Maintenance Decision Support System
Pooled Fund Study TPF-5(054)
Progress Report September 15, 2004

The work effort during this quarter emphasized the incorporation of the results of the limited deployment tactical integration (LDTI) into the development of the test deployment version of the Pooled Fund Study (PFS) MDSS software. Further efforts were devoted to evaluation of client-server relationships to be utilized during the test deployment during winter 2004-05 (Phase III).

Test Deployment Development

The development activities included the construction of prototype graphical user interfaces (GUI) and the refinement of server-side applications to provide data to the graphical user interface. The GUI developed incorporated an evaluation of the Federal Highway Administration's Functional Prototype (FP) MDSS GUI through feedback from Iowa DOT personnel and in-house evaluations. The result of this design review resulted in a GUI design that incorporates the following primary screen components:

- Menu Bar
- Alert Panel
- Active Panel
- Support Panel
- Status Bar

The Menu Bar will provide a method of saving and restoring individual user configurations and to support the capability for users to print and/or store screen materials and summary information. The consideration for the menu bar follows from standard window design features that will permit the user to retain a sense of association with typical Microsoft Windows applications.

The Alert Panel is an adaptation of the methods used by the FP MDSS to provide timely visual cueing of information through the use of color-coded information for discrete intervals during a 24-hour period beyond the current display time. The information provided will follow the format of the FP MDSS including information on critical weather, road/pavement status and blowing snow. The alert information will be derived from PFS MDSS forecast information and augmented by severe weather statements from National Weather Service sources.

The primary information display will exist in an Active Panel that will both provide weather/pavement information and serve as the maintenance decision support display. The philosophy of the active panel follows the FP MDSS, but the layout and information display methods will differ in the PFS MDSS. The principle differences include more flexibility in the display capabilities and user control over display functions in the active panel. The GUI will use geospatial methods when the map view is in the active panel. The map view presents weather, RWIS, and pavement specific information over a geo-referenced background. The geospatial representation is facilitated by the use of an open source Java software package known as OpenMap. This software permits easier integration of ESRI Shapefile, which will provide a greater flexibility in open source data files and software by State DOTs. The GUI will permit an easy transition to the maintenance decision support treatment view which will also incorporate OpenMap features permitting easier graphics data depiction. The features within the maintenance decision support view inside the active panel will contain similar information to the FP MDSS, but users will be able to design, store, and recall favorite display configurations. These user-defined preferences support customization amongst maintenance users and provide flexibility to meet State DOT operational requirements. All information in the active panel will be time and space coordinated to provide users to easily identify the timeframe of data and decision recommendations.

The Support Panel has been designed to provide navigation between the various view formats of the active panel. User may easily select transitions between screen views in the active panel and change the dimensions of the geographic background in the map view.

Finally, a Status Bar is included following standard windows design features. This information will provide the user status information of data transfers, time code features and information regarding potential conflicts and errors encountered.

Other GUI design features included in the prototype include user-enhancing screen control mechanisms. These were determined to be important user considerations that are commensurate with expectations by most levels of computer users including:

- Mouse provides primary onscreen selection control,
- Selection of options limited to single left click on mouse, and
- Extensive use of mouse-over popup displays.

The processes that perform automatic data download, archiving, and cleaning on the client's computer are presently operational. Data organization has been accomplished through a simple index file created by the server that directs the MDSS application which files to use for each dataset at each time step. A process on the server watches for new data arriving on the server from various sources and serves as a central coordination effort in the client-server relationship. As new data is detected on the server, the data is compressed on the server, the index file adjusted and the data is scheduled for delivery to the client.

In addition to the work preparing the client-side graphical user interface, development of the tool for generating maintenance action recommendations has progressed significantly. This tool will make recommendations in a dynamic manner rather than using a rule-based system as has been incorporated in the FP MDSS. To complete this effort the tool evaluates the state of the contaminant layer over time, and when the contaminant layer strays out of acceptable bounds it seeks the most cost-effective action that will sustain an acceptable state in the contaminant layer until another maintenance action can be performed or the event is finished. The actions suggested are constrained by local maintenance practices and policies, specified route traversal and cycle times, the availability of material resources and staff, characteristics of equipment used, and adapt to other user-specified dead times such as those created by rush hour traffic or an equipment breakdown. All constraints placed on this guidance tool will be easily adjustable on the fly by the user via a special interface on the GUI.

Evaluation of Client-Server Relationships

A significant difference between the PFS and FP MDSS efforts has been the relationship between the client and server side of the MDSS. The FP relationship utilized a direct Internet connection between the DOT client and the NCAR servers. This reduces the level of potential bottlenecks in data flow and gives fewer potential points of fault. While this would be a desirable capability of the PFS MDSS and one that will be capable, the direction provided by information technology personnel in the PFS State DOTs almost uniformly require the use of a centralized software distribution and hosting method. Only the Indiana DOT does not utilize a central hosting of software, however they, too, have a central software distribution requirement. Most PFS States utilize the Citrix method of central hosting of software. While this method of centralized hosting will reduce the distribution challenges when initial and subsequent PFS MDSS versions become available, this will potentially generate restrictions on functionality over software that is hosted on the local client computer. The method of software development being followed to support the central client-side software hosting is to design the GUI and the data flows such that they reduce bandwidth requirements. This includes minimization of animation overhead and the use of on-the-fly data compression to maximize the bandwidth utilization. Efforts are underway to provide flexibility in user configuration to permit the system to be adapted to the variable bandwidth that individual garages and State DOTs will have.