SCHOOL OF
CIVIL ENGINEERING

INDIANA
DEPARTMENT OF TRANSPORTATION

JOINT HIGHWAY RESEARCH PROJECT
Executive Summary
JHRP - 91/2

AUTOMATED CONSTRUCTION DATA MANAGEMENT SYSTEM

B.G. McCullouch

PURDUE UNIVERSITY

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TO: Harold Michael
Joint Highway Research Project

January 8, 1991

Project:C-36-67FF

From: Bob G. McCullouch
Research Engineer

File: 9-11-32

This letter serves as a transmittal for the Final Report entitled "Automated Construction Data Management." It was prepared by Bob G. McCullouch and represents the work of the INDOT Long Range Data Processing Committee and Bob McCullouch.

This report serves as a study and definition document for developing an automated construction data management system. The report contains seven chapters. Chapter 1 contains background information on what other states have and on some current INDOT projections for construction and manpower needs. Chapter 2 is a description of activities performed during this study. Chapter 3 describes the system features by hardware configuration, software capability, and other capabilities. Chapter 4 quantifies the system costs. Chapter 5 describes the system benefits. Chapter 6 describes how the system should be developed and implemented and chapter 7 is the conclusions.

This report is presented for review and approval as evidence of fullfillment of the objectives of this report.

Sincerely,

Bob McCullouch

Bob G. McCullouch
Research Engineer

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Automated Construction Data Management System

by

Bob G. McCullouch

Joint Highway Research Project

Project No.: C-36-67FF
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Prepared for an Investigation
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Engineering Experiment Station
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Purdue University
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Final Report

Background Information

INDOT construction supervision personnel spend a considerable amount of time processing construction data. An informal survey revealed that five(5) hours a day is spent by the PE or PS and the inspector. Based upon existing trends of increased construction activity without parallel increases in INDOT personnel, data management will continue to expand, making more demands on their time. Not much can be done to reduce the amount of construction data generated and managed, but a new, innovative automated data management system should be developed to solve this impending problem.

Work Activities

The Long Range Data Processing Committee (LRDPC) performed several work activities in order to reach the goal of defining a system. Work activities performed by the committee included: review existing INDOT computer systems; study construction forms; State DOT computer survey; Connecticut DOT system review; local computing capability, and; evaluating hardware, software, development options, and costs and benefits.

System Features

Essential capabilities of the system include: a BAMS tie-in; computerized specs; user ease; localized computing capability; miscellaneous features that bring more automation to the system which include portable data collectors, asphalt/concrete plant tie-

in, RF tags, bar code usage, lab equipment RS232 interface, laboratory information management system(LIMS), electronic signatures, document scanner, electronic clipboard capability, and Graphics Interfaced Transportation Information System(GITIS) Interface.

System Benefits

States that have developed and are using this type of a system have documented some significant time benefits. In Connecticut a pay estimate would take a PE one week at 75% time, now it is performed in 1 to 2 days. Stated earlier in the report was that on an INDOT project about five hours per day is spent on paperwork. Of this five, 3-1/2 was spent by the PE. In comparison a PE in Connecticut spends about 1-2 hours a day on paperwork, a time savings of a couple hours a day when compared with INDOT. In New Jersey, by the manual method, it would take 1.5 hours to produce a daily report, 1.5 hours to produce a weekly report, and four hours to produce a monthly estimate. With the automated system these same reports are produced in 10 minutes, 15 minutes, and 20 minutes respectively.

Costs and Benefits - This is a summary of expected system costs and benefits.

Startup Costs:

PC work stations(300 @ 3000) = $900,000

PC software (300 @ $650) =	$195,000
District hardware & software =	$330,000
(6 @ $55,000)	
Mini software (6 @ $11,000) =	$ 66,000
Training costs (estimated) =	$ 10,000
Extra Security(300 @ $200) =	$ 60,000
Total startup cost =	$1,561,000

Annual Costs:

Communication =	$210,000
Maintenance (300 @ $200)=	$ 60,000
Miscellaneous (Supplies, etc.)=	$ 10,000
Information Services Support =	$ 8,320
(1 day/week= 8*52*$20)	
Total annual costs =	$288,320

The main savings identified by the committee are summarized.

Postage =	$ 60,000
Position elimination =	$239,400
Form printing & storage =	$ 37,000
Permanent Record storage =	$ 17,000
Management inquiries =	$ 40,000
Total annual savings =	$393,400

The following $ savings are due to expected reductions in time for processing paperwork from various personnel.

District M&T clerks =	$ 79,560
(1 per district @ 30 hr/wk)	
District Testing Engineer =	$ 6,240
(1 per district @ 1 hr/wk)	
District Const. Final clerk =	$ 65,520
(1 per district @ 20 hr/wk)	
District Const. Final clerk =	$ 42,120
(1 per district @ 10 hr/wk)	
Project Engr. & Proj. Sp. =	$1,540,500
(316 @ 2 hr/day during const.)	
District Const. Engr. =	$ 6,240
Central Finals =	$ 2,080
Total time savings =	$1,742,260

The annual cost savings do exceed the estimated annual costs but what about recovering the startup costs($1.5 million) and the additional development cost for the complete system? To answer the question you have to place value on time saved by utilizing this system. The number calculated($1,742,260) represents this value. Even though INDOT will not reap this in real money its construction operations and personnel will benefit significantly.

Recommendations

Hardware Configuration - The LRDPC is recommending hardware option 3 in the main report which is comprised of a PC in the field, a mini system at the district office, and utilizing the main frame at the central office. Data entry will occur at the field PC, transferred to the district hardware for storage and some processing and latter transferred to the main frame for storage and accessibility from other systems.

Outside Consultant - The committee recommends that if money is available a consultant should be hired. One price received is $3.3 million for the construction data system within a 13 month period. This is a very short development time so it would provide a system very quickly. But with the recent state budget "belt tightening", this money may not be available. So as a contingency plan, the committee is proposing another alternative.

System Development - The committee is recommending a short and long term approach. The short term solution will utilize the Paradox construction records program currently operating on selected projects. This program will be expanded and enhanced to perform the initial features described in the report. The long term solution could evolve from this initial one or after exploring the Paradox capabilities it may be decided to use a higher level language and outside consultant to develop.

This initial system can be performed and coordinated through an conditionally approved JHRP project at Purdue University. Implementation would occur in one district on new projects to

adequately test it. At the same time it will also be available to the other five districts for their use and feedback.

To design and test this system some software and maybe a PC at the district office may need to be purchased. This shouldn't exceed more than $7,000(includes cost for a Paradox compiler). Development of the initial system would be supervised by the Long Range Data Processing Committee and be coordinated with the committee involved in the construction records program and the Information Services department. One person from Information services has been working on the construction records program so this individual should be the one to work on this project.

Miscellaneous - Other recommendations from the committee are the following. PC hardware should have 386 capability because of trends in software and hardware. A formal training program should be developed for system users. A system improvement depository should be established for incorporating user suggestions and revising the system. And the Long Range Data Processing Committee should continue to function until the system is field implemented to help insure system capabilities.

Conclusions

Development and implementation of the system will require a considerable amount of effort, coordination, and cooperation. But before this system can become reality it has to be perceived by INDOT management as necessary and a priority. Two realities should

not be overlooked. One is that with transportation facilities continuing to deteriorate, and heavier use expected, more construction will be needed to keep pace with the demand. Secondly, because of a shrinking work force, less INDOT personnel will be available to manage construction projects. These realities should demand the development and utilization of an Automated Construction Data Management System by INDOT.

COVER DESIGN BY ALDO GIORGINI