RESOLUTION R-40-12

A RESOLUTION AUTHORIZING THE EXECUTION OF AN ENGINEERING SERVICES AGREEMENT FOR THE CITY PAVEMENT CONDITION EVALUATION AND ANALYSIS

WHEREAS, the City of Wheaton, DuPage County, Illinois, is desirous of performing pavement condition evaluation and street rehabilitation analysis for a pavement management system of all City streets; and

WHEREAS, the engineering consultant, MDS Technologies, Inc. of Park Ridge, Illinois, has submitted an engineering services proposal to perform the pavement condition evaluation of all City streets; and

WHEREAS, it is necessary for the City to enter into an agreement for the engineering services.

NOW, THEREFORE, BE IT RESOLVED by the Mayor and City Council of the City of Wheaton, Illinois, that the Mayor is authorized to execute an agreement between the City of Wheaton and MDS Technologies, Inc. of Park Ridge, Illinois for the pavement condition evaluation of all City streets.

ADOPTED this 4th day of June, 2012.

Mayor

ATTEST:

City Clerk

Roll Call Vote

Ayes:	Councilman Suess
	Councilwoman Ives
	Councilman Rutledge
	Mayor Gresk
	Councilwoman Pacino Sanguinetti
	Councilman Scalzo
Nays:	None
Absent:	Councilman Mouhelis

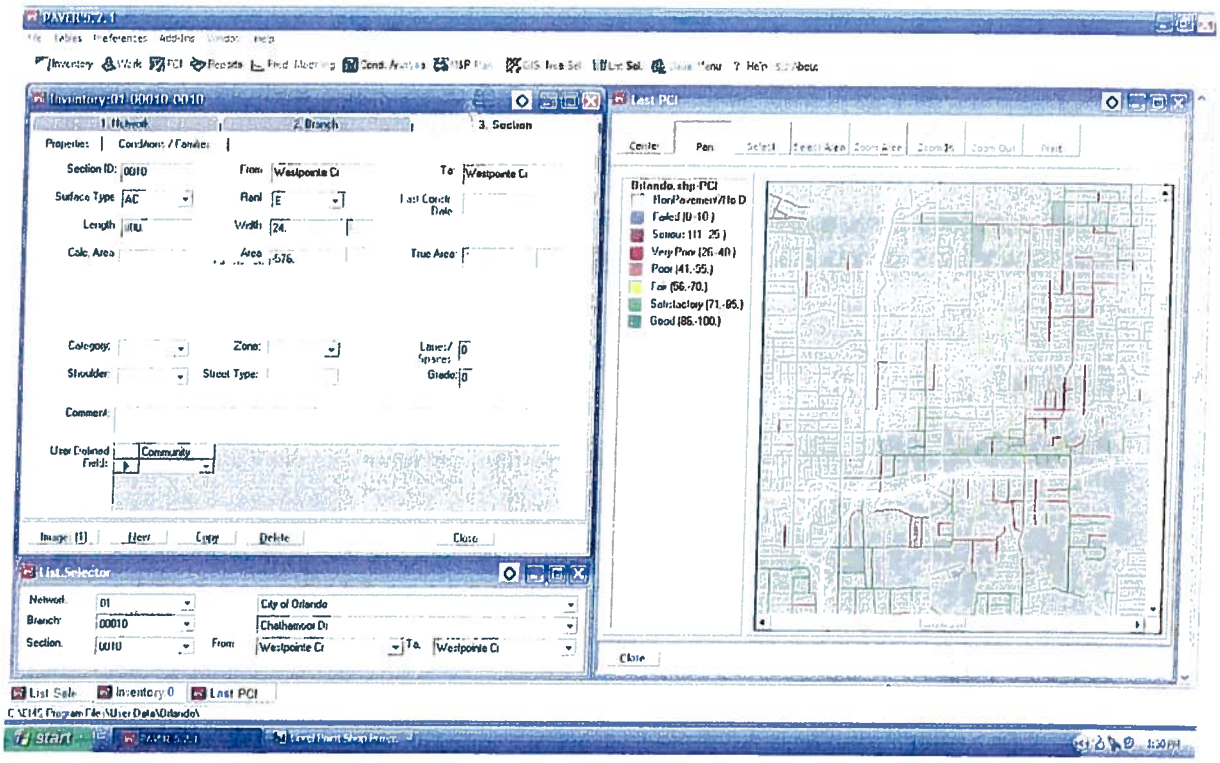
Motion Carried Unanimously

MDS Technologies, Inc.

Proposal to Provide Pavement Condition Evaluation and Related Services

Prepared for:

City of Wheaton
Engineering Department



Pavement Management Systems • Right of Way Asset Management Systems • GIS
Geo-Referenced Digital Imagery

February 21, 2012

City of Wheaton
Engineering Department
303 W. Wesley Street
1st Floor
Wheaton, IL 60187

Attention: Mr. Paul Redman
Director

Re: Proposal to Provide a Pavement Condition Evaluation and Related Services

Dear Sir:

MDS Technologies, Inc. is pleased to submit this proposal to provide the above referenced services to the City of Wheaton. In addition to our proposal, a report provided to one of our clients in the Chicago area from whom we provided similar services is provided for your review.

If any questions arise regarding our submission, please contact me for clarification at any time. We look forward to working with City staff on this project.

Sincerely,

MDS Technologies, Inc.

Trevor Triffo

Trevor T. Triffo
Principal

Table of Contents

1 Company Overview

MDS Technologies, Inc. (MDST) specializes in implementing pavement and right of way asset management systems for the public works departments of county and municipal governments. MDST staff has successfully implemented upward of one hundred pavement management systems for clients throughout the United States and Canada.

We use vehicle-based technology to evaluate the condition of entire road networks quickly, accurately and systematically. MDST provides services to implement pavement management software developed by third parties. We have successfully implemented the most common commercially available pavement management systems for a number of county and municipal governments around the country.

MDST was incorporated in 2002 as a 'C' Corporation in the State of Illinois. MDST is located in the metropolitan Chicago area and will provide services to the City from this location.

2 Qualifications and Experience

MDST possesses considerable experience and expertise regarding implementation of pavement management systems. This experience and expertise is highlighted below.

Pavement Condition Evaluation – MDST staff have also evaluated pavement condition for tens of thousands of miles of pavements nationwide. The severity and extent of distresses occurring on a wide variety of pavement types have been evaluated using a number of techniques including manual surveys, windshield surveys, key board surveys, and condition assessment from digital imagery.

Development of Engineering Models for Pavement Management – A key part of implementing a pavement management system is modeling the behavior of the agency's roads and decision process with regard to selection and prioritization of rehabilitation projects. Although there are often similarities between agencies, every agency is unique in some way and this should be reflected in the models developed for the pavement management system. This modeling component requires a thorough understanding of the detailed workings of pavement management software and engineering judgment that is developed through experience. MDST staff has developed this expertise and judgment through twenty years of experience performing this task for county and municipal governments throughout the United States.

Pavement Management System User Training – MDST staff has provided system administrator and user training as part of implementing pavement management systems. Training is tailored to meet the needs and experience level of the agency and can range from navigating the user interface, viewing data, and creating standard reports to modifying engineering models, performing complex analysis, creating custom reports, adding new fields, and creating new functionality.

Pavement Management System Linkage/Integration to GIS – Many of the systems implemented by MDST staff have been linked to GIS. In some cases this has been done on a fixed segment basis, and in other cases routes have been created to take advantage of dynamic segmentation functionality in GIS.

Integration of Inertial Navigation and Digital Imagery Technology – MDST staff were early pioneers to integrate inertial navigation and geo-referenced digital imaging technology into pavement oriented data collection vehicles. This was done to provide accurate position and orientation data in the event of a GPS outage, provide roadway geometrics data such as radius of curvature and cross fall, and to provide a method of capturing spatially accurate right-of-way asset inventories.

Development of Automated Crack Detection Technology – MDST staff have been involved in efforts to automate crack detection through pixel analysis of high resolution pavement imagery.

Pavement Management Software Development – MDST staff has been responsible for the ongoing maintenance and development of pavement management software that was used by municipal and county governments throughout the country. This includes prioritizing and performing bug fixes, and planning, designing, developing and distributing systems enhancements.

2.1 Profiles of Similar Projects

MDST has significant experience implementing pavement management systems for municipalities and evaluating pavement condition. Project Profiles and contact information for some sample projects are provided below.

Project Name: **Pavement Management System Implementation Project**

Agency: **Village of Mt. Prospect**
Public Works Department
1700 W. Central
Mt. Prospect, IL 60056

Project Completed: 2011

Contact Info: Mr. Joel Michalik
Project Engineer
Tel: 847.870.5640
E-mail: jmichalik@mountprospect.org

Project Description:

This project involved implementing the MicroPAVER pavement management system for the Village of Mt. Prospect, IL. The City maintains approximately 135 centerline miles of roads and alleys.

MDST built a pavement database that defined the Village's road network as a number of road segments. The segments typically ran block to block and the end points of segments were defined by the centerline of intersecting streets. This was done to facilitate a linkage to GIS through a pavement centerline file provided by the Village.

MDST used our vehicle based data collection technology to capture sequential digital images of Mt. Prospect's road network. All images were tied to positioning data acquired from Global Positioning Systems. A two camera system was used. A roof mounted forward looking camera provided pavement oriented right of way imagery. A second camera, mounted at the back of the vehicle, provided detailed images of the pavement surface. The same approach is proposed for the City of Wheaton.

Using a specially designed software tool, MDST staff performed a 'virtual drive' of these pavements in an office environment and captured the severity and extent of various pavement distresses that were present on each road segment. This pavement condition data was uploaded into the pavement management database and a Pavement Condition Index (PCI) score was calculated for each segment. MDST installed the pavement management system on Village computers and provided user training to Village staff.

Project Name:	**Pavement Management System Implementation Project**
Agency:	**Village of Bartlett** **Public Works Department** 1150 Bittersweet Drive Bartlett, IL 60103
Completion Date:	2007 – Initial Implementation 2009 – Update Pavement Condition Data 2011 – Update Pavement Condition Data
Contact Info:	Mr. Robert (Bob) Allen, P.E. Staff Engineer Tel: 630.837.0811 E-mail: rallen@vbartlett.org

This project initially involved implementing the MicroPAVER pavement management system for the Village of Bartlett. MDST built a pavement database that defined the Village's 135 mile road network as a number of road segments. The segments usually ran block to block and the end points of segments were typically defined by the centerline of intersecting streets. In some cases segments ends were defined by changes in pavement type or significant changes in pavement condition.

MDST used its vehicle based data collection technology to capture sequential digital images of the Bartlett's road network. All images were tied to positioning data acquired from Global Positioning Systems. A two camera system was used. A roof-mounted, forward-looking camera provided pavement-oriented right-of-way imagery. A second camera, mounted at the back of the vehicle, provided detailed images of the pavement surface.

Since the initial implementation, MDST has been re-hired twice to re-evaluate road conditions and update the pavement management database.

Project Name:	**Pavement and Sidewalk Management System Implementation Project**
Agency:	**City of Boulder, CO** **Public Works Department** 5050 Pearl Street Boulder, CO 80301-2436
Completion Date:	2007 – Initial Implementation 2009 – Update Pavement Condition Data 2010 – Update Pavement Condition Data 2011 – Update Pavement Condition Data
Contact Info:	Mr. Mark Getman Tel: 303.413-7115 E-mail: getmanm@ci.boulder.co.us

Project Description:

This project involved implementing the Cartêgraph asset management system for pavements and sidewalks for the City of Boulder, CO. The City maintains approximately 360 centerline miles of roads with both AC and PCC surfaces and approximately 720 miles of sidewalks and multi-use paths.

The pavement management database contained road segments that typically ran block to block. The end points of segments were defined by the centerline of intersecting streets. This was done to facilitate a linkage to GIS through a pavement centerline file provided by the City.

MDST used its vehicle based data collection technology to capture sequential digital images of the City's road network. All images were tied to positioning data acquired from Global Positioning Systems. A two camera system was used. A roof mounted forward looking camera provided pavement oriented right of way imagery. A second camera, mounted at the back of the vehicle, provided detailed images of the pavement surface.

Using a specially designed software tool, MDST staff performed a 'virtual drive' of these pavements in an office environment and captured the severity and extent of various pavement distresses that were present on each road segment. This pavement condition data was uploaded into the pavement management database and a Pavement Condition Index (PCI) score was calculated for each segment. MDST also provided training to City staff to manually perform PCI pavement condition inspections with internal forces.

MDST confirmed the existence/location of sidewalks through the street level imagery captured by our data collection vehicle. Lines representing sidewalks were created in GIS and sidewalk damage points were located in GIS based on a review of the digital imagery. MDST staff created a Sidewalk Management module in Cartêgraph so that City staff could plan and track work performed.

Project Name: **Pavement Management System Implementation Project**

Agency: **Chatham County, GA**
Public Works and Parks Services Department
7235 Sallie Mood Drive
Savannah, GA 31412

Completion Date: 2009 – Initial Implementation
2011 – Update Pavement Condition Data

Contact Info: Mr. Marc Ginsberg
Tel: 912-652-6867
E-mail: MBGinsbe@Chathamcounty.org

Project Description:

This project involved implementing a pavement management system for Chatham County, GA. The City maintains approximately 325 centerline miles of roads.

MDST built a pavement management database based on the City's GIS pavement centerline file. The pavement management database contained road segments that typically ran block to block. The end points of segments were defined by the centerline of intersecting streets.

MDST used its vehicle based data collection technology to capture sequential digital images of the City's road network. All images were tied to positioning data acquired from Global Positioning Systems. A two camera system was used. A roof mounted forward looking camera provided pavement oriented right of way imagery. A second camera, mounted at the back of the vehicle, provided detailed images of the pavement surface. The same approach is proposed for the City of Wheaton.

Using a specially designed software tool, MDST staff performed a 'virtual drive' of these pavements in an office environment and captured the severity and extent of various pavement distresses that were present on each road segment. This pavement condition data was uploaded into the pavement management database and a Pavement Condition Index (PCI) score was calculated for each segment.

Sequential digital images of the roadway/streetscape were also provided. These images can be accessed though the pavement management software.

3 Project Team

MDST will perform this project in its entirety with experienced in-house staff. We do not anticipate the use of any sub-consultants for this project. The key individuals involved in the project are identified below.

3.1 Project Manager

Mr. Trevor T. Triffo will function as MDST's **Project Manager** for this project. Mr. Triffo holds a Master of Science Degree in Civil Engineering and is a registered Professional Engineer in the Province of Ontario.

He has worked in the pavement and right of way asset management field in roles of increasing responsibility over his twenty-three year professional career and is a recognized leader in this field. He has participated in literally hundreds of pavement and right-of-way asset management system implementation projects as field engineer, data analyst, project manager, and principal in charge. These projects have been located throughout the United States, Canada, and the Middle East. Clients include municipal and county governments, metropolitan planning organizations, DOTs, and foreign governments.

Mr. Triffo has recently functioned as Project Manager of successful pavement management implementation projects for:

- Village of Mt. Prospect, IL
- Village of Bartlett, IL
- Village of Carpentersville, IL
- Village of Glen Ellyn, IL
- City of Carmel, IN
- City of Boulder, CO
- City of Orlando, FL
- Chatham County, GA

Mr. Triffo has made numerous presentations to senior staff and elected officials of municipal and county governments to provide/summarize the results of pavement management studies. He has also conducted numerous training sessions to transfer knowledge to new and experienced users of pavement management applications. A detailed resume for Mr. Triffo is provided in Appendix B.

3.2 Project Manager Role and Involvement

As Project Manager, Mr. Triffo will be intimately involved in all aspects of the work for the duration of the project. Any work not done specifically by Mr. Triffo will be directly overseen, reviewed for quality, and ultimately approved for release to the City by Mr. Triffo.

As MDST's Manager of this project, Mr. Triffo will:

- function as the project team's point of contact for City staff;
- implement a Project Communication Plan to facilitate effective communication between the City and MDST;
- personally attend all project meetings at the City;
- manage the activities of the MDST field crew;
- oversee office based data capture/pavement condition assessment activities;
- lead and oversee the design, development, and implementation of the GIS application;
- personally train City staff to use the pavement management system and the separate GIS application; and,
- monitor the status of the project from a cost and schedule perspective and take action as required to keep the project on track.

3.3 Field Operations Technician

Mr. Anthony Raitano will function as MDST's **Field Operations Technician** for this project. Mr. Raitano has functioned in this capacity with MDST for seven years and has operated our data collection vehicle on a number of data collection projects including Chatham County, GA; Village of Bartlett, IL; Village of Glen Ellyn, IL; Village of Carpentersville, IL; and the City of Carmel, IN. A detailed resume for Mr. Raitano is provided in Appendix B.

As part of the assignment, Mr. Raitano will keep the City staff informed of his progress and whereabouts as desired by the City.

4 Work Plan

The City wants to capture pavement condition data for the entire City maintained road network. This corresponds to roughly 135 centerline miles of roads. The consultant must provide all necessary field inspectors, vehicles, tools, and equipment required to perform the work.

The pavement condition data must be collected in a sound, systematic, and reproducible manner to accurately reflect the condition of the road network and facilitate comparison between road segments. This data must be loaded into the City's Lucity asset/pavement management system, although the City has stated that is interested to explore other options.

MDST has created a Task-driven Work Plan to meet the needs of the City in an expeditious and cost effective manner. The main Tasks in the Work Plan are as follows:

Task 1: Initiate Project
Task 2: Perform Field Work
Task 3: Evaluate Pavement Condition
Task 4: Upload Data and Calculate Condition Scores

Each of these Tasks is discussed in detail below. Optional approaches that the City might consider are also provided in this section.

Task 1: Initiate Project

Objective: The objective of this Task is to acquire the necessary information to begin the project and prepare for field activities.

We assume that the City can provide an electronic map (i.e. GIS pavement centerline file) that identifies the City maintained streets to be included in the project. Once this data is made available to MDST, this data will be reworked as required for use in our data collection vehicle for the Field Work Task as discussed below.

We also assume that the City's road network has been defined as a series of segments and loaded into the Lucity database.

Task 2: Perform Field Work

Objective: Collect pavement condition data in a sound, systematic, and reproducible manner for approximately 135 centerline miles of City-maintained pavements.

Data Collection Technology:

MDST proposes to utilize vehicle-based technology to capture the required pavement condition data quickly, safely, and cost-effectively. The main components of the system are high resolution digital cameras, GPS receivers and related technology, and on-board computers. A software application manages and coordinates the flow of digital imagery from the cameras and ties each frame to position and orientation data obtained from the GPS receiver.

The digital cameras are precisely located and mounted to the roof of the data collection vehicle. Two cameras are required for pavement condition evaluation. A forward-looking camera captures a pavement-oriented view of the streetscape. A downward-looking camera is used to capture detailed imagery of the pavement surface. A third camera can be angled forward and to the right to capture imagery of assets such as traffic signs, sidewalks, storm drains, etc.

MDST uses industrial grade cameras that are capable of outputting images up to 4 Megapixels in size at rates up to 15 frames per second. Each frame is written to on-board, high-capacity hard disk drives in AVI or JPG format. Images are typically captured at approximately 15 foot intervals to ensure complete coverage of the pavement surface.

MDST uses a Trimble Ag132 GPS receiver to capture position and orientation data. This data is corrected in real-time and typically positions the vehicle to within three feet of its actual location under open sky conditions. Each frame/digital image is tied to position and orientation data so that it can be used to position objects visible in the imagery and mapped in GIS.

Camera views can be displayed inside the vehicle and are constantly monitored by MDST field crews to confirm that high quality imagery is being captured at all times.

Approach: MDST will capture digital imagery along approximately 135 centerline miles of County maintained roads. Two (2) lane roads will be driven in one direction. Roads with four (4) or more lane will be driven in both directions so that condition across the entire width of these roads can be evaluated.

Data Collection Procedures and Quality Control:

MDST has developed standardized procedures that dictate how the data collection vehicle is to be configured and operated to maximize the consistency and quality of the data. Some of these are:

- Fieldwork does not proceed if the pavement surface is obscured by standing water or other substances/debris.
- The sun must be sufficiently high off the horizon in order to collect quality imagery. This is because a certain amount of light is required to prevent under-exposure. Also, images captured looking into the sun when it is too low on the horizon are subject to a "flash" effect that results in sub-standard images. These problems are avoided by starting fieldwork at least one hour after sunrise and finishing at least one hour prior to sunset.
- Camera settings such as aperture, shutter speed, and color parameters are reviewed and adjusted at the start of every day to reflect the current weather conditions. Once initialized, the cameras continually self-correct to account for instantaneous changes in lighting conditions. In addition, the vehicle operator can view the images as they are being captured and make any manual adjustments as required.

We also have standard procedures to review the data on an on-going basis while the fieldwork is progressing. Each image is tagged to spatial data that defines the location at which the image was obtained. This data is forwarded to our office on a daily basis so that office based staff can monitor progress and confirm that all roads to be included in the system have digital imagery associated with them. This is done by loading the spatial data into GIS and performing analysis to compare the image locations to the road network to be tested to determine if any roads have not been driven. The result of this analysis is passed back to our field crew so that any roads that may have been missed initially are included in the fieldwork effort. A thorough final review is performed at the end of the fieldwork before the vehicle is de-mobilized from the City.

Task 3: Pavement Condition Evaluation

Objective: Analyze the digital imagery to assess pavement condition in accordance with the pavement condition rating manual provided by Lucity. This rating system is based on MicroPAVER Asphalt and Concrete Distress Rating Manuals published by APWA. MDST is very familiar with this rating system and has successfully evaluated pavement condition using this system for many clients.

Inspection Procedure:

Pavement Condiiton data will be acquired through analysis of the sequential digital imagery captured with the data collection vehicle. Both the forward-looking streetscape view and the downward-looking detailed pavement view will be used to assess the severity and extent of up to 19 distresses for both asphaltic concrete (AC) and Portland Cement Concrete (PCC) surfaces.

A sample image pair is shown below. Because each frame is tied to positioning data acquired from GPS, the location of each image pair can be easily tied to a road segment.

Condition Assessment Options:

The Lucity system can be used to calculate a numeric Pavement Condition Index (PCI) for a road segment. The PCI calculation uses an approach in which a deduction is made from the base/perfect score of 100 for each distress that occurs on a road segment. Two main options are available. One option involves the deduct value for each distress being assigned directly by a technician. This approach is the most subjective and for this reason is not recommended. The second option involves assessing the severity and extent of each distress and using a matrix to determine an appropriate deduct value. For example, if Moderate severity Alligator Cracking occurs "Intermittently", the deduct value of "25" can be assigned.

The deduct values in the matrix can be modified to suit the needs of each individual organization. More information about how MDST assesses the severity and extent of pavement distresses is provided below. We assume that this matrix and other parameters that impact the calculation of the PCI score have been previously configured to meet the City's requirements.

Assessing the Severity and Extent of Pavement Distresses:

An experienced pavement inspector performs a 'virtual drive' along a road segment by stepping through the image pairs one frame at a time. The inspector marks the location, severity, and extent of the distresses along each segment using software tools built for this purpose. Distress severity and extent are assessed in accordance with the Lucity/MicroPAVER Asphalt Distress and Concrete Distress manuals.

The severity of a distress is related to the width of cracking for cracking-type distresses and the degree of deviation from the plane of the original surface for distortion-type distresses. For asphalt surfaced pavements, the extent of distress is determined by area (e.g. alligator cracking), length (e.g. longitudinal cracking), or occurrence (e.g. potholes) depending on the type of distress encountered.

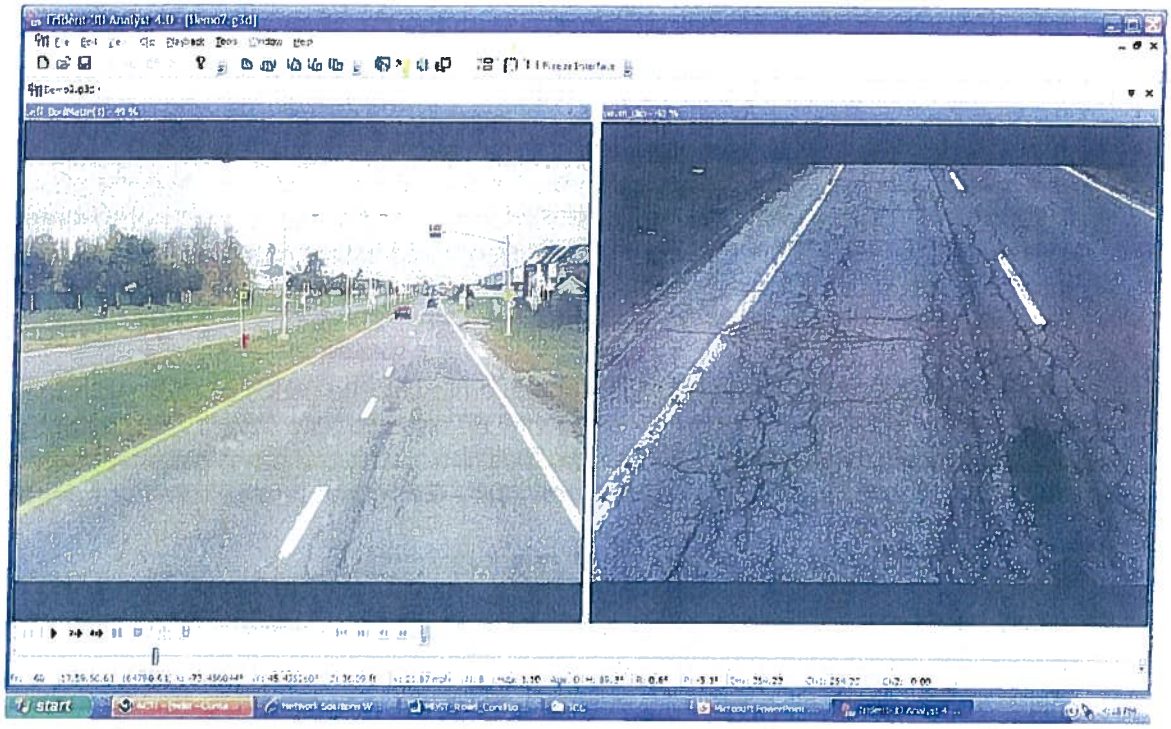
For PCC surfaced pavements, extent is determined based on the number of slabs affected by a distress.

Lucity PCI vs. MicroPAVER PCI

It is very important to note that the Lucity PCI and the MicroPAVER PCI are different. Even though they share the same name, the method used to calculate the PCI varies significantly between the two systems. Also, the scores from one system cannot be converted to an equivalent score in the other system simply through the use of a conversion constant.

It is our understanding that the City has previously used the MicroPAVER system. *If it is important to be able to compare the PCI scores determined as part of this project to previous*

results, the fact that the two PCI cannot be directly compared is a significant issue. If comparison to previous results is not important, then this is issue is not as significant.



Task 4: Provide Data for Upload to Pavement Management System

Objective: Provide an upload file containing the pavement condition data in the required format so that the data can be imported into the Lucity database.

Procedure: Creating this upload file requires several steps as described below:

- A new Inspection record must be created to house the new inspection data. Since an Inspection occurs at a point in time, an inspection date must be assigned to each new Inspection. In this case, the Inspection Date is the date that the data collection vehicle traveled the road and captured the digital imagery.
- The Inspection is tied to the corresponding segment/sub-segment.
- The type, severity, and extent of the observed distresses are entered for each Inspection.
- Once loaded, the Lucity system calculates a numeric Pavement Condition Index (PCI) score based on this data for each road segment. This score can range from 100 (no distresses present) to zero (very heavily distressed).

Other Possible Approaches

Use MicroPAVER to Calculate an ASTM Standard PCI Score and Import to Lucity

The City is using the Lucity system to manage other City maintained infrastructure. Historically, however, the City has used MicroPAVER to manage its road network. The MicroPAVER system has a number of advantages, including the fact that its pavement condition algorithm is an ASTM standard. Also, if it is important to be able to compare current pavement conditions to the results of previous studies, then the City might consider using MicroPAVER to calculate PCI scores and then import those scores into the Lucity system. This data could then be used within Lucity to perform budget analysis and create multi-year rehabilitation programs.

Use MicroPAVER as the City's Pavement Management System

In this option the City would only use MicroPAVER as its pavement management system. This system has a number of advantages including the fact that it is maintained and enhanced by APWA, it has a large user base, it uses the ASTM standard PCI calculation method, it is easy to use, and it is inexpensive. Disadvantages include the fact that the City's infrastructure management data would be in two separate systems.

Optional Task: Budget Analysis and Rehabilitation Planning

MDST can assist the City to perform Budget Analysis and to generate multi-year Rehabilitation Plans using the Lucity software. Configuration of the Lucity system is required before these analyses can be performed and yield meaningful results.

MDST will hold discussions with County staff to acquire data to build Wheaton-specific pavement performance models in the Lucity system to model future deterioration rates of various types of pavements. The models will be based on calculated PCI scores, available historical construction data, and/or the knowledge of City staff.

MDST will also input a list of the rehabilitation activities and unit costs that are performed on the various types of roads at various stages in the life of City-maintained pavements based on information provided by City staff.

To the degree practicable, MDST will model Wheaton-specific pavement rehabilitation policies and practices in the Lucity system. Once these models are constructed, analysis can be performed to create multi-year rehabilitation plans for various funding scenarios. The effect that implementing any particular plan would have on the overall condition of the road network can also be estimated.

This work can be performed on-site at the City of Wheaton.

5 Project Schedule

MDST can complete the entire project over a ninety (90) day time period once we receive authorization to proceed.

6 Fee Schedule

MDST is prepared to perform this work for a fee of $135 per centerline mile. This figure exclude any duties, levies, taxes, or other fees that may be imposed on MDST by a government entity to provide the services. This fee will need to be adjusted if any of the other possible approaches are selected by the City. The optional budget analysis and rehabilitation planning task can be performed for an additional lump sum fee of $7,500.

MDST will submit invoices to the Village monthly. Invoiced amounts will be pro-rated based on percent complete by Task. Payment terms are Net Thirty (30) days. This fee schedule is valid for ninety (90) days.

Appendix A: Resumes

Trevor T. Triffo
President, MDS Technologies, Inc.

Introduction

Mr. Triffo is President of MDST Technologies, Inc. In this position, Mr. Triffo is responsible for all aspects of company operations. Mr. Triffo has spent the vast majority of his twenty three year career in the pavement and transportation infrastructure asset management industry. He has participated in several hundred initial implementation and data update projects for clients at the municipal, county, regional, and state level throughout the United States and Canada. On these projects, he has functioned in a variety of positions including Project Engineer, Project Manager, and Principal in Charge. Mr. Triffo has also functioned as co-Project Manager of a comprehensive infrastructure asset management system for the State of Kuwait.

Pavement Inventory and Condition Assessment Experience

Mr. Triffo has designed, participated in, and supervised data collection programs for numerous agencies ranging from small municipalities to state DOTs. Mr. Triffo has extensive experience with a variety data collection technologies and techniques.

- *Automated Condition Data Collection* – Mr. Triffo has been involved in over 200 projects in which non-contact technology was used to acquire pavement roughness, and wheel track rutting. A significant percentage of these projects also required collection of automated geometric information such as grade, cross-fall, and radius of curvature. This data was collected using a combination of laser cameras, accelerometers, inclinometers, and rate gyroscopes.
- *Surface Distress Surveys* – Mr. Triffo has been involved in roughly an equal number of projects that involved collection of surface distress data. Mr. Triffo is very familiar with numerous ways to collect this data including manual methods and semi-automated (windshield) methods. Mr. Triffo has also been involved in research efforts to develop a totally automated optical crack detection system that utilized high resolution digital cameras, a strobe lighting system, and a parallel process computing system to perform pixel analysis/crack detection in real time.
- *Non-Destructive Deflection Testing* – Mr. Triffo is intimately familiar with non-destructive deflection (NDT) testing of pavements. Mr. Triffo has analyzed deflection data acquired by a Dynaflect device and Falling Weight Deflectometer (FWD) on thousands of miles of pavements of all types and in all areas of the United States and Canada.

Mr. Triffo is trained as an engineer and with an emphasis in soils, materials, and pavements. His Master's research Thesis involved the study of concrete pavement deterioration due to exposure to freeze/thaw cycles. The combination of Mr. Triffo's academic training and practical experience put him in a very strong position to understand an Agency's unique pavement issues and address them in the pavement management application.

Pavement Management System Implementation Experience

The vast majority of the data collection projects mentioned above involved loading data and/or implementation of a pavement management system for client Agencies. Mr. Triffo has vast experience with all aspects of system implementation including:

- Agency needs analysis to determine the required functionality of the system;
- Design of appropriate data collection programs that meet the technical needs and budget constraints of the agency;
- Design and implementation of appropriate quality control plans to ensure data integrity;
- Development of Agency specific models so that the output of the system reflects the Agency's unique combination of conditions, policies, and practices; and
- Training of Agency staff on field data collection, principals of pavement management, and use of the selected system so that the Agency does not need to rely on outside sources to maintain the system.
- Design interfaces between the pavement management application and other systems such as GIS and Work/Maintenance Management.
- Presentation to senior staff and/or elected officials to communicate findings, conclusions, and recommendations resulting from implementation of the system.

System Design and Development

Mr. Triffo has successfully led the design and development of pavement management applications for the private and public sector. For the public sector, systems were designed to meet the specific needs of municipalities, counties, and DOT agencies.

Mr. Triffo also designed and managed the development of a comprehensive right of way asset management system. This system utilized a generalized analytical engine that enabled users to inventory and assess the condition of a wide range of infrastructure assets. The types of assets that can be accommodated by this system are signs and supports, sidewalks, curb and gutter, pavement markings, sound and retaining walls, traffic signals, lighting systems, drainage inlets and manholes, fire hydrants, underground utilities such as storm sewer, sanitary sewer, and water distribution networks.

Work History

MDS Technologies, Inc. *President*	Park Ridge (Chicago), IL June 2003 to Present
IMS Infrastructure Management Services, Inc. *Senior Vice President*	Arlington Heights (Chicago), IL January 1998 to June 2003
Stantec, Inc. *Manager, Implementation Department*	Cambridge, ON, Canada 1989 to December 1997
Shiplake Management, Ltd. *Construction Engineer*	Toronto, ON, Canada 1988 to 1989
Trow Geotechnical, Ltd. *Pavement Engineer*	Brampton, ON, Canada 1987 to 1988
Pavement Management Systems, Ltd. *Data Analyst*	Cambridge, ON, Canada 1986 to 1987

Education

York University 1989- 1992
Toronto, ON, Canada
Coursework toward MBA

University of Manitoba 1984 - 1987
Winnipeg, MB, Canada
M.Sc. Civil Engineering (Geotechnical/Pavements)

University of Manitoba 1980 - 1984
Winnipeg, MB, Canada
B.Sc. Civil Engineering

Registrations

Professional Engineers Ontario
License No. 46972808

Anthony Raitano
Field Operations Technician

Professional Experience

Mr. Raitano has functioned as a Field Operations Technician with MDST for over seven years. In this capacity Mr. Raitano operates the MDST data collection vehicle. He performs daily calibration/quality checks and operates the vehicle in conformance with established company policies and procedures.

Mr. Raitano communicates with clients to keep them informed of his whereabouts as their roads are driven, and keeps them abreast of his progress. He also contacts our clients when it appears that the map documents appears inaccurate or incomplete to address the situation and ensure that all roads to be included in the field work program are tested. He has performed demonstrations of our vehicle based technology to clients.

Project Experience

Mr. Raitano has operated the MDST data collection vehicle on a number of successful pavement and right-of-way asset management implementation projects, including systems we have implemented for Green River, WY; Bartlett, IL; Glen Ellyn, IL; Carpentersville, IL; Chatham County, GA; and Carmel, IN.

Work History

MDS Technologies, Inc. — Park Ridge, IL
Field Operations Technician — 2004 to Present

City of Park Ridge — Park Ridge, IL
Police Officer — 1996 to 2004

Education

Harper College, Palatine, Illinois
Criminal Justice Major
Continuing Education 1989 - 2004

Illinois State Police Academy, Springfield, Illinois
Graduated 1995 Class 400-54

Schaumburg High School, Schaumburg, Illinois
Diploma
Graduated 1988