penditure of maintenance dollars. We believe it is imperative that each highway agency make use of the applicable recommendations from other state studies. Whether you call it value engineering or productivity management, each state highway agency, either on its own or preferably in conjunction with two or three other agencies, should conduct an in-depth analysis of its maintenance activities.

Publication of this paper sponsored by Committee on Maintenance and Operations Management.

Development of a Computerized System for Pavement Maintenance Management

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This paper describes the development of a computerized system called PAVER for use in the management of pavement maintenance and repair. Included are problems encountered in developing PAVER, characteristics of a successful computerized system determined through experience gained from field tests, system description and user procedures, and a discussion of system benefits and initiation and operation costs.

In recent years, the rapid growth of new pavement construction has leveled off, and emphasis has been placed on maintaining existing pavements. Choosing the maintenance and repair alternative that will provide the desired level of pavement performance and be most cost-effective in the long run is a difficult task. It requires consideration of data that describe distress in existing pavement, rate of pavement deterioration, and pavement load-carrying capacity. Even if this information is available, it is often too time consuming to compile and analyze it for each section of pavement in a large pavement network that requires repair. Consequently, it is estimated that millions of dollars are wasted each year in the United States as a result of uninformed pavement repair decisions.

In the age of computerization, the logical solution seems to be the development of a computerized pavement maintenance management system. Such a system has been developed at the U.S. Army Construction Engineering Research Laboratory (CERL). The system, called PAVER, consists of a method for inspecting and evaluating the condition of a pavement; a data base for storing relevant pavement information; simplified methods of data input, update, and retrieval; and an economic analysis program to aid in selection of repair methods. PAVER is operated by the pavement engineer on a desk-size, typewriterlike computer terminal and small card reader that transmit and receive data from the computer over telephone lines.

This paper discusses the problems encountered in the development of PAVER and describes the resulting system, which is a product of 5 years of development, field testing, and efforts to respond to the needs of the field pavement engineer.

SYSTEM DEVELOPMENT

Initial Computerized System

It was decided at the onset of the project to use a generalized data base management system to construct the PAVER data base, the advantage being that a data management system provides built-in capabilities for alteration of the data structure and updating and retrieval of information. The data management system selected was SYSTEM 2000 (1). Within SYSTEM 2000, data are stored in "data elements"; each data element has a name that describes the kind of data stored in it. Related data elements are organized into "repeating" groups.

Once the data management system was selected, the data elements had to be defined and organized into a data structure. The result was the data structure shown in Figure 1. The boxes represent groups of data elements (repeating groups).

This initial data structure was tested by collecting data at one installation. It was found that only a very small subset of the data could actually be collected. In addition, both data storage and retrieval were prohibitively expensive. The decision was made to limit the data base design to only those data elements that would be used in the next 10 years. To prevent repeated revisions of the data base definition, it was decided that the technology of pavement management would be developed and manually tested and then, based on the field test results from the manual system, data elements would be defined and a computerized system developed.

Manual System

After several iterations of field testing and revision, a manual pavement maintenance system was developed. The system consists of the following main activities, which are summarized in the flow chart shown in Figure 2.

Figure 1. Initial data structure of PAVER.

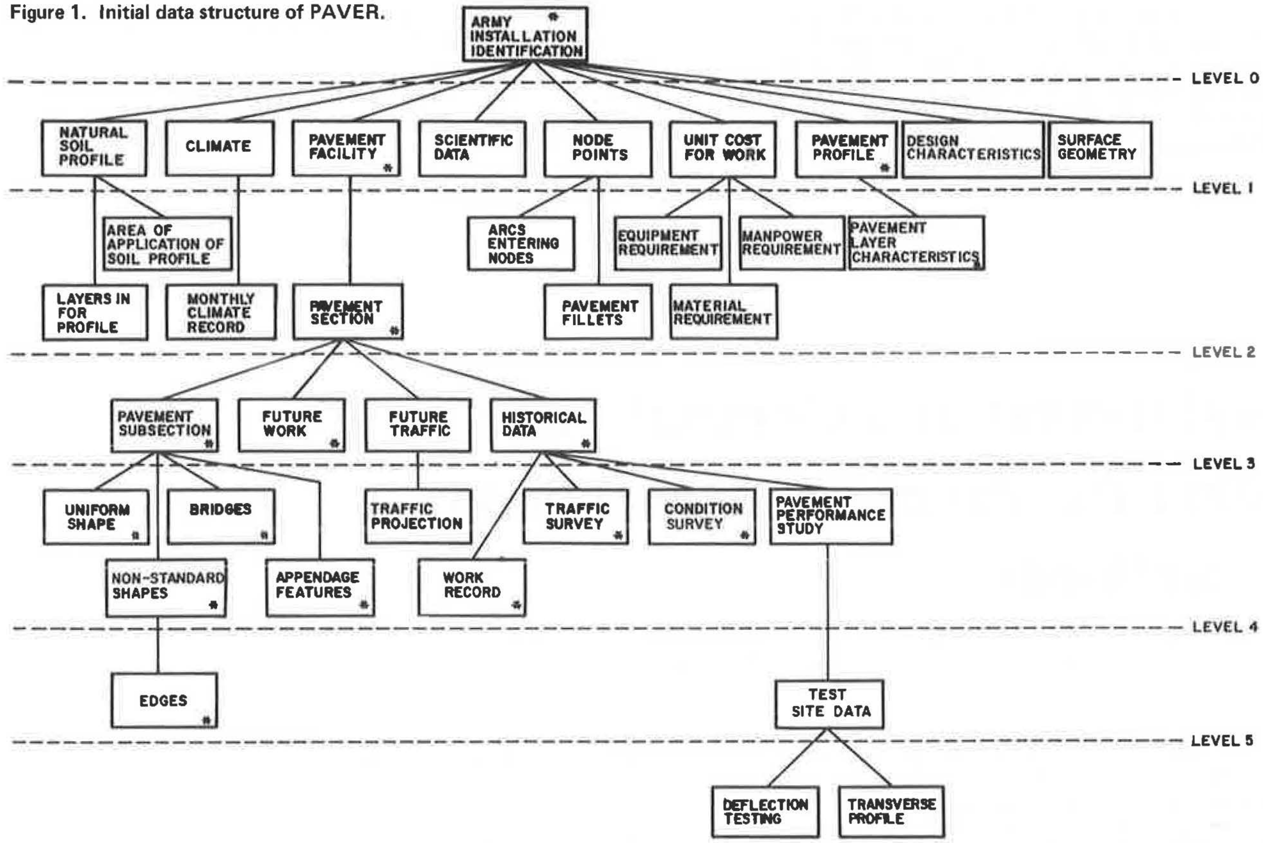
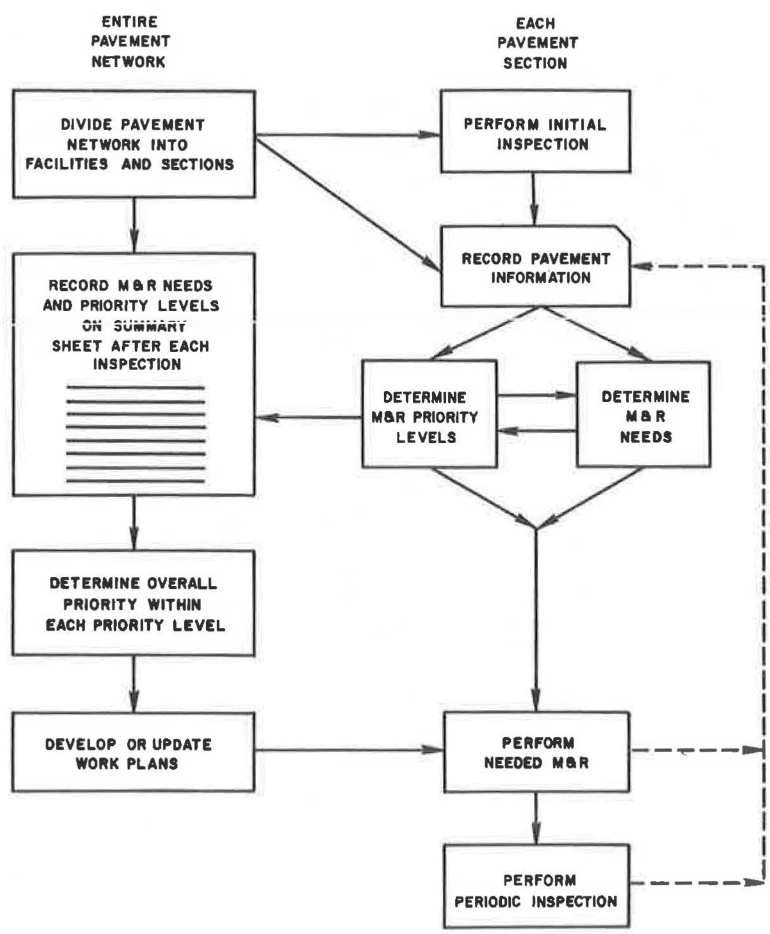


Figure 2. Summary flow chart for manual system of maintenance management.



Subdivision of Pavement Network Into Facilities and Sections

The first step in initiating a pavement maintenance management system is to identify the pavement facilities and divide them into sections that have similar characteristics. The word "facility" refers to an easily identifiable entity; for example, North Avenue and Park Avenue are two separate facilities on the pavement network map shown in Figure 3. A facility is divided into sections to account for variations in pavement structure, traffic, and other characteristics that affect pavement performance. Section end points are indicated by arrowheads in Figure 3.

Pavement Inspection and Condition Rating

Pavement sections are inspected to determine the types, quantities, and severities of existing distress so that maintenance and repair can be planned. Additionally, the inspection data are used to calculate the pavement condition index (PCI) for the pavement section. The PCI is a number between 0 and 100 that indicates the structural integrity and surface operational condition of the pavement section. The procedures for calculating the PCI are summarized in Figure 4 and can be briefly described as follows:

1. The pavement section is first divided into sample units. A sample unit for concrete pavement is approximately 20 slabs; a sample unit for asphalt is an area of approximately 450 m^2 (5000 ft^2) for airfields and 225 m^2 (2500 ft^2) for roads and parking lots.
2. The sample units are inspected, and distress types and their levels of severity and densities are recorded according to the guidelines provided by Shahin, Darter, and Kohn (3) for airfields and Shahin and others (4, 5) for roads and parking lots.
3. For each type, density, and severity level of distress within a sample unit, a deduct value is determined from the appropriate deduct curve similar to those shown in step 3 of Figure 4.
4. The total deduct value (TDV) is determined by adding all deduct values for each distress condition observed for each sample unit inspected.
5. A corrected deduct value (CDV) is determined from correction curves similar to those shown in step 5 of Figure 4; the CDV is based on the TDV and the number of distress conditions observed with the individual deduct values over five points.
6. The PCI for each sample unit inspected is calculated as PCI = 100 - CDV.
7. The PCI of the entire section is computed by averaging the PCIs from all sample units inspected.
8. The pavement condition rating of the section is determined from step 8 in Figure 4, which presents verbal descriptions of pavement condition as a function of PCI value.

Since it is often time consuming to inspect all the sample units in a large pavement section, a sampling procedure was developed based on stochastic theories. If the sampling procedure is used, only a certain number of the sample units are inspected and distress data are extrapolated for the pavement section.

Record Keeping

In the manual system, the information for each pavement section that is relevant to maintenance decisions is stored on cards. A separate card was designed for each of the following information categories:

1. Physical identification of the pavement section, which includes length, width, area, shoulders, drainage, and secondary structures;
2. Condition history, which includes distress information, PCI, ride quality, safety, and drainage condition;
3. Maintenance history;
4. Pavement structure; and
5. Traffic record.

An additional card was designed for summarizing all the work requirements identified for the pavement sections. The design of the cards was a difficult task that required

Figure 3. Identification of facilities and sections.

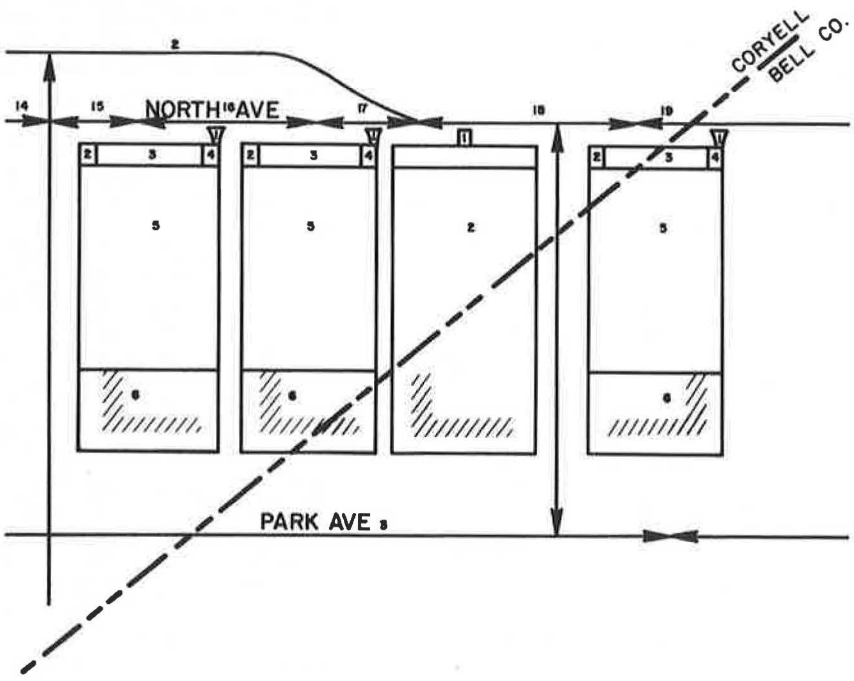
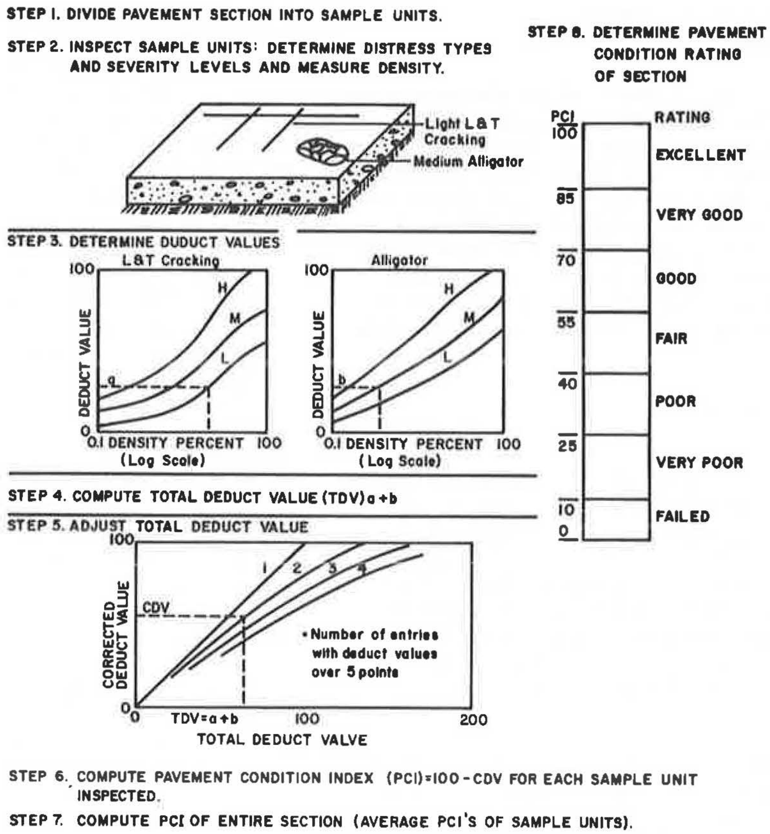


Figure 4. Steps for determining PCI of a pavement section.



interviews with practicing maintenance engineers and field testing and revision to ensure that the data requirements were sufficient for making rational maintenance decisions but were not so exhaustive that data collection was beyond practical means.

After the manual system was prototype tested at several U.S. Army installations, requests were received for a computerized version of the system. The requests came largely from Army installations that had pavement networks equivalent in size to 80.5 km (50 miles) or more of two-lane road.

Characteristics of a Successful Computer System

A computerized management system cannot succeed unless it suits users' needs. From experience gained during the development process and from interviews with potential users, it was determined that the computerized version of PAVER should have the following characteristics:

1. Ease of use—Data storage and retrieval and operation of programs should be simple and easy to learn and should not require any prior computer knowledge.
2. Conciseness—The user should be able to retrieve exactly the information he or she wants and not be inundated with many pages of computer output.
3. Timeliness—The user should get the information wanted at the time he or she needs it and should not have to wait for reports that are printed at prescheduled times.
4. Cost-effectiveness—Benefits received should outweigh the cost of operation.

These characteristics were all incorporated when the manual system was computerized.

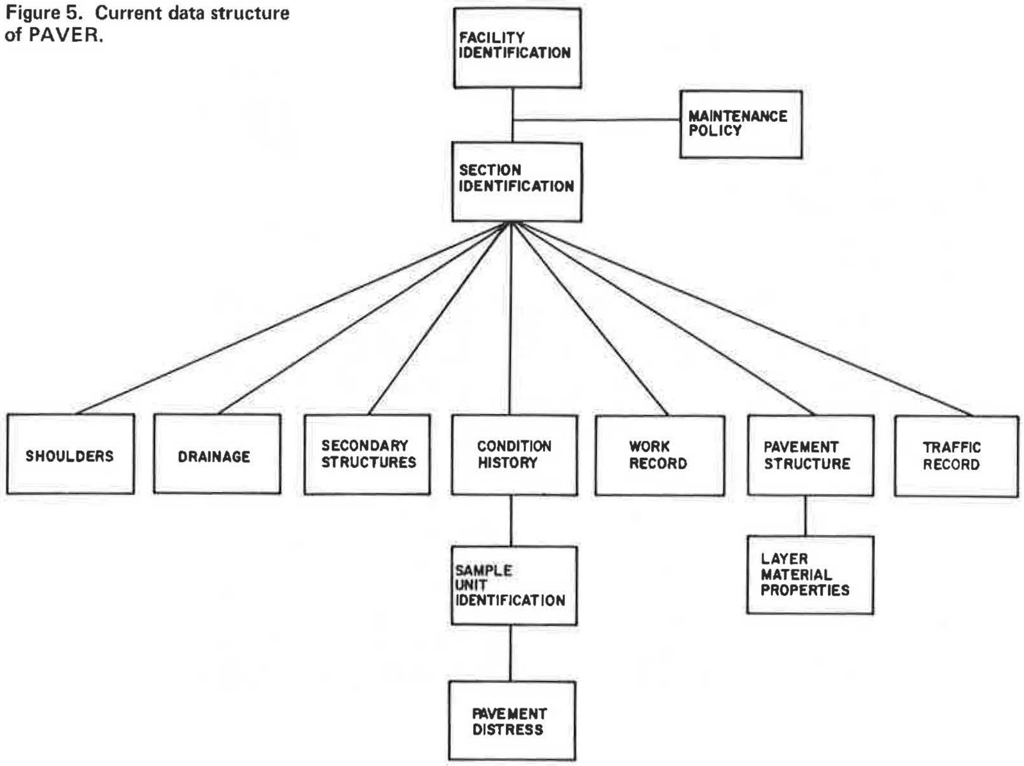
COMPUTERIZED SYSTEM

The data structure of the initial computerized system (Figure 1) was revised to reflect the knowledge gained during the field use of the manual system. The resulting data structure is shown in Figure 5. At the top of the tree, the pavement facilities and sections are defined. The section-identification repeating group is below the facility-identification repeating group because there may be several pavement sections for each pavement facility. Detailed information about each pavement section is stored in the repeating groups below the section-identification repeating group. The shoulder, drainage, and secondary-structure repeating groups contain descriptions and locations of the various types of shoulders, drainage provisions, and secondary structures in the pavement section. Because this information is stored in separate repeating groups, new sections do not need to be defined each time the shoulders or drainage provisions change.

The condition-history repeating group contains the overall results of each inspection performed on the pavement section (e.g., overall riding quality, drainage condition, shoulder condition, and PCI). Detailed information about the individual sample units and types, quantities, and severities of distresses found during each inspection is stored in the lower level sample-unit-identification and pavement-distress repeating groups.

The work-record repeating group is used to store both work planned and work completed on the pavement section. When a work requirement is first defined, preliminary job description and cost estimate data are stored. When the job has been completed, the date completed and any necessary changes in cost data are entered into the data base. The work requirement is automatically deleted, and the information becomes a permanent record of maintenance history.

Figure 5. Current data structure of PAVER.



The repeating groups for pavement structure and layer material properties describe each layer in the structure of the pavement section. The traffic-record repeating group contains the results of periodic traffic surveys performed on the pavement section.

The maintenance-policy repeating group is not related to any particular pavement section. It contains the maintenance policy that the pavement engineer generally applies to the pavement network. That is, for each type of distress, the pavement engineer stores the type of maintenance he or she recommends and the current unit cost for this work broken down by labor, equipment, and material. This information is used by a PAVER program that prints out work recommendations and cost estimates based on inspection results. The pavement engineer has the option of accepting these automated work recommendations and storing them as work requirements in the work-record repeating group or revising them because of special circumstances.

The stored maintenance policy can be updated as often as the pavement engineer feels it is necessary.

Data Input

The input forms used in the computer system are similar to the record cards used in the manual system except that the format has been changed slightly to allow direct keypunching. Figure 6 shows an example of the section identification input form. (Units of measurement in the PAVER system are formulated in U.S. customary units; therefore, Figures 6 through 9 appear in U.S. customary units and no SI equivalents are given.) The inclusion of an add/change/delete code on each form (second column in Figure 6) also allows the forms to be used to modify existing data in the data base. The cards keypunched from the information on the forms are read in through the small card reader in the pavement engineer's office and are checked for format errors by a validation program. Once the cards are error free, an input program stores the data in the proper place in the data base or changes or deletes existing data. As inspection data are entered, the input program also automatically calculates and stores the PCI for each pavement section and each sample unit within the section.

Data Retrieval

The primary advantages of the computerized system relate to data handling and report generation. By typing in simple commands on the desk terminal, virtually any question concerning the basic data can be answered, from reiteration of data entered to sorting in any conceivable fashion, summaries, priority selection, and self-generated economic analyses.

Samples of reports that have been generated for illustrative purposes are shown in abbreviated form in Figures 7, 8, and 9.

Use of System

An illustration of how the pavement engineer can use PAVER to manage pavements is shown in Figure 10 and is briefly described below:

1. Pavement inspections are performed by trained personnel. As each section is inspected, the results are entered on a PAVER inspection results input form and presented to the pavement engineer.

2. The pavement engineer determines work requirements for the pavement section based on the inspection results and aided by the automated work recommendations program and any other information retrievable from the data base. (This may include a history of past repairs performed on the pavement section, structural

Figure 6. Section identification input form.

SECTION IDENTIFICATION

FAMILY HOUSING
Y = YES
N = NO

PAVEMENT RANK
P = PRIMARY
S = SECONDARY
T = TERTIARY
X = OTHER
N = NOT APPLICABLE

SURFACE TYPE
AC = ASPHALT
ST = SURFACE TREATMENT
PCC = CONCRETE
GR = GRAVEL
X = OTHER

FORM ID # (1–2)	ADD/CHG/DEL (3)	FACILITY NUMBER (4–8)	SECTION NUMBER (9–10)	ZONE (11–14)	Ⓝ SECTION LENGTH (LF) (15–20) (LEAVE BLANK FOR IRREGULARLY SHAPED SECTIONS)	Ⓝ SECTION WIDTH (LF) (21–24)	Ⓝ SECTION AREA (SY) (25–31) (LEAVE BLANK IF LENGTH & WIDTH ARE ENTERED)	FAMILY HOUSING (32)	PAVEMENT RANK (33)	SURFACE TYPE (34–36)	Ⓝ SLAB WIDTH (LF) (37–39) (PCC ONLY)	Ⓝ SLAB LENGTH (LF) (40–42) (PCC ONLY)	SECTION BEGINS (43–61)	SECTION ENDS (62–80)
02	A	00236	01	E10	6158	31		N	P	AC			E EDGE OF WILSON	CENTER OF HAGOOD
02	〃	〃	02	E10	2078	20		N	P	AC			CENTER OF HAGOOD	BLDG 256
02	〃	〃	03	E11	888	20		Y	S	AC			BLDG 256	E EDGE OF MADISON
02	〃	00237	01	BS	624	16	1125	Y	S	PCC	8	15	S EDGE OF JACKSON	N EDGE OF PATTON
02	〃	〃	02	CS	319	18		Y	S	PCC	10	15	S EDGE OF PATTON	N EDGE OF PERSHING
02														
02														
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layering data, traffic information, previously defined work requirements, or a cost comparison between various maintenance and repair alternatives.) The inspection results and the newly defined work requirements for the pavement section are then entered into the data base by means of the computer terminal.

3. The pavement engineer may generate a listing of proposed work from the data base at any time. The list may be restricted to a particular type of work, location within the installation, priority level, or manner of accomplishment (in-house or by contract). The work assignments are then routed to the shop or to a contractor through the appropriate channels.

4. When work is completed, the shop or the contractor returns the work list and any necessary revisions in work quantity and cost to the pavement engineer.

5. Final data on work completed (for work performed both in-house and by contract) are entered into the data base. The computer automatically deletes the corresponding work requirement from the list of work to be done and adds the work completed to the work history.

SYSTEM BENEFITS AND COSTS

Benefits

The following benefits are expected to be gained through the use of PAVER or any similar computerized system:

1. Maintenance management through field control over the pavement network rather than a piecemeal operation;
2. Rational determination of work requirements and better management of available maintenance dollars and in-house resources;
3. Selection of cost-effective maintenance and repair methods based on pavement structure, traffic, rate of deterioration, previous maintenance, and economic analysis if needed; and
4. Availability of pavement information as needed and when needed.

The result should be better pavement condition and performance throughout the network for the same available maintenance budget. Moreover, the system will provide the pavement engineer with justification of actions taken and justification if more maintenance funds are needed.

Costs

The costs for implementing the system may be divided into initiation cost and annual operation cost—initiation cost being the highest of the two. At two Army installations where the system is being prototype tested, most of the initial data collection was done on contract. At one installation, the contract amount was $25 000; at the other, it was approximately $80 000. The scope of the second contract included dividing the network into facilities and sections; inspecting pavement to determine types, severities, and amount of distress; collecting shoulder and drainage information; performing traffic surveys; determining maintenance and repair needs in cooperation with the installation pavement engineer; and coding and keypunching all data collected and correcting any resulting errors. The pavement area for which the data were collected was 2 230 013 m^2 (2 667 161 yd^2) of asphalt concrete, surface treatment, and jointed concrete-surfaced roads and parking lots. It should be emphasized, however, that the relation between cost and pavement area is not linear. For example, when a 120-m (400-ft) long pavement section in a downtown area is inspected, the sampling procedure requires that the section be inspected in its entirety. However, on an 8-km (5-mile) long state or Interstate road, the sampling procedure requires that only 5 percent of the sample units be inspected.

A detailed analysis of the annual cost for operating PAVER after the data base is established was performed for the Army. The analysis assumed a pavement network equivalent to 241 km (150 miles) of two-lane road, which is equivalent to the size of a small city. The network was assumed to be divided into 400 pavement sec-

Figure 7. Sample inventory report generated by PAVER.

```
GENERATE ALL WHERE SURFACE TYPE EQ PCC AND FACILITY USE EQ ROADWAY
:EXIT:


REPORT DATE:   04/18/78

                                INVENTORY
                       NON-FAMILY HOUSING PAVEMENTS

                                          SURF    FACILITY      PAVEMENT       AREA
                                          TYPE      USE           RANK         (SY)
-----------
00110 ACADEMIC DRIVE
      SECTION 01                          PCC     ROADWAY       SECONDARY      21210
      FROM: S SIDE OF BATTALION
      TO:   SS OF OLD BATTALION

                                                   TOTAL FACILITY AREA        21210

-----------
00103 NORTH AVENUE
      SECTION 01                          PCC     ROADWAY       PRIMARY         8480
      FROM: 540FT W OF 75TH ST
      TO:   W SIDE OF 72ND ST

                                                   TOTAL FACILITY AREA         8480

-----------
00072 72ND STREET
      SECTION 02                          PCC     ROADWAY       PRIMARY         3730
      FROM: NS CENTRAL AVENUE
      TO:   SS BATTALION AVENUE

                                                   TOTAL FACILITY AREA         3730

           TOTAL AREA OF SELECTED NON-FAMILY HOUSING PAVEMENTS               33,420
```

Figure 8. Sample work requirements report generated by PAVER.

```
GENERATE ALL WHERE WORK DESCRIPTION EQ CRACK FILLING
:EXIT:


REPORT DATE-04/18/78

                              WORK REQUIREMENTS
                              NON-FAMILY HOUSING PAVEMENTS
                              WORK TO BE DONE IN HOUSE

WORK PROPOSED- 01108    CRACK FILLING - LONG/TRANS CR
-----------------------------------------------------------------------------------
FACILITY          SEC  LABOR LABOR MAT'L EQUIP  WORK QUAN  TOTAL  PRIOR REC  FIN-
IDENTIFICATION    NO   HOURS COST$ COST$ COST$     LF      COST$  -ITY  FY  ANCED
-----------------------------------------------------------------------------------

FACILITY #00082
BASE ROAD
                  01                              1177.00    176         78
                  02                              6016.00    902         78
                  03                              6084.00    912         78
-----------
FACILITY #00108
BATTALION AVENUE
                  02                              4261.00    639         78
-----------
FACILITY #11050
MOTOR PARK, BLDG 11050
                  02                             18030.00   2705         78
-----------
FACILITY #30017
MOTOR PARK, BLDG 30017
                  03                              8728.00   1309         78
-----------
FACILITY.#30033
MOTOR PARK, BLDG 30033
                  03                              9132.00   1370         78
```

tions, each approximately 600 m (2000 ft) long. (The number of pavement sections has a direct bearing on the cost of operation because data are stored and retrieved from the data base by section.) The following yearly costs of operation were determined:

Cost	Amount ($)
Labor (data coding, keypunching, input, and retrieval)	3100
Computer	4300
Total	7400

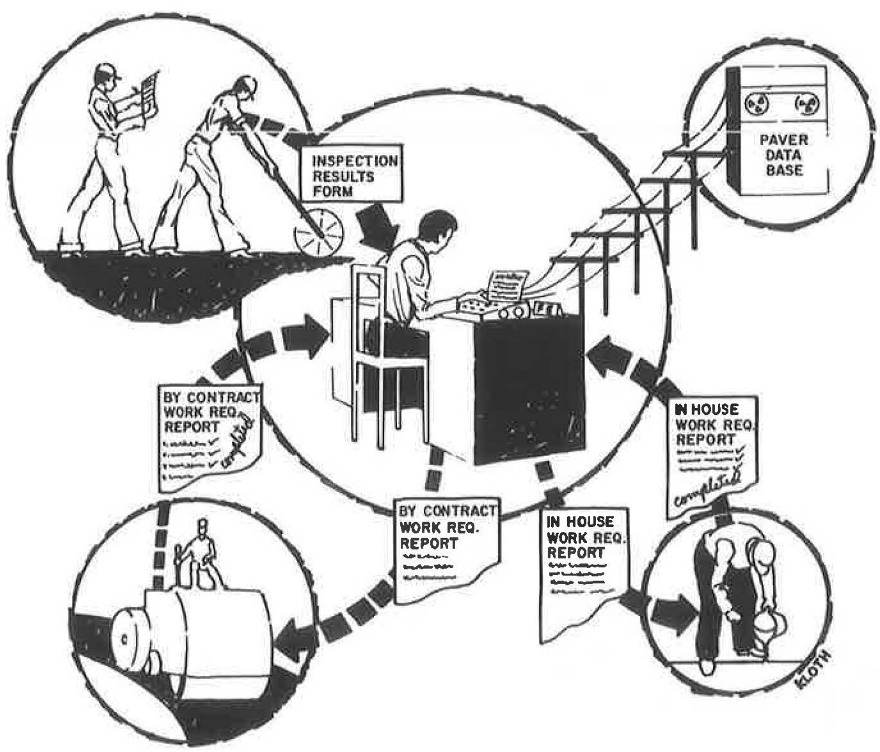
This indicates a cost of approximately $18.50/pavement section.

From these results, the cost of operating PAVER for a state highway district can be estimated. Since state highways exhibit much less variation along their lengths in terms of structure, traffic patterns, and shoulder and drainage facilities, lengths of pavement sections will be longer for highways than for city streets. A highway district with 6000 km (3728 miles) of two-lane road divided into sections of approximately 6 km (3.7 miles) each will have 1000 pavement sections. At $18.50/pavement section, the cost of operating PAVER would be approximately $18 500/year. Assuming an average annual maintenance cost of $0.10/m^2 ($0.08/yd^2), the annual

Figure 9. Sample economic analysis generated by PAVER.

```
REPORT DATE - 04/18/78

                    COMPARISON OF M&R ALTERNATIVES
                               ELM ST
                             SECTION  3

                                                 INFLATION RATE   6.00 PERCENT
ANALYSIS PERIOD -   5 YEARS                      INTEREST RATE    8.00 PERCENT

ALTERNATIVE       DESCRIPTION                                 NET PRESENT COST
          A       LOCALIZED REPAIR EACH YEAR                             2324.
          B       OVERLAY 1.5 INCH,YEAR ONE                              3421.
          C       REPROCESS AND OVERLAY 1 INCH,YEAR ONE                  3606.


                 DETAILED COMPARISON OF M&R ALTERNATIVES

            *      ALT A         *      ALT B        *     ALT C        *
            *             PRES   *             PRES  *             PRES *
YEAR        *     COST    COST   *    COST     COST  *    COST     COST *
            *                    *                   *                  *
 1 (FY78)   *     1470    1470   *    6726     6726  *    7886     7886 *
 2 (FY79)   *      150     147   *       0        0  *       0        0 *
 3 (FY80)   *      300     288   *       0        0  *       0        0 *
 4 (FY81)   *      450     424   *      50       47  *       0        0 *
 5 (FY82)   *     1000     923   *      75       69  *      50       46 *
            *                    *                   *                  *
 TOTAL      *     3370    3253   *    6851     6842  *    7936     7932 *
            *                    *                   *                  *
 SALVAGE    *              929   *             3421  *             4326 *
            *                    *                   *                  *
 NET PRES   *             2323   *             3421  *             3605 *
     COST   *                    *                   *                  *


DO YOU WISH TO MAKE SAME ANALYSIS
WITH DIFFERENT INTEREST AND INFLATION RATES?(YES/NO)
  ?NO
```

Figure 10. Use of the PAVER system.



maintenance budget for a network of that size is approximately $4 570 000. Therefore, the annual cost of operation of PAVER would be less than 0.5 percent of the total budget. When this cost is compared with an expected annual cost avoidance of 10 percent of the total budget (based on estimates made by pavement engineers who currently use the system), the estimated return on investment is considerably high.

ACKNOWLEDGMENT

The views presented in this paper are ours and do not necessarily reflect the views of the Department of the Army or the U.S. Department of Defense.

REFERENCES

1. System 2000 Level 2 User Information Manual. Control Data Corp., Publ. 76074000, 1975.
2. M. Y. Shahin, M. I. Darter, F. M. Rozanski, and R. Stark. Development of an Installation Surfaced Area Maintenance and Repair Management System. U.S. Army Construction Engineering Research Laboratory, Technical Information Pamphlet C-49, Sept. 1975; NTIS, Springfield, VA, AD A017 328.
3. M. Y. Shahin, M. I. Darter, and S. D. Kohn. Development of a Pavement Maintenance Management System: Volume 1—Airfield Pavement Condition Rating. Air Force Civil Engineering Center, Technical Rept. AFEC-TR-76-27, Nov. 1976.
4. M. Y. Shahin, M. I. Darter, and S. D. Kohn. Development of a Pavement Maintenance Management System: Volume 2—Airfield Pavement Distress Identification Manual. Air Force Civil Engineering Center, Technical Rept. AFEC-TR-76-27, Nov. 1976.
5. M. Y. Shahin and others. Development of a Pavement Inspection Reference Manual. U.S. Army Construction Engineering Research Laboratory, Interim Rept., in preparation.
6. M. Y. Shahin and others. Pavement Inspection Reference Manual. U.S. Army Construction Engineering Research Laboratory, 2nd Ed., in preparation.
7. M. Y. Shahin, M. I. Darter, and S. D. Kohn. Development of a Pavement Maintenance Management System: Volume 3—Maintenance and Repair Guidelines for Airfield Pavements. Air Force Civil Engineering Center, in preparation.

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Photologging and Roadway Information System

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Photologging was used as the data collection tool for developing a computerized roadway information system for Ann Arbor, Michigan. The study included the development of serviceability characteristics for all roadway segments in the city by use,of various condition factors that have an impact on the service life of highways. A weighting scheme was also used to aggregate the serviceability characteristics. The entire data file has been computerized in such a way as to be capable of aggregating and summarizing various roadway characteristics. The data system is capable of being updated as required so that it is kept current at all times. The information system can be used for prioritizing roadway improvement works and in planning and budgetary decision making.

Knowledge of roadway conditions and geometric information are essential if municipal engineers are to perform rational operation and maintenance work in a community. Road maintenance work is often done as a result of routine inspection and public complaint and not on the basis of planned maintenance work. This, coupled with budget constraints, often leads to inadequate work and ultimately to deterioration of highways.

A highway needs study requires a careful assessment of the condition of the roadway for purposes of determining both short- and long-range highway improvement programs. In most communities, data for needs studies are based on visual inspection of roadways and subjective assessment of deficiencies. If roadway condition data are continuously collected and maintained, engineers will be able to prepare realistic short- and long-range improvement plans, develop optimal maintenance programs and schedules, and maintain highways in better condition. The traditional visual inspection of roadways requires significant time and labor but may still produce inaccurate data as a result of subjective assessments, changing personnel, and distractions in the field.

Photologging and extraction of data under a controlled environment thus emerge as an alternative tool (1). This process involves photographing roadways from an instrumented vehicle with a 35-mm cine/pulse camera by using predetermined increments of distance for each picture frame. Each frame of the movie film has the street name, mileage (because units of measurement included in the process are formulated in U.S. customary units, no SI equivalents are given for generic terms), direction of travel, and a 10-digit auxiliary data display that is optically transmitted to the camera and superimposed on the bottom of each frame. The 10-digit display includes (a) the date, (b) the time of day, (c) resolution, and (d) major street, state street, or local street code. To establish footage in addition to mileage, a grid overlay is used during the data extraction process. This allows the viewer to establish a distance between frames and thus provides greater accuracy.