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# The Practical Application of Computer Highway Costing Programs

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Highway departments sometimes use computer highway costing programs that are designed to help managers evaluate maintenance programs, establish priorities, and select construction programs. The highway costing program discussed in this paper was written for an IBM mainframe computer; supplementary programs were written for an IBM-PC. The highway costing program consists of four modules: highway maintenance costing, equipment costing, inventory, and construction activities. The use of the modules and their relation to one another are discussed to show how the development of a historical data base can help forecast trends in road and equipment maintenance; break down labor, equipment, and material costs; keep inventory; and generally help managers and workers make informed decisions and minimize administrative time. The highway costing program met the goals and objectives it was designed to meet. Although it did not significantly decrease the workload, it increased the level of responsiveness to problems. The availability of data also increased productivity and efficiency.

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## PROGRAM PURPOSE AND HARDWARE USED

The computer highway costing programs described in this paper are designed to meet the management needs of highway departments in evaluating maintenance programs, establishing priorities, and selecting construction programs. The primary highway costing program was written for an IBM System 34 or 36 mainframe computer. Supplementary programs were written using a dBase program on an IBM-PC.

## PLANNING AND DEVELOPMENT

The initial program was developed to assist management in extracting critical and meaningful data from large data bases.

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The program had to be flexible enough to meet the needs of both small highway departments, with four or five managers, and larger highway departments. It also had to accommodate and interface with a variety of diverse accounting systems and it had to be compatible with state requirements of mandated reporting items.

It was also important that the information be reported at several levels of detail to meet the needs of several levels of management.

## IMPLEMENTATION

The system includes 10 major reporting categories, or programs, and about 50 sub-categories, or activities, that are reported on daily time cards by field personnel. A short training session is needed to acquaint field personnel with forms and the importance of accurate reporting. Office personnel should also receive orientation on the system to ensure that they record and input information into the system accurately.

It may also be advantageous to spend some time orienting the different levels of managers on how to effectively use the reports that are available.

## HIGHWAY COSTING SYSTEM DETAILS

The highway costing system is composed of the following four modules:

1. Highway maintenance costing,
2. Equipment costing,
3. Inventory, and
4. Construction activities.

## HIGHWAY MAINTENANCE COSTING MODULE

The highway maintenance costing module is probably the most beneficial because it has the most data and is the most difficult

to analyze. Transactions in this module come in the five basic forms of labor, equipment, materials, purchases, and adjustments, as follows:

1. Labor data are collected from daily time cards.
2. Equipment usage data are also collected from daily time cards.
3. Material usage data is collected from an inventory withdrawal ticket.
4. The majority of purchases are entered into the system by vendor and paid by a Commissioner's Warrant from the highway accounting section.
5. Adjustments are recorded by highway office staff and must include a detailed explanation of the adjustment to satisfy the needs of an audit trail. These explanations could include labor errors, purchases that are not Commissioner's Warrants, and so forth.

Data collection is the most time-consuming task, but if all persons record their daily time sheets correctly, the system will process the data and provide the necessary reports, which minimizes the time that management must spend on analysis. Time card reporting includes five sub-categories of such activities as patching, crack sealing, blading gravel roads, mowing grass, plowing and winging snow, sanding roads, replacing culverts, and painting bridges.

About 35 different reports are available. The most detailed reports show a breakdown of labor, equipment, and material costs, as well as total costs on each road. This report is referred

to as the Cost Account Ledger, and lists all costs by activity on each road each month. This bulky report is composed of about 60 pages each month; it is not frequently used, but is necessary to isolate costs. Table 1 is an example of this report, in which daily costs are listed for each road.

The second level of reporting is the Trial Balance Report, which summarizes the costs by activity each month and is about 20 pages long. Activities include maintenance activities, equipment costs, inventory usage, engineering costs, administrative costs, and the current balances in the various revenue accounts that contain the funds to finance operations. Table 2 is an example of the Trial Balance Report.

The third level of reporting is by road number. It reports maintenance costs by program such as routine maintenance, repairs and replacements, betterments, and special work. The report is three pages long on the system and is used by management to identify major areas of expenditures. Information is no longer detailed by labor, equipment, or materials, but is reported as a total cost. An example of this report is provided in Table 3.

The fourth level of reporting is by the major groups mentioned in the third level of reporting. The report is one page long and, in addition to the program, it shows the part of the highway system in which costs are incurred, which includes rural state aid routes, rural county financed routes, and urban routes. Table 4 is an example of this report.

These reports provide information that isolates which roads are costing the most to maintain and also locates which category of maintenance is highest. It is therefore possible to

**TABLE 1 COST ACCOUNT LEDGER**

Cost Account	Description (Activity)	Road Number	Labor Costs	Equipment Costs	Materials Costs	Other Costs	Total Costs
11-0201	Crack Filling	33					
11-0201	Crack Filling	4					
11-0201	Crack Filling	9					

**TABLE 2 TRIAL BALANCE REPORT**

Cost Account	Description (Activity)	Labor Costs	Equipment Costs	Materials Costs	Other Costs	Total Costs
11-0201	Crack Filling					

**TABLE 3 SUMMARY OF MAINTENANCE COSTS BY ROAD**

Road Number	Routine Maintenance	Repairs and Replacements	Betterments	Special Work	Special Agreements	Total Cost	Cost per Mile
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**TABLE 4 SUMMARY OF COSTS BY PROGRAM**

Account Number	Description	State Aid Routes	Cost per Mile	County Routes	Cost per Mile	Municipal Routes	Cost per Mile
11-0000	(Program) Routine Maintenance (Activity)						
11-500	Snow Removal						

determine which roads need the most attention. An analysis of the type of maintenance costs can assist in determining what corrective action should be taken to reduce maintenance costs.

### **EQUIPMENT NEEDS MODULE**

The highway costing program is also used to analyze equipment replacement needs in much the same way it analyzes road maintenance needs. The repairs on a piece of equipment tend to rise gradually; maintenance costs eventually reach a point where it is more economical to replace a truck or motorgrader than to try to maintain it. As time goes on, a history of costs that indicate a pattern or trend can help predict when certain pieces of equipment should be replaced. This information is used to supplement recommendations on projected or probable upcoming maintenance costs from experienced shop personnel. The phrase "pay me now or pay me later" is appropriate when applied to equipment maintenance because if equipment is not replaced, the money will be spent in repairs.

It is necessary to evaluate each piece of equipment in terms of its cost to the county on a short- and long-range basis. Other variables must be considered when evaluating equipment; for instance, if an engine or transmission has been rebuilt or replaced, the cost of the overhaul must be amortized over the extended life of the piece of equipment. It is easier to keep informed on equipment condition and take quick corrective action with the data available through the costing system.

### **INVENTORY MODULE**

The third module of the highway costing program is inventory. The shop supervisor and an office clerk have the responsibility to keep this module up to date and to take the annual inventory.

### **ROAD CONSTRUCTION PROJECT COSTS MODULE**

The fourth module, road construction, tracks costs to a contract, project, funding source, and specification item and prints out partial and final payment vouchers as work is completed. It has been a useful tool in improving the efficiency of office and management personnel.

### **SUPPLEMENTARY PROGRAMS ON AN IBM-PC**

In addition to the highway costing program a computerized sufficiency rating program was developed to establish a 5-year construction program. The highway costing program is used to supplement or complement the sufficiency program. If a road

has geometric and structural deficiencies, it will probably show up high on a reconstruction priority list. A review of maintenance costs on a segment of road will verify or substantiate the need to reconstruct the roadway.

An example of how the system can be used is to review the summary road maintenance report by road for the previous year. It is noted that five roads have excessive charges against them. The summary report shows that the majority of those costs are betterment costs, and one road had high repair and replacement costs. A review of the next lower report level shows that the betterment consisted primarily of a bituminous treatment, in other words, a paver laid patches.

Indications are that this road is showing signs of structural failure and a decision must be made on how to correct the deficiency. Some alternative corrective measures to consider include continued maintenance betterments, a reconstruction project, or a complete bituminous overlay. As new data become available in the current year, the analysis is updated and corrective action is modified as necessary. The field data input into the computerized priority rating system is then reassessed and adjustments are made as necessary. The priority rating system is the primary source for determining priorities and the highway costing system supplements that system. The priority factors are not generally updated every year, whereas the highway costing system is usually current to within 1 month.

A key to minimize management's time is to have a variety of reports at several levels of detail available and also to have the option to review the reports by road or activity.

### **SUMMARY**

It is important to note that the highway costing system interfaces with the financial accounting system. In fact, the system will interface with any accrual-based, budgetary financial system. The interface is automated to avoid the duplication of data entry.

It should also be noted that the computer highway costing system did not significantly decrease the workload, but it did increase the level of service in terms of responsiveness. The availability of data increased productivity and efficiency.

The system's management reports give thorough, accurate, and current information that is useful when communicating with elected officials and justifying budget changes. The costing system and other computerized programs have provided adequate and timely data that have increased the responsiveness to sudden changes in equipment needs and changes in road maintenance needs with a minimum of personnel.

The variety of reports available, both in type and amount of detail, fits the needs of management because less time is required for data collection and analysis. The highway costing program met its goals and objectives.