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Think Jersey DOT

Tech Brief

Manual of Guidelines for Inspection of ITS Equipment and Facilities

FHWA-NJ-2008-006 September 2008

BACKGROUND

- Advanced technology, in the form of ITS, is a valuable tool to improve the operations and management of NJ's heavily used transportation facilities. ITS technologies consist of a wide range of electronic devices and communication technologies that are used to ensure the most efficient utilization of surface transportation systems.

- ITS play a vital role in ensuring increased efficiency and connectivity of the New Jersey's highway transportation system, which continues to evolve in order to respond to the challenges of an economically vibrant State. Thus, given the high-density growth of the region, it is important to ensure that deployed ITS equipment works properly and efficiently. Central to this objective is the need for new tools that will provide the State with complete, practical, and efficient acceptance and/or inspection procedures for the proper installation and preventive and/or routine maintenance of its ITS equipment.

NJDOT maintenance crew deploying a traffic sensor in South Jersey

WHAT'S THE PROBLEM?

- Prior to this research project, NJDOT did not have an ITS acceptance and maintenance inspection manual (NJDOT RFP - Project 2005-13). This manual was needed as a reference document to assist the Department's inspectors, ITS design and traffic operations and ITS maintenance personnel to ensure effective inspection and maintenance of ITS facilities. The manual should be a comprehensive reference document that has separate inspection (acceptance) and maintenance sections.

- A wide variety of engineers—including civil, mechanical, electrical, software and computer, and communication engineers—are required to design and construct ITS facilities. ITS device manufacturers, system vendors, suppliers, and contractors develop and provide drawings, guides, manuals, inspection procedures, and maintenance procedures. Thus, a vast amount of knowledge must be extracted and then incorporated into a manual of guidelines for effective inspection and maintenance of ITS equipment by knowledgeable NJDOT personnel and well-trained inspectors and subcontractors.

HERE'S THE SOLUTION

- The main challenge in this project is to develop an effective methodology to extract knowledge from a diverse set of experts and sources. This knowledge extraction process can be achieved by using a well-designed scientific methodology tested for this kind of problems. An ad-hoc approach based on a series of informal interviews with experts from the public and private sectors would fail to produce a high-quality and reliable result.

- The methodology used in similar projects where the problem domain is large and experts and expertise are scattered is called "knowledge base development." There are various techniques and approaches developed by knowledge engineers who work on capturing the expert knowledge of domain experts. As our role is to define an effective process that will capture the expertise of NJDOT personnel as the main resource, we supplemented this resource with knowledge that already exists at other DOTs as well as published material from the manufacturers and suppliers of the ITS equipment to be inspected and/or maintained. Thus, we propose an intense knowledge base development process that involves the following steps:

  - **Step 1: Knowledge Acquisition:** This step involves meeting with experts, reviewing documents in the field, and conducting site studies to acquire the knowledge to be used in developing the knowledge base necessary to produce the content for the manual, its checklists, the software, and the training content.

- **Step 2: Knowledge Elucidation:** This step involves processing expert knowledge to clarify different aspects of the knowledge acquired from the experts and other cited resources.
- **Step 3: Knowledge Representation:** This step consists of developing written material including the manual, the procedures, and the guidelines using the expert knowledge obtained and processed previously.
- **Step 4: Validation and Verification of Developed Material:** Most of the information in the manual is highly technical and procedural, and it is important to carefully verify and validate it before using it. Upon the development of various components including the manual, its checklists, the software, and the training content, they are evaluated by the experts or the developers to ensure their accuracy and appropriateness for the tasks they are designed for. Depending on the results of this step, the research team decides whether to go back to steps 1 and 2 and to make changes. This step is done in close collaboration with domain experts who are able to give practical advice about proposed procedures.

THESE ARE THE OBJECTIVES…

The four major scopes of our study can thus be summarized as follows:

- Acquire the knowledge and experience related to the maintenance and inspection of ITS equipment that reside with New Jersey Department of Transportation (NJDOT) personnel, consultants, ITS device manufacturers, system vendors, suppliers, and contractors.
- Compile additional information from well-structured comprehensive interviews with experts, manuals, research literature, other DOTs, FHWA web sites, and manufacturers' published material.
- Develop a state-of-the-art inspection and maintenance manual (ITSIMM) in the form of checklists composed of inspection and maintenance questions for a wide variety of ITS equipment.
- Develop a user-friendly and versatile computer tool based on the structure and knowledge base of ITSIMM to enable users to conduct efficient and careful computerized inspection and maintenance of ITS equipment.

HERE IS WHAT WE DID…

- Rutgers University research Team has compiled information from interviews, manuals, research literature, other departments of transportation (DOTs), FHWA, related web sites (Internet), manufacturers' publications, etc., to develop a comprehensive ITS inspection and maintenance manual (ITSIMM) for the use of NJDOT. Therefore, a literature survey was conducted to identify the experiences of other transportation agencies and the private sector. This preliminary compilation of existing research followed by the careful review and synthesis of a wide variety of reports and documents, including policies of the U.S. Department of Transportation, FHWA, the Institute of Transportation Engineers, several States

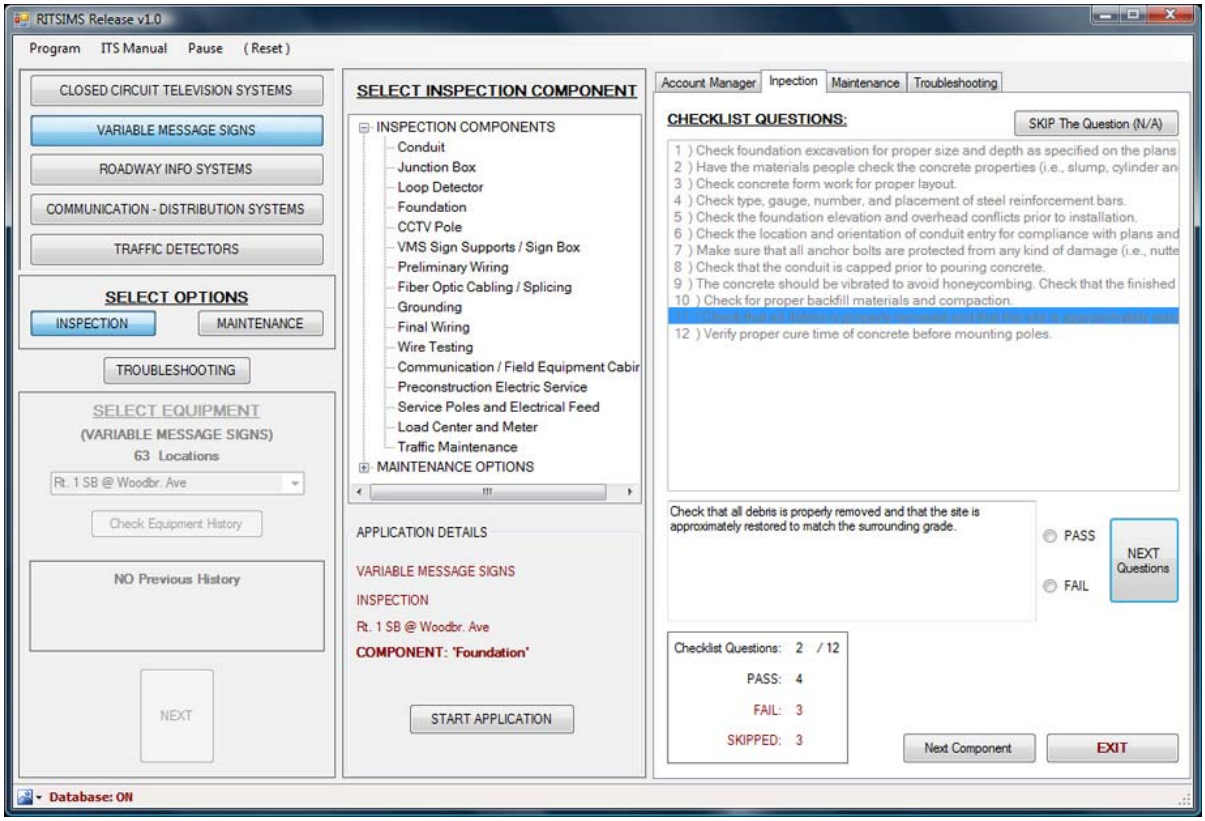
(Idaho, Kentucky, Texas, Virginia, Alabama, North Carolina, Minnesota, Arizona, Oregon, Colorado, California, Florida, North Dakota, Oklahoma, Utah, Vermont, and Wisconsin) and several countries (Canada, Ireland, Wales, Scotland, and England), guidelines from the Manual on Uniform Traffic Control Devices (MUTCD), and various private sector reports.

- Using the information obtained from the above sources, a preliminary ITS inspection and maintenance manual (ITSIMM), in the form of a number of checklists for inspection and maintenance of ITS equipment, was developed. Then, surveys and and individual interviews were conducted in order to be able to use the experience and knowledge of domain experts and stakeholders to improve the first version of the manual

- Finally, the Rutgers ITS Inspection and Maintenance Software (RITSIMS) was created using the guidelines, checklists, work flow, and structure obtained based on the literature review, surveys, and expert meetings. This software was also given to engineers and experts for further debugging of the user interface. As a result, a user-friendly software (RITSIMS) that can be used efficiently by NJDOT personnel for inspection and maintenance of ITS equipment was implemented. Another important feature of RITSIMS is the capability to identify relevant checklists that can then be printed for performing the inspection and maintenance without a computer just using hard copies.

- Rutgers team also conducted a series of training sessions where RITSIMS was introduced to prospective users. The feedback obtained during these training sessions was also used to improve its functionalities as well as to identify future improvements.

HERE IS WHAT RITSIMS LOOKS LIKE…



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