FINAL REPORT

TRANSPORTATION PROGRAM MANAGEMENT SYSTEM

"TPMS"

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**Highway Division
of the
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Project No. HR-394

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Abstract

HR-394 was a software and database development project. Via funding provided by the Iowa Highway Research Board, the Iowa County Engineer's Association Service Bureau oversaw the planning and implementation of an Internet based application that supports two major local-government transportation project activities: Project programming and Development tracking.   The goals were to reduce errors and inconsistencies, speed up the processes, link people to both project data and each other, and build a framework that could eventually support a 'paperless' work flow.   The work started in 1999 and initial development was completed by the fall of 2002.

Since going live, several 'piggy back' applications have been required to make the Programming side better fit actual work procedures. This part of the system has proven adequate but will be rewritten in 2004 to make it easier to use.   The original development side module was rejected by the users and so had to be rewritten in 2003. The second version has proven much better, is heavily used, and is interconnected with Iowa DOT project data systems.

Now that the system is in operation, it will be maintained and operated by the ICEA Service Bureau as an ongoing service function.

Total Cost of Transportation analysis of road and highway issues

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TRANSPORTATION PROGRAM MANAGEMENT SYSTEM

for Iowa local government transportation projects.

Introduction

This project involved creating an Internet-based software and data management system to assist Iowa local governments in carrying out two parts of the process via which local government transportation projects get implemented: Programming and Development tracking. The goals were to link process participants to a statewide, unified database and to provide electronic tools with which associated functions could be performed on-line. These objectives have largely been achieved, despite many complications, setbacks, and scope of work changes. The resulting system functions satisfactorily, but needs to undergo one more round of refinement before it will be ready for the long term.

TPMS was developed, is operated, and will be maintained by the Iowa County Engineer's Association Service Bureau, in coordination with the Iowa Department of Transportation. Original funding for the system came from the Iowa Highway Research Board: $564K for Phase I (Programming) in 1998, and $103K for Phase II (Development) in 2001. Those resources helped get the system in operation and paid for development costs through the fall of 2002.

Initial development work under HR-394 is now complete. This report is presented to document what has been done, why it was undertaken, where things are now, and what the future holds for TPMS.

Process overview

Before discussing HR-394's objectives, history, and accomplishments, it's appropriate to review the processes it supports. This will provide understanding of the context in which it exists.

Local government transportation projects in Iowa get initiated and built via the following sequence of actions:

a) **System assessment** – which consists of identifying what parts of the transportation network need to be repaired, rebuilt, or upgraded.

b) **Definition of projects** – in which engineers and elected public officials break down the identified needs into specific projects.

c) **Programming** – wherein a local jurisdiction declares which projects it plans to build in the immediate future, in what years, and how they'll be funded funding.

d) **Development** – which involves the surveys, design, and regulatory compliance work required to get a project ready to let.

e) **Bidding** – where a project is advertised, let and awarded to the lowest responsible bidder.

f) **Construction** – physical implementation of the repair or improvement.

TPMS focuses **Item c)** *(Programming)* and **Item d)** *(Development)*. This focus is because most jurisdictions already have satisfactory means for determining needs and deciding upon projects, **(Items a)** and **b))**, plus standard procedures for the Bidding and Construction phases have been in existence for many years and/or are available from the Iowa DOT, **(Items e)** and **f) .)** In this way TPMS contribute to the overall sequence without duplicating anything already available.

Programming, involves setting up a plan that declares which projects are to be built, in what years, and how they will be funded. There are two types of programming used in local government transportation work:

a) All county road departments must annually list the projects they have planned for the next five years, (known as the County Five-year Program, or "CFYP".) This document enumerates all projects no matter how financed.

b) All local jurisdictions, with the assistance of affiliated planning agencies, must annually develop lists of all projects to be built with Federal Aid over the next three years and identify the FA programs from which the work will be paid for. (The regional version of such programming is called a Transportation Improvement Program, or "TIP". The consolidated statewide summary of all TIP's is called the "STIP".)

The CFYP's, TIP's, and even the STIP all undergo review and approval processes. Reviewers check the proposed programming against financial capacity and make sure that projects are actually eligible to be financed from the sources specified. After the review work is complete, programs are considered "Approved" and then govern which projects may be let for construction during the program's official fiscal year. To avoid delays, the CFYP and TIP/STIP programs need to match each other – something that sounds easy but is, in practice, hard to achieve.

Development consists of taking a programmed project and performing the various tasks required to get it ready to be let for bids: surveys, engineering, submissions, reviews, permits, clearances, right-of-way acquisition, and compliance with such other regulatory requirements as may apply. Unlike programming, which is a repeating, annual process, development work generally follows a linear sequence of steps that need only be performed once -- and may require only a few weeks or many years. Because different rules apply depending in funds used, ROW needs, type of work, and letting location, it can be difficult to determine the actions required for any single project.

HR-394 Objectives

The HR-394 project was conceived to provide automation that would improve and speed up the Programming and Development tracking processes for local government transportation improvements.

The goals for the programming process were:

1) Capture all data needed, for both CFYP and TIP type programs, in a one-record-to-serve-all-needs format, so that all resulting programs would match each other exactly.

2) Link all participants in the programming process: cities, counties, DOT planners, planning agencies, and DOT central offices, together – and to a common database – electronically.

3) Provide means by which each participant could make entries and updates, according to their roles, with the system recording and reporting the status as needed.

4) Make sure that projects in development don't get dropped from programs until after they've been let.

Goals for development tracking were:

1) Discourage or eliminate development of un-programmed projects

2) Automatically provide a clear outline of requirements for each project, based on funding, ROW, type of work, and letting location.

3) Enable faster communication between local government submitters and corresponding DOT reviewers.

4) Create a framework to support gradual automation of all development process activities.

5) Enable electronic preparation and submittal of key development documents.

6) Permit consultants to view and update projects on behalf of local government clients, when appropriate.

Project History

This project originated from 1995 discussions, between county engineers, regarding CFYP and TIP/STIP

mismatches and other frustrations with then existing procedures. After initial brain storming, the ICEA Computer

Committee set about developing a concept for what became the TPMS project. The idea for automating the

processes was shared with all parties known to be involved in the programming process and, by 1996, it

appeared that adequate interest existed to proceed with writing specifications. By this time, the concept had

been expanded to also include development tracking features, since it naturally follows and is inter-dependent

with programming.

In 1997, the project was proposed to the Iowa Highway Research Board, which authorized commencing a

software developer selection process. A committee representing all potential TPMS users was recruited,

solicitations for proposals were sent to seven firms, and three were interviewed. At the conclusion of this effort,

Analysts International Corporation, of Omaha, Nebraska was selected as both the most responsive and financially

feasible candidate. This information was reported back to the IHRB, which then authorized work to commence

on the programming side of TPMS, as Phase I. After some final negotiations, an agreement was signed in 1998.

Programming

AIC commenced development work in 1999 and had a workable system in operation by late fall of 2000. At this time, data from the FY2001 CFYP's and STIP was entered into the data tables to provide a startup basis. After some pre-testing, TPMS was launched with an introductory conference and around-the-state training sessions in the spring of 2001. The goal was to get people started using the system and enable them to file their FY2002 programs electronically. The immediate results were mixed. Users were able to enter and submit programming via the on-line interface, but a combination of immature software and an overloaded server made the experience very frustrating. Also, it quickly became apparent that while TPMS was good at tallying the programming data, the associated review and approval interface did not fit into the way the work was actually done. So it ended up being abandoned and the ICEA Service Bureau developed "piggy back" applications to perform the edit/submit/review/approve functions of the process in a more traditional format.

In October of 2001, after a "piggy back" CFYP and County budget application had been added, the system was 'rolled over' to set things up for the entry and submission of FY 2003 programming. As a part of this, an electronic inter-link between TPMS and the DOT's STIP database was performed so as to enable projects submitted via TPMS to be automatically transferred to the STIP. This exercise did not work and was eventually replaced with a protocol via which TPMS gets updated from the STIP.

Later, it became apparent that TPMS and the piggy back Budget/CFYP tool also needed to be able to handle the filing, review, and approval of *AMENDED* county road programs and/or budgets, too. This need was met by rewriting the Budget/CFYP tool and placed in service in the summer of 2002

In October 2002, the TPMS system roll-over and resynchronization with the STIP were performed anew and completed with much less time and effort than required the year before. This time around, things worked out much better and all 99 county road departments were able to file their CFYP's and budgets electronically. With refined software and a new, more powerful server, serious problems declined and support calls changed from "how can I get this to work" to "how should I report this type of project." The ICEA Service Bureau also undertook to extract Federal Aid project data from TPMS and supply it to RPA's and MPO's. The goal was to find out if there was a way for TPMS to assist them in the process of assembling their TIP documents. The consensus

on this experiment was that a) it provided too much data, b) the information's format did not match individual agencies' in-house databases, and c) it perhaps duplicated already existing planning agency processes.

At the time of this final report, things are nearly ready for the October 2003 rollover, which will ready both TPMS and the CFYP/Budget tool for editing, submission, and approval of county programming for FY 2005. Starting with FY 2005, STIP data will be merged into TPMS via a semi-automated process.

Development

AIC commenced work on the Development side in early 2001, after authorization of Phase II was obtained from the IHRB. The system became ready for use in late May of that year, but problems with converting the DOT's old database of active projects into TPMS format delayed opening the system to end users until September. There was an initial burst of usage, but as time went on, it became apparent that people didn't find that the system 'fit' into their work processes. As a result, users began dropping out and, by August of 2002, it was obvious that the development side was failing.

Conversations with both county engineers and DOT users revealed that the basic concepts behind the system were sound but that the way that they were made available was too cumbersome to be useful. After additional user research, the ICEA Service Bureau concluded that three options existed:

1) try to revise the AIC interface into a format that would prove useful.

2) rewrite the module from scratch to eliminate the problems encountered with the initial version

3) discontinue the development module

After evaluation of these options, it was decided to do a complete re-write. This effort required four months of planning and took six weeks to implement. It was launched in May of 2003 and has so far proven successful. Both DOT and county engineer users are active and plans for enhancements are being made.

Current Situation & Plans

Although TPMS' inititial development is complete and the system in is daily use, it is not yet finished. Both the programming and development modules need further refinement and, since the underlying processes are always changing, some work will be required every year to keep current.

Programming:

The programming side will need to be updated within the coming year.   As so far built, the system performs all necessary tasks but, unfortunately, does so via a somewhat clumsy and arcane interface.   To remedy this, a complete rewrite will be commenced in the Fall of 2003, with a goal of having a "Version 2" ready for use by July 1, 2004.   This means that FY 2005 programming will still be handled with the existing code, with FY 2006's programming being the first to benefit from the revision.

Key changes and additions will include:

- Integration of the CFYP and County Budget tools into the main TPMS database and code.
- Correction of program initiation and amendment problems created by the ninety day offset between the State and Federal fiscal years.
- Creation of a 'future projects' pool to hold all potential program candidates – from which sponsors will be able to move jobs into or out of programs as the need arises.
- Automatic insertion of STIP updates from the DOT
- Drastically enhanced speed and ease of use.
- Addition of a special screen to help county road departments manage and submit Federal Aid candidates.
- Enabling counties to electronically file resolutions to add or advance projects in their CFYP's.

Development:

The development module is enjoying a high degree of use and exchanges data nightly with the DOT's Project Scheduling System. Project sponsors use it to activate projects, request assignment of DOT project numbers by District Local Systems Engineers, and to update clearance items.   DOT district personnel use it to record receipt and approval of the various submittals required for the project to get approved for letting. It also serves as a auto-notifcation tool and enables communication between all parties linked to the project.

This module has an open framework design that will permit adding in new tools and task automation over time, with a long-term goal of handling everything, up to and including submittal of final plans. In the next 15 months, the emphasis will be on adding a few features to demonstrate to end users what can be done in this area. Key ideas include:

- creation of an electronic version of Federal Aid concept statement that can be filled out, submitted, reviewed, and approved on-line.

- Providing access to current SI&A data for bridge projects

- On-line access to a project's development action log.

- Addition of special, user-requested reports

Longer term, the framework could support more ambitious services, such as providing a means by which project owners could apply for and receive permits or access to online design services. But experience with TPMS so far has shown that a slow, evolutionary approach to such things is best.

Project Assessment

This section of the final HR-394 report summarizes how well original goals have been met and enumerates lessons learned.

Original goals

The original goals have been about sixty-five percent achieved. This is partially because, in some areas, TPMS' technical abilities did not always out as good as hoped, and in others because the background processes kept changing even while coding was being done. The following paragraphs provide an assessment of where the starting objectives have or have not been met:

Goal 1 : Capture all programming data for each project in a single database – to be used by all parties – so as to reduce the 'tower-of-babel' effect from having 99 CFYP's, 26 TIP's, and the STIP in each fiscal year.

> **Results:** The single database concept has not worked out. Differences in the way counties, planning agencies, and the DOT store and use programming data have worked to prevent full consolidation. But TPMS does get updated to match the STIP, (via the DOT to TPMS download protocol), so very good

correspondence between those two programs has been realized.   Efforts to share data with planning agencies has not work out to date, both for technical and agency perspective reasons. Overall the number and magnitude of discrepancies between programs has been substantially reduced but full integration has not occurred.

Goal 2 : Link all participants to project data and to each other.

Results: This goal has been fully realized for county road departments and DOT staff. Access to development data will soon be granted to engineering consultants this fall. Cities and planning agencies will be invited to start using the system in FY 2005. Utilization of on-board communications services remains weak but is picking up as people become better acquainted with the system.

Goal 3 : Automate data input/editing and the review/approval processes

Results: The data structure used for programming has worked out reasonably well, but users greatly disliked the initial format for performing review/approval actions.   As a result, separate CFYP and County Budget tools were created to automatic those processes via step-by-step outlines, with built in analysis functions.   This latter approach has worked out well for programming.   Similar dissatisfaction with the original development tracking interface prompted the complete rewrite of that side of the system this past year.   The new version, which uses a 'tabbed pages' format to give access to all necessary data and action items, seems to be a success.

Goal 4: Enforce programming vs. development protocols

Results: This goal has been met. The system prevents people from developing un-programmed projects and keeps those jobs that are in development in the system until they have been let or cancelled.

Lessons learned:

In the process of planning, developing, and deploying a project like TPMS, many insights and discoveries come to light.   The following list summarizes the key findings learned in this project:

- **Don't spend too much time pre-planning tech solutions**: Although its important to have a reasonably clear plan for what an information technology project is to accomplish, one shouldn't try to

work things out completely before starting. It seems better to just start and plan on having to go through several generations of code before getting done. In TPMS, many external factors changed between the time that coding started and when it was completed: the DOT STIP database moved from a spreadsheet to the mainframe; the DOT reorganized it's procedures and structure; the need arose to interface with the DOT's PSS system; software and coding tools became more sophisticated; business rules and work methods that people hadn't clearly articulated became apparent whenever an "exception to the rule" was encountered; and people came up with innovative ideas after using the system.

- **Don't impose too much change on end users**: It was found that users respond best to tools that mimic the older, paper based system being replaced. This means that screens should be made to look like conventional paper forms and that work processes are best presented via a sequential checklist that guides people from step by step. New formats and shortcuts should be introduced slowly, lest users get overwhelmed. And once they have become used to a new format, people prefer to stick with it for some time before having to absorb any more changes.

- **Creating technology is easy but serving real world needs is hard**: The key test for a new information technology application is this: Can people get their work done faster with it than any other method? Unless the answer is "Yes", they will stop using it as soon as the novelty wears off.

- **Software is never finished**: Although software can reach stages where they are temporily stable, they will always need more work: work rules will change, new ways to work with electronic data get discovered, and users will gradually demand more "ease of use" and "systems integration".

- **Minimize clicks, keystrokes, and data**: The key to a successful implementation is to enable users to find what they need to work one or two clicks of their mouse, have the screens simple enough that they can quickly spot the data they need, and be able perform actions or updates with just a few more keystrokes. The software must be designed to permit them to call up, view, and edit a project on short notice, then be able to put it back away and move on to something else. Software that can be used in

such an ad-hoc fashion is preferable to software that requires that time be set aside for formal work sessions.

Future directions:

This final report is submitted to declare that the initial HR-394 software development project is complete. TPMS will continue operating, from here on, as a service provided and managed by the ICEA Service Bureau without needing further financial support from the Iowa Highway Research Board. However, TPMS itself will never be completely finished. The pace of development will slow after the programming side Version 2 goes live in 2004, but future changes in the base procedures -- and gradually increasing user sophistication -- will require ongoing growth and refinement. The basic framework will stabilize in 2004 and the majority of work in 2005 will focus on getting the system to run very smoothly and reliably. After that, as time and user interest dictates, additional automation tools will be gradually added, with the goal of eventually converting all parts of the processes to electronic access.