionnaires, while providing additional insights into the current use of video technology within FDOT. In most of the meetings, the interviewees were given a demonstration of some of the capabilities incorporated into the current video-image and data system designed by the Connecticut Department of Transportation. The demonstrations included distance-measurement capabilities, results of the processing of geometric data, and different ways in which smoothness (IRI values) can be presented in graphic form.

The results of the interviews generally fall into three categories: 1) problems with the existing system; 2) required enhancements; and, 3) concern with privatization of FDOTs services and functions.

Most of the deficiencies with the existing system, which were brought to light in the questionnaires, surfaced again in the interviews. Basic complaints that were registered included the unacceptable 3-year videologging cycle, noncorrespondence between video mileage and actual mileposts, and problems with Infonet access. One problem, which did not surface in the questionnaires, and is now perceived as endemic throughout the department, was the fact that many employees were unaware of the existence of image availability on the Infonet. For example, informal, unannounced visits by the interviewers to the desks of nine (9) employees in the Central Office revealed that seven (7) of the nine were either unable to access the video images on the Infonet as a result of lack of instruction, or were totally oblivious to their existence. Similar visits in the district offices yielded similar results. In one case where an individual was made aware of the availability of the images, he commented that, "Had I known this, I wouldn't ever have had to make a field trip".

The interviews also brought out the safety aspect associated with the traditional field trips required to gather information or data. Almost everyone, who had been, or is still utilizing the field trip to obtain information, whether for RCI, design, traffic, maintenance, or other purposes, dwelled upon the inherent danger in sitting in a vehicle moving slowly along the shoulder, or the actual invasion of a heavily traveled roadway by persons to obtain measurements or other information related to their work.

On a more positive note, various interviewees were encouraged by the ability to obtain required information from the images. The use of overlay grids to obtain longitudinal and transverse distances, lane widths, etc. was well received. The ability to measure signage, amount of guiderail, bridge clearances, etc. and to process appropriate instrument output to obtain such roadway attributes as grade, transverse slope, rutting, and degree of both horizontal and vertical curvature with an accuracy sufficient for practical applications was considered equally attractive.

C. Summary of Florida Survey Issues

1. The mileages indicated on video images do not always correspond to FDOT field mile markers. As noted previously this problem is known and is being addressed by FDOT staff. It is a problem when users need to conduct multi-year studies of specific locations on the highway network.

2. Many FDOT employees are unaware of the existence of the image-retrieval capability on the Infonet, and if they do know, have not had training or instructions on its use.

3. As it exists now, the Infonet image-viewing program is difficult or occasionally impossible to access, and when accessible, the procedure employed to arrive at a desired location is confusing and time-consuming. The program also has a slow "image-refresh" rate, i.e., the scan rate of one image per second does not make it possible to simulate a drive-over.

4. Current images, which contain only the forward windshield view, do not provide sufficient information on the areas to the left (median) and right (shoulder) within the right-of-way. Personnel interested in these areas have no alternative but the field trip.

5. The current image-acquisition interval of 0.01 mile of travel creates a problem where an object that is visible, but not clearly defined, in one image is out of the field of view in the next one.

6. The current three-year cycle for videologging of the state is too long. Due to the time required for processing, editing, and QA/QC of the images, and their inclusion on the Infonet, some of the material being viewed is four years old, and no longer representative of what is actually in the field.

7. FDOT deploys crews from various functional areas to collect information relative to their respective disciplines, generating many field trips, which often represent a duplication of effort. This effort could, as experience in other states has demonstrated, be markedly reduced by mandatory use of up-to-date video images.

8. Benefit/cost ratios derived in this study indicate that future simultaneous acquisition of images and related geometric, condition, and geographic position data would be highly cost-effective, whether provided by contract or in-house staff.

9. Although the cost effectiveness of FDOT's experimental aerial-photogrammetric study is yet to be determined, the merging of ground- and aerial-based image and data collection could be complementary to the point where 95-98% of all information could be acquired in the safety of the office without the expense of a field trip.

VII. SURVEY OF OTHER TRANSPORTATION AGENCIES

Appendix 2 shows the questionnaire sent to other transportation agencies and a listing of the agencies polled. Its purpose was to: define the state of image-and data-acquisition practice in these agencies; determine the technologies and systems employed; and, seek information on the value of this technology to these agencies. In addition to seven state transportation departments, input was also obtained from a county and a city. The information obtained represents a gamut of transportation agencies responsible for roadway systems ranging from 16,500 to 400 miles. The data provided were placed in a spreadsheet for analysis. The data present a picture of the widely varying techniques and levels of technology employed in the day-to-day operations of a transportation agency.

Table 2 summarizes the methods employed by the transportation agencies to collect and disseminate information. In the majority of cases, the agencies obtain and edit their own images. The area recorded is the driver's windshield view of the roadway, with some agencies obtaining additional lateral and pavement images. The most frequent collection interval is one image every 0.01 mile; and 8 of the 9 agencies obtain data in two directions. The image-acquisition or collection cycle for the roadway network varies substantially according to individual agency.

In like manner, the medium used to record images, and the means by which the images are stored and distributed differ widely with respect to agency. There appears to be a trend, however, toward storing images in an electronic medium, and using various types of servers to distribute them to users.

Table 3 presents various instrument data acquired simultaneously with images. They are obtained by several subsystems in the vehicles used for the imaging. Table 4 presents the methods used to process and distribute the data to various agency users. As indicated in the table, certain data require post-processing, while others are output real-time in field operations.

Tables 2-4 reflect the data and images acquired, processed, and disseminated by other transportation agencies. Although the methods employed, collection frequency, data obtained, and methods of distribution vary widely, the fact that these systems are in use attests to the value of one-pass image- and data-acquisition technology in the transportation environment. Several of the agencies queried in follow-up phone interviews noted that the images and data

Table 2

Summary of Data Collection and Distribution Methods
Employed by Other Transportation Agencies

12 Questionnaires Sent Out	10 to DOTs		
	1 to a city		
	1 to a county		
9 Questionnaires Returned	7 DOTs, City & County		
Question	Summarized Response		FDOT
Who Obtains Images	Agency	7	
	By Contract	2	←
Medium to Obtain Images	Film	2	
	Analog tape	2	←
	Digital Tape	1	
	CD-ROM or DVD	2	←
	Not Reported	2	
Area Recorded	Driver's Eye View	9	←
	Right Side View	3/9	
	Pavement View	1/9	
Extent of Imaging	Bi-Directional (All Roads)	8/9	←
	I-Ramps	1/9	
	1 way-2 lane undivided	1/9	
Collection Frequency	Once/year	2*	
	Once/2 years	3**	
	Other (3-10 yr.)	5	←
Distance Interval	Continuous video	2	←
	0.01/mile	6	←
	Other	1	
Editing	Agency	7	
	By Contract	1	←

	Both	1	
Edit Interval	0.005/mi	1	
	0.01/mi	4	←
	None	4	

Table 2(Continued)

Storage Medium	Tape	2	←
	CD-ROM	2	←
	DVD	1	
	Hard Disk	6	←
	Laser Disk	1	
	Film	1	
Digital Storage Parameters	MPEG	1	
	Compression JPEG	6	←
	Resolution 640 x 480 to 1300 x 1030pixels	6/9	←
	File Size 50-110 kb	6/9	←
	Not Reported	2	
Distribution System	Network (Server)	7/9	←
	Film	1/9	
	Laser Disk	1/9	
	CD-ROM		←
	Tape		←

* Arkansas Interstate Only
** Arkansas all non-Interstate

Table 3

Additional Data Obtained During Videolog Field Activities

Data Item	Number of Agencies	Interval
Roughness	3	1@10m 1@0.005mi 1@0.025mi
Grade	5	1@0.005mi 1@4m 1@0.025mi 1@0.01mi 1 unreported
Cross Slope	3	1@0.005mi 1@5m 1@0.025mi
Distance (Chainage)	6	1@0.005mi 3@0.01mi 1@4,5&10mi 1@0.025m
Texture	None	
Transverse Profile	3	1@0.005mi 1@4m 1@0.025mi
GPS *	5	1@0.005mi 1@10m 3@0.01mi
Heading	4	1@0.005mi 1@4m 1@0.025mi 1@0.01mi

* One State to add to GPS

Table 4

Processing, Storage and Distribution of Data Acquired by Other Transportation Agencies

Data Item	Post Processing	Storage: CD-ROM	Hard Disk	Digital Video Disk
Horizontal Curve	5	1	4	1
Vertical Curve	5	1	5	1
Longitudinal Profile	1	1	2	1
Transverse Profile	2	1	2	1
Rut	4	2	4	1
Texture	—	—	—	—
Shim Quantity	—	—	—	—
	Real Time			
Roughness		2	4	1
Grade		2	6	1
Cross-Slope		2	3	1
Distance		3	4	1
Texture			NONE	
Trans. Profile		2	3	1
GPS		3	6	1
Vehicle Altitude		2	4	1
Skid Number			NONE	

obtained are used on an agency-wide basis. Uses vary from safety and engineering studies and documentation of existing conditions to providing concise, accurate input for public hearings and legal issues and claims. Limited data were provided to quantify benefits obtained, but all respondents agreed that the data and information were extremely valuable.

Based on the data provided by other agencies the research team believes that FDOT is well positioned to distribute images and data to its departmental users. The Infonet provides an excellent means to accomplish their tasks, although effort will be required to bring the Infonet system up to the standard of use expected by district personnel.

In terms of the images obtained FDOT does not utilize this resource to the same extent as states such as Arkansas and Connecticut. This is due to various factors ranging from lack of system knowledge to limited data provided.

VIII. DATA ACQUISITION AND MANAGEMENT ISSUES

A. Data Acquisition

Although not formally within the purview of this study, the acquisition of measured parameters relative to roadway geometry and condition, as well as geographic positioning, cannot be overlooked. A single-pass, single-platform, all-inclusive, information-acquisition system, which provides automated measurement of roadway characteristics, would make it possible to calculate or plot such parameters as ride quality (IRI), cross fall, grade, rutting, transverse profile, longitudinal profile, shim quantities for overlays, horizontal and vertical curvature, passing-sight distance, surface texture, distress, and many other attributes. When linked to images, corresponding data sets can answer many questions raised from viewing the images such as, for example, "What is the average grade of that hill, and would it require a steep-grade warning sign", or conversely, "why are the IRI values so high here?" The first two questions can be readily answered by scanning grade data as calculated from gyro-pitch output and output from sensors measuring the distance from the ground to the measuring platform of the vehicle, while the last question can be answered by viewing appropriate images to determine the cause of the excessive roughness perhaps in the form of bridge joints, utility cuts, or other forms of damaged pavement. Images and instrument data frequently complement one another, providing a powerful tool that can be expanded in many different directions. If we are already collecting images from a moving platform, why not obtain as much related geometric, condition, and geographic positioning information as possible simultaneously, particularly when the benefit/cost ratio would be greater than unity.

We believe FDOT could upgrade its data acquisition in either of two ways. They are: 1) that the FDOT contracts for all image and data acquisition; and, 2) that FDOT acquires the equipment that would permit it to perform all image-and data-acquisition activities in-house. The costs associated with each option are, of course estimates based on past experience, and may differ somewhat from actual market prices at the time of purchase. It should be pointed out that like image acquisition, the technology employed to capture much of the data in question here is changing so rapidly that some of the options listed could very shortly be rendered obsolete in terms of accuracy statements, method of acquisition, cost, etc.

To demonstrate the savings that could be accrued by FDOT, tangible current costs must be analyzed. Such an analysis is performed in Appendix 4. Although there are appreciable intangible savings associated with automated image and data collection, such as better quality of work, and less exposure to the dangers of manual data collection (improved safety), these benefits are difficult to quantify, and will therefore be omitted from any benefit/cost calculations. In performing the benefit cost analysis, conservative assumptions were made primarily on the basis of ConnDOT's experience with the collection, processing, and distribution of images and data, and its user-tracking system. The estimates of annual savings generated through the ConnDOT system are currently set at $1,000,000, calculated from eliminated field trips or less time in the field per trip, reduced fleet usage and gasoline consumption, and fewer unproductive person-hours logged in traveling to and from the work site. For this analysis, we adopted $800,000 as a conservative estimate of savings accrued in a small state such as Connecticut which has only 3700 centerline miles of state-maintained highways. In contrast, Florida contains approximately 12,000 centerline miles of similar roadways. For ease of computation, the documented accrued savings in Connecticut ($800,000) was linearly extrapolated to Florida on the basis of centerline miles of roadway in each state (e.g. FL saving = 12/3.7 * CT savings). This is an assumption, but probably a conservative one. For example, field trips in Connecticut hardly ever exceed 60 miles in one direction, negating the need for overnight lodging, meals, and heavy amounts of overtime. In Florida, on the other hand, traveling in one direction may amount to 200 miles or more, requiring overnight lodging and meals, and/or heavy overtime payments.

Other considerations in the analysis were:

1. Mr. Sullivan, who represented FDOT's Design Office, stated in his interview that use of the videolog images alone saved roughly $25,000 average on each of the 300 projects that are subject to design proceedings each year. In this case, a conservative estimate of $15,000 per project was used for the analysis;

2. FDOT currently conducts a pavement condition survey each year on its entire system (both directions on divided highways, and one direction on undivided highways). The cost to conduct this survey with two-person (urban) and one-person (rural) crews is $27/mile over 17,800 miles. With the collection of roughness (IRI), pavement images, and transverse profile, it would be assumed that the data obtained would be sufficient to either eliminate, or significantly lower the expense of the manual data collection process;

3. For the past two years, FDOT has contracted for services to provide pavement images from downward-facing cameras, a crack analysis from these images, smoothness (IRI), crossfall, and horizontal curvature on 8000 lane-miles of its Interstate System and the Florida Turnpike at a rate of $35 per mile. Were the entire state-highway system logged each year, much of this effort would obviously be considered redundant, and could be eliminated, or reduced in great part; and,

4. Improve applications to serve videologs to users.

The following benefit/cost ratios were therefore arrived at for Options 1 (Contract) and 2 (In-house) considering only high-end collection and processing equipment (see Appendix 4):

<u>Option 1 (Contract)</u>	<u>Option 2 (In-house)</u>
$8,757,100/$2,394,000 = 3.7	$8,757,100/$1,261,200 = 6.9

As can be seen, both options provide significant savings. Although more expensive, Option 1 relieves the FDOT of all encumbrances associated with equipment maintenance, and the problem of acquiring and retaining good personnel with appropriate experience in this high-tech discipline. The advantage of Option 2 is that schedules can be altered at a moment's notice for the collection vans, without renegotiating contracts. They can also be used for emergency or project-level duty where possible without jeopardizing network-level activities.

B. Ground-Based Data and Aerial Data Acquisition

As previously mentioned, FDOT is currently exploring use of aerial photography and steroscopic photogrammetry as a medium through which much of the roadway geometry can be determined, and the overwhelming majority of roadside culture and appurtenances can be located and geographically positioned in the RCI. The decision as to whether this medium will be incorporated on a state-wide basis as a permanent means of collecting engineering data has yet to be made. As compared with ground-based image and data collection, the apparent advantages of this methodology lie in greater measurement accuracy, better definition of objects well off the shoulder lines and in the medians, and a continuous view of the roadway and its environs. The determination of grade, horizontal and vertical curvature, offsets to objects and their relative heights can apparently be accomplished with an accuracy to about ±3 inches. The drawbacks however, lie in the inability to observe objects hidden by heavy-vegetative canopy on narrow roads, measure and calculate certain roadway characteristics with the required accuracy (IRI roughness characteristic, transverse profile, rutting, cross fall, texture), and decipher the messages conveyed on roadway and advertising signs.

The combination of a properly designed complementary ground-based capability for image and data acquisition and aerial photogrammetry could probably supply required information on well over 95% of all tangible and measurable items both within, and well outside the bounds of the roadway. Although beyond the scope of this project, the marriage of these two methodologies cannot be overlooked in designing future image- and data-acquisition systems.

C. Data Management

Whatever decisions are made on equipment, methodologies, product distribution, and retrieval systems, professional management of required field operations, and QC/QA of the data and images is essential. The responsibility and accountability for all work involving physical data collection whether from images, automated data collection, or field crews should be centralized under a single control authority. This authority would be responsible for the following:

- drafting and negotiation of contracts involving ground- and aerial-based image and data acquisition;
- processing of all images and acquired data;
- technical support for in-house acquisition, processing, distribution, and retrieval equipment;
- establishment of programs designed to make personnel aware of the existence and capabilities of the various systems;
- training of those unfamiliar with system attributes;

- design of software that may be required in special cases;
- tracking of usage;
- upgrading and improvement of all systems to increase usage on a continuous basis; and,
- establishment of quality-assurance programs to ensure the most accurate information possible.

Because most of the physical information contained in the RCI could be garnered from both the ground-based and aerial images and their related data sets, authority over the update of the RCI should also be housed under the same roof.

This is supported by the following reasons:

1) Cost - it is obviously much less expensive to operate on a single-pass, single-platform basis than to spread acquisition activities out over various functional areas deploying their own crews to collect essentially the same data. The same thing would also apply to the processing, distribution and retrieval of images and data, and all technical-support and quality-assurance activities;

2) Ease of administration - the current and future needs of all functional areas (planning, design, construction, pavement management, environmental planning, traffic operations, etc.) could be fulfilled through an in-place operational unit whose primary function would be to ascertain the needs of all current and potential users, and provide solutions in a timely manner under contracts already in force, or through new contracts for the purchase of appropriate equipment or software;

3) Functional confinement - ConnDOT's experience with functional deployment of the unit currently responsible for image and data acquisition has been an education to say the least. The question originally arose as to where to place the unit within the department's organizational hierarchy. Formed as a result of a research study, the unit was retained as an operational entity within the Division of Research and Development, where its goal was to serve the needs of all functional areas on an equal basis. After a number of years, the unit was transferred to the Division of Planning, where it floundered under managers who were only interested in how their planning organization could utilize the system, and failed to consider the needs of other functional areas. Later on, the unit was returned to the Division of Research and Development, where it not only flourished as an operational entity, but was also aligned more closely with persons who could devote time to the development and implementation of new concepts, equipment, and software.

To confine the functionality of a sophisticated image- and data-collection unit to a single functional area would tend to "tunnel" the utility of the unit toward fulfillment of the needs of the functional area under which it exists, whether it be planning, design, construction, pavement management, etc.

IX. CONCLUSIONS

1. FDOT's existing videolog effort does not address the current needs of FDOT based on questionnaire responses and follow-up interviews. It requires upgrading, not just for the sake of upgrading, but to employ different ways of data acquisition and handling to take advantage of new and evolving image technology.

2. FDOT should combine various field data acquisition activities with its videologging efforts. Substantial cost savings will accrue from this action.

3. The Infonet provides an excellent means of distributing images and related roadway data. An application upgrade is required to satisfy the needs of the district office staff.

X. RECOMMENDATIONS

The following recommendations outline avenues that the FDOT can take to improve its video-image and field data-acquisition efforts. The recommendations are formulated on the basis of information from the questionnaires received from FDOT personnel and departments of transportation in other states, as well as from experience gained through Connecticut's roadway image and data systems. Benefit/cost (B/C) computations, where possible, are presented in Appendix 4.

For ease of presentation the recommendations are set forth to address FDOT's existing videolog operations with regard to both image retrieval and image acquisition expanded data acquisition in FDOT, and data management.

A. Image-Retrieval System

Presented below are recommendations to facilitate viewing of images on the Infonet:

1. Accelerate access to videolog images by means of icons, state, county, and local maps, and short-cut entry via *favorites* routines. Not all users are, or would necessarily be familiar with the county route and milepost systems currently employed. Here, maps would be helpful in locating areas of interest on the Infonet.

2. Accelerate the "image-refresh" rate in performing drive-overs. The current rate of approximately one image per second is too slow. Variable rates ranging from one to 20 images per second would facilitate viewing.

3. Implement an "awareness" program to ensure that all employees recognize the existence of the Infonet images. This should be done through publications, and issuing of pamphlets, brochures, and access and use instructions for each desktop viewing system, as well as hands-on training sessions. These advertisements and sessions should be expanded to other departments within the state of Florida (State Police, Department of Environmental Protection, Public Works Departments, etc.) to broaden the user base for overall cost effectiveness.

4. Install a tracking system for use of the Infonet video-image system. Currently, there is no accurate means of determining the extent to which and by whom the images are being used. The tracking system should be invisible for the most part to the user.

5. Install software to permit horizontal measurements in the plane of the roadway.

6. Develop software to link video-image mileages with actual mile markers. There is difficulty in returning to the same location on a roadway for various engineering and safety related studies. More accurate and repeatable location of images with respect to FDOT mile markers will result in less confusion to the user.

B. Image-Acquisition Systems

1. Provide an additional camera to secure a view of the right-of-way along the right side of the outer lane. This would provide a more detailed view of appurtenances that cannot be clearly defined from the windshield view.

2. Using the existing windshield camera, make an additional pass with the image-collection van traveling the inner lane of multilane divided highways with the windshield camera aimed slightly left of the vehicle's longitudinal axis. This requires added time in the field but would provide a view not only of the inner lanes, but also the median and its appurtenances. On divided roadways of three or more lanes, these items are lost from view in the foreground and where visible, can only be observed from great distances.

3. Provide an additional camera oriented to the left on multi-lane roadways to acquire a view of the left side of the right-of-way traveling the inner lane on divided highways with roadways of three lanes or greater. On two-, three-, or four-lane undivided highways, this information would obviously be captured by the right-side camera during the run in the opposite direction. On roadways with three or more lanes per direction, it is more than likely that an additional pass will be required in the inner lane.

4. Provide a downward-facing view of artificially illuminated pavement surface for automated distress analysis. Such an objective analysis could replace the subjective condition assessments currently made via driveovers by two-man crews. One-third of the cost associated with the field crews and post-processing of the data that they collect could be saved were the videologging interval to remain the same (once every three years), one-half if the interval is changed to a two-year cycle, and the crews completely eliminated were the interval changed to an annual cycle (all roads videologged every year).

5. Reduce the existing 0.01-mile image interval to 0.005 mile. This could be done by decreasing the capture interval of digital images.

6. Shorten the current three-year image-acquisition cycle to one year. An alternative is so initially shorten the cycle to two years, and then one year if usage warrants.

If FDOT upgrades its field data acquisition to address the needs of its field and district staff as described above, significant cost savings could accrue (see Appendix 4), and the quality of the FDOT work effort, which relies on needed field data, will improve.

C. Data Management

FDOT should create a unit to manage the consolidated image- and related field data-acquisition, -processing, -storage, and retrieval operations. The unit should be charged with department-wide responsibilities, and placed adequately within the administration to accomplish this charge.

Selected References

1. Hudson, J.H., and Seitz, R.L., "Evaluation of a Videowindows PLV Viewing System - Final Report," Report No. 1538-F-95-4, June 1995. Published in TRB Record 1538.
2. Garrick, N.W., and Achenie, L.E.K., "Automated Pavement Evaluation System for Pavement Distress Assessment," JHRAC Report No. 97-261, 1997.
3. "Research Pay Off: Laser Videodisc Technology Meets Changing Operational Demands," TRB News, 1995.
4. "Storage and Retrieval Systems for Highway and Transportation Data," NCHRP Synthesis 55, 1978.
5. "Pavement Management Practices," NCHRP Synthesis 135, 1978.
6. "Photologging," NCHRP Synthesis 94, 1982.
7. "Applications of GPS for Surveying and Other positioning Needs in Departments of Transportation," NCHRP Synthesis 258, 1998.
8. "Highway Statistics - 1997, : FHWA Report Number FHWA-PL-98-020, 1999.

APPENDIX 1

Current Use of Videolog by FDOT Staff

Florida Department of Transportation Questionnaire

Current Use of Videolog on Florida Roadways

The Florida DOT captures images of its roadways, as well as certain data items applicable to the roadway environment. In order to develop greater usage of the images and data and to generate savings in the Department's operations, the FDOT has initiated a study to determine ways of improving the availability of information to current and potential users.

This form is a request to describe how your office, section or unit currently utilizes videolog images that have been made available to your area. Usage could, for example, deal with inventory, planning, construction, design, maintenance, and/or traffic studies. Usage by any functional area may be for the purpose of review, measurement, confirmation, documentation and/or familiarization, and, at all hierarchical levels including technical, engineering, managerial and executive.

In addition to or instead of videolog, your area may collect video or still pictures for internal use. If so, please describe the extent and purpose of these in the area provided below.

Please be precise as to how you specifically use images and data to accomplish your work.

We value and thank you for your response and would welcome any additional information or comments you would care to offer.

Name of office, unit or section: ______________________________

Name of respondent: ______________________________

Location:

District: ______________________________

City or town: ______________________________

Street address: ______________________________

Telephone: (_____) - ________-__________

Fax: (_____) - ________-__________

E-mail: ______________________

1. Do you use the Department's videolog images? Yes No
2. If yes, how do you obtain them? Infonet CD ROM Videotape
3. What functional areas are involved (e.g., inventory, planning, traffic studies, etc)?

____

4. How are the videolog images used (e.g., documentation, measurement, familiarization, etc.)

____

5. Please elaborate on Item #4, i.e., how do you specifically use the videolog in your area to accomplish your work? Examples might be using the video log to confirm the existence of stop signs for litigation purposes; or using the videolog to undertake a sign or guiderail inventory.

6. Do you use imaging methods, other than videolog, to accomplish your work? Yes No

7. If yes, what do you use (e.g., hand held cameras, videotape, etc.)?

8. What functional areas are involved (e.g., inventory, planning, traffic studies, etc)?

9. How are these images used (e.g., documentation, measurement, familiarization, etc.)

10. Please elaborate on Item #9, i.e., how do you specifically use these images in your area to accomplish your work? Examples might be to confirm the existence of stop signs for litigation purposes or to undertake a sign or guiderail inventory.

Additional comments and/or suggestions for the use of videolog.

Please return this questionnaire to:

Anita P. Vandervalk, P.E.
Manager, Transportation Statistics Office
Mail Station 27

APPENDIX 2

Current Use of Videolog by Transportation Agencies

Questionnaire to State DOTs
Current Experience with Images and Data Obtained from the Highway Environment
(Please return completed survey to Dr. Charles Dougan at address shown on last page of Questionnaire)

I. Images

A. Acquisition:

1. Where — Approximate Centerline Mileage
   - State-maintained highways: ____________
   - County-maintained highways: ____________
   - Town-maintained highways: ____________
   - Other facilities: (describe)

     ________________________ ____________

     ________________________ ____________

   Total: ____________

2. By whom: — Approximate % of Total Centerline Miles
   - In-house ____________
     Name of Unit: ____
   - Contractor: ____________

3. Medium employed for image acquisition: — Approximate % of Total Centerline Miles
   - Film: ____________
   - Videotape: ____________
     - Analog ________
     - Digital ________
   - CD, DVD or Hard Drive ____________
   - Other: (describe):

     ___________________________________ ____________

4. What areas of the highway environment are being focused on? (Indicate with a checkmark.)

   _____ Driver's eye view ahead
   _____ Right side view
   _____ Left side view
   _____ Rear view along road
   _____ Pavement surface
   _____ Other: (describe)

   ____

   ____

5. Indicate the extent to which imaging is being carried out on a highway?

   a. Directional (Indicate with a checkmark.)

   _____ One direction on all roads
   _____ Both directions on all roads
   _____ One direction only on undivided two-lane roads
   _____ Bi-directional on undivided two-lane roads
   _____ Bi-directional on divided roads
   _____ Multiple passes on divided roads of three lanes or greater
   _____ Other: (describe)

b. Time interval between acquisitions: (Indicate with a checkmark.)

_____ Images acquired once a year

_____ Images acquired once every two years

_____ Images acquired alternating in one direction one year and in the other direction the next year

_____ Other: (describe)

____

____

c. Distance interval for image acquisition

_____ Continuous

_____ Every .01 miles

_____ Other

B. Processing:

1. What is the editing interval; that is, what is the chainage interval between each video frame selected, (e.g., 10 meters; 0.01 mile, etc.)? Enter **NE** if no editing is performed or enter **NA** if not applicable.

_____ Front view

_____ Right side view

_____ Left side view

_____ Rear view along road

_____ Pavement surface

_____ Other (describe)

____

____

2. Is editing undertaken in-house, by a contractor, or by both?

_____ In-house

_____ Contractor

_____ Both

C. Storage:

1. What medium is used to store edited or unedited images. Indicate with checkmark.

	Videotape	CD	DVD	Hard Drive
_____ Front view	___	___	___	___
_____ Right side view	___	___	___	___
_____ Left side view	___	___	___	___
_____ Rear view along road	___	___	___	___
_____ Pavement surface	___	___	___	___
_____ Other:_____________	___	___	___	___

2. If images are stored digitally, please provide the following information:

a. Compression strategy (i.e., how do you compress your files, e.g., JPEG, Bit Map, TIF, MPEG, etc)? ______________________________

b. Image resolution in pixels (e.g., 640 X 480 pixels)? ______________________

c. Average image file size? ______________________________

D. Distribution:

Please provide a detailed explanation of how your state currently distributes images to internal users. This explanation should include the hardware and software components involved as well as the distribution of the viewing stations with respect to management and operational units within your department. An organizational chart of your department indicating the number of viewing stations or, perhaps, the viewing capability superimposed next to each unit might best serve this purpose.

____

____

____

____

____

____

II. Data

A. Acquisition:

1. If any of the following physical data items are being collected simultaneously with the above images, enter "S" if by the same vehicle collecting the images or enter "O" if by other vehicles made on separate passes.

_____ Surface roughness (International Roughness Index (IRI) or other index)

_____ Grade

_____ Crossfall or cross slope

_____ Cumulative mileage or chainage

_____ Texture

_____ Transverse profile measurements

_____ GPS coordinates (x,y,z)

Vehicle attitude (gyroscopic output)

_____ Yaw (heading - rotation about vertical axis of vehicle)

_____ Roll (deflection about longitudinal axis of vehicle)

_____ Pitch (deflection about transverse axis of vehicle)

_____ Skid number

_____ Other: (describe) ____

____

2. At what intervals are the data output to files, e.g., 0.001 km; 0.01 mile, etc.)?.

_____ Surface roughness (International Roughness Index (IRI) or other index)

_____ Grade

_____ Crossfall or cross slope

_____ Cumulative mileage or chainage

_____ Texture

_____ Transverse profile measurements

_____ GPS coordinates (x,y,z)

Vehicle attitude (gyroscopic output)

_____ Yaw (heading - rotation about vertical axis of vehicle)

_____ Roll (deflection about longitudinal axis of vehicle)

_____ Pitch (deflection about transverse axis of vehicle)

_____ Skid number

_____ Other: (describe) ____

____

B. Processing:

1. Are any of the above data processed through computer programs to yield additional information for any of the following? (Indicate with a checkmark.)

_____ Horizontal curvature

_____ Vertical curvature

_____ Longitudinal profile

_____ Transverse profile

_____ Rutting

_____ Average texture depths

_____ Shim quantities

2. Are any of the above data used to produce either of the following? (Indicate with a checkmark.)

_____ Maps of roadway sections

_____ Three dimensional views of a roadway

C. Storage:

Indicate the medium on which data is stored (i.e., diskettes, CDs, DVD, hard drives).

_____ Surface roughness ______________________________

_____ Grade ______________________________

_____ Crossfall or cross slope ______________________________

_____ Cumulative mileage or chainage ______________________________

_____ Texture ______________________________

_____ Transverse profile measurements______________________________

_____ GPS coordinates (x,y,z) ______________________________

_____ Vehicle attitude ______________________________

_____ Skid number______________________________

_____ Horizontal curvature______________________________

_____ Vertical curvature______________________________

_____ Longitudinal profile ______________________________

_____ Transverse profile______________________________

_____ Rutting ______________________________

_____ Average texture depths______________________________

_____ Shim quantities______________________________

III. Usage

Current Use of Videolog Images and Data Acquired on Your State's Roadways

Your State Transportation Agency may capture images of its roadways, as well as certain data items applicable to the roadway environment.

This form is a request to describe how your State Transportation Agency utilizes the videolog images and data that have been made available to it. Usage could, for example, deal with inventory, planning, construction, design, maintenance, and/or traffic studies. Usage by any functional area may be for the purpose of review, measurement, confirmation, documentation and/or familiarization, and, at all hierarchical levels including technical, engineering, managerial and executive.

In addition to or instead of videolog, your area may collect video or still pictures for internal use. If so, please describe the extent and purpose of these.

Please be precise as to how you specifically use images and data to accomplish your work.

We value and thank you for your response and would welcome any additional information or comments you would care to offer.

Name of department, unit or section: ______________________________

Name of respondent: ______________________________

Location:

District: ______________________________

City or town: ______________________________

Street address: ______________________________

Telephone: (_____) - ________-__________

Fax: (_____) - ________-__________

E-mail: ______________________________

____

____

____

____

Please return this Questionnaire to:

Dr. Charles E. Dougan
Connecticut Transportation Institute
179 Middle Turnpike, U-202
Storrs, CT 06269-5202
Telephone: (860) 486-5535

List of Respondents

State DOT	City	County	Network Mileage
California			15,200
Connecticut			3,700
New York			16,500
Utah			5,900
Wisconsin			12,000
Arkansas			16,500
Tennessee			14,000
	Tucson, AZ		400
		Oakland, MI	2,600

APPENDIX 3

Videolog Interviews Conducted

CENTRAL OFFICE
TALLAHASSEE, FLORIDA

Location: Room 213, Burns Building
Florida Department of Transportation
605 Suwannee Street
Tallahassee, FL 32399
(860) 638-0250

Interviewees:

Monday, October 16th

8:00 am-10:30 am
Doug Barch
Highway Data Section
(850) 414-4848

Lula Revels/Tommy Houck
11:00 am-12:30 pm
Safety Office
(850) 488-3546

Frank Sullivan
1:30 pm-3:00 pm
Roadway Design
(850) 414-4310

Tuesday, October 17th

8:00 am-10:00 am
Kristin McCrary
Maintenance Office
(850) 488-8815

David Anderson
10:30 am-12:00 noon
Traffic Engineer Office
(850) 488-4284

Bruce Dietrich
1:00 pm-3:00 pm
Pavement Management Office
(850) 414-4370

DISTRICT 3 CHIPLEY
Wednesday October 18th

Location: Interviewees' Offices
Administration Building
FL DOT
1074 Hwy, 90 East
Chipley, Fl 32428
(850) 638-0250

Interviewees:

Billy Powell
8:30 am-10:00 am
Maintenance Office

DISTRICT 4 FORT LAUDERDALE
Thursday, October 19th

Location: Interviewees' Offices
FL DOT
3400 West Commercial Blvd.
Ft. Lauderdale, Fl 33309

(954) 486-1400

Cleo Marsh
8:30 am-10:00 pm
Maintenance Offfice

CHIPLEY (cont'd)

Joe Poole
10:30 am-12:00 noon
Traffic Operations Office

Denny Wood
1:00 pm-2:30 pm
Planning/Program Office

Brian Blanchard
3:00 pm-4:30 pm
Design Office

FORT LAUDERDALE (cont'd)

Mark Plass
10:30-12:00 noon
Traffic Office

Gus Schmidt
1:00 pm-2:30 pm
Planning Office
(954) 486-1400

Gerard O'Reilly
3:00 pm-4:30 pm
Highway Design Office

DISTRICT 5 & TURNPIKE ORLANDO
Friday, October 20th

Location: Lake Harris Conference Room
Florida Department of Transportation
Orlando Urban Office
Orlando, FL 32807
(407) 482-7800

Interviewees:

8:30 am-10:00 am
George Gilhooley
Operations Office

8:30 am-10:00 am
Chris Warren
Maintenance Office

10:30 am-12:00 noon
Ann Brewer
Maintenance Office

10:30 am-12:00 noon
Ingrid Birenbaum
Communication Management

1:00 pm-2:30 pm
George Borchik
Design Engineer Office

1:00 pm-2:30 pm
Michael Stewart
Production Office

3:00 pm-4:30 pm
Lennon Moore
Planning Office 05

3:00 pm-4:30 pm
Bruce Barrett
Turnpike Consultant
Planning & Program Office

APPENDIX 4

Cost/Benefit Analysis

Details of Benefit Analysis

Estimated Design Saving

$15, 000 per project [1]

300 Projects/year [2]

Estimated annual savings = 300($15,000) = $4,500,000

Estimated Saving from Current Operations

Manual Pavement-Condition Survey

17,800 miles per year

Total cost of $27/mile [3]

Estimated annual savings = $27 (17,800) = $480,600

Automated Pavement Condition Survey

8,000 lane-miles per year

Total cost of $35/mile [4]

Estimated annual savings = $35 (8,000) = $280,000

Estimated FDOT User Savings

ConnDOT - $800,000/yr with 3,700 centerline miles

FDOT maintains 12,000 centerline miles

Estimated annual savings = 12/3.7(800,000) = $2,590,000

+ 35% estimated additional savings [5] = $906,500

$3,496,500

$8,757,100

Notes for Benefit Analysis

[1] Estimated savings in design cost provided by FDOT design personnel.

[2] Estimated projects/year from FDOT pavement management personnel.

[3] Cost from FDOT materials personnel.

[4] Cost provided by pavement management personnel.

[5] Estimated additional savings due to travel reductions (Florida's large area vs Connecticut) and greater availability of data to users via the Infonet (CT has only 50 videolog stations for use by DOT staff). We believe this % increase is very conservative.

Cost Analysis

Estimated cost to manage the improved videlog activities. Function required if work performed by contract or by FDOT staff. Estimate is based on Connecticut's salary structure.

1- Engineer		$70,000
1- Information systems specialist		$60,000
1- Analyst		$50,000
Technicians	1 if work contracted	$40,000
	2 if work done in-house	$80,000
Sub Total	Contract	$220,000
	In-house	$260,000
Burden & Fringe @ 60%	Contract	$132,000
	In-house	$156,000

Miscellaneous (Supplies, building costs, equipment and software)		$50,000
Management total	Contract	$402,000
	In-house	$466,000

Below are shown the estimated cost of two options to videolog the Florida highway system annually. The costs were provided by industry and will vary depending upon accuracy and precision required, number of miles videologged, protocols employed, and type of equipment and van used. It is assumed that a comprehensive suite of data will be obtained. The FDOT highway system is assumed to be videologged in two directions and the data and respective images will be provided as contract deliverable.

Option 1 – Contract services

Equipment	Estimated Cost/mile
1 digital camera and one side analog tape	$27
2nd camera for right-side view	$6
3rd camera for left-side view	$5
Pavement distress through pattern-recognition software	$25
Roughness (IRI), transverse profile, and rutting	$10
GPS	$5
Grade, horizontal and vertical curvature	$5
Total/mile	$83

Total estimated annual cost for contract services

Management	$402,000
Videologging (24,000 miles @ $83/mile)	$1,992,000
Total	$2,394,000/year

Option 2 – Estimated cost for FDOT to acquire and operate videolog equipment

For this option it is assumed that FDOT would purchase three new videolog vans fully equipped as outlined below as well as needed support system, i.e., software ,and tape editing capability. Field personnel to operate the system must be added to videolog image and data activities. Our cost projection follows.

Equipment cost

Image and data systems (a)

Acquisition

Item	Cost
Van with Cameras (3)	$330,000
GPS, dead-reckoning, grade, and curvature	$175,000
Pavement cameras and strobes	$102,000

Roughness (IR), transverse profile, and rutting	$263,000
Total	$870,000

Image and data processing systems (b)

Item	Cost
Hardware and Software Base	$14,000
X-Y-Z-measurement software	$65,000
Editing workstation	$45,000
Pavement-distress software	$75,000
Total	$199,000

(a) The van costs are assumed to be depreciated over 10 years.

(b) Processing systems costs are assumed to be one time. Minor software upgrades are accounted for in service contracts. The cost of major software changes are unknown at this time.

System Operating Cost Estimate

Personnel one two-man crew per van (2 technicians)	$80,000
Vehicle and field operating cost/van	
Vehicle costs- $0.45/mile for 16,000 mile/year	$7,200
Service contract on all equipment	$40,000

Travel per diem	$110*2 @60 days	$13,200
Supplies, buildings auxillary equipment		$40,000
Total		$100,400

Total Estimated Annual Cost

Item	Annual Cost
Management	$260,000
Field personnel (3 vans)	$240,000
Equipment –3 vans	$261,000
Processing equipment	$199,000
Operating costs (3 vans)	$301,200
Total Annual Cost	**$1,261,200**