Idaho's Equipment Management System: A Review

RON PETERSON

ABSTRACT

The Idaho Transportation Department completed work on a contract with FHWA in March 1980 to test and evaluate an Equipment Management System (EMS). Idaho's EMS has been in operation since July 1980. In this paper the system is outlined, and benefits, problems, and changes since 1980 are discussed.

The Idaho Transportation Department (ITD) has historically provided some type of information for equipment managers. The majority of the information was financial and not timely. The output was rigid and often voluminous. Equipment managers were not getting the information that they needed to make decisions. During the 1970s replacement costs soared and the revenue to operate and replace equipment dwindled.

Interest was growing nationwide in the equipment management system (EMS). During this period, FHWA sponsored a pooled-fund study on the EMS. ITD contracted with FHWA in March 1979 to test and evaluate an EMS based on the FHWA EMS manual.

ITD's contract with FHWA was for 1 year. Because the supply and financial functions were already being developed, the contract was short term. It was finalized in March 1980 and the final report was submitted to FHWA in May. Work continued on the EMS after the contract had been completed. The system became operational in July 1980. The ITD EMS is very much a product of the work performed under the FHWA contract.

IDAHO'S CURRENT EMS

The ITD EMS consists of one major system that gathers information from four sources:

1. Highway maintenance districts: Idaho is divided into six districts. A major repair shop is located at each district headquarters. These shops perform repair and maintenance of equipment for the district. Each district office is linked to the main computer at ITD headquarters in Boise. This computer network has been in place since 1977.
2. Transportation Resource Management System (TRMS): TRMS is a financial management system. It replaced the old accounting system in July 1981. The processing in this system is primarily batch, done nightly.
3. Supply system: The supply section receives and issues all supplies for ITD. The supply system provides information to EMS on fuel use, disposal, and replacement of equipment and on parts and supplies. Batch processing is done nightly before TRMS runs.
4. Capital Properties Inventory System (CPIS): CPIS is an inventory system. It is a batch system updated by the districts as equipment locations and attachments change. These locations and attachments are then made a part of the EMS.

Input

Five input forms provide EMS with information from the field. The data from these forms are entered in each district office through ITD's computer network. The forms are

1. Job order form,
2. Preventive maintenance (PM) form,
3. Employee time sheet activity report,
4. Supply request form, and
5. Fuel issue form.

The data collected by the district goes to EMS, TRMS, and the supply system. Information from the PM form goes directly to EMS. Data from the job order and employee time sheet activity report go to TRMS before being passed to EMS. The supply system receives information from the fuel issue form and the supply request document. This information is later passed to EMS. Although information from all five forms is important, the job order and PM forms contain most of the significant information for EMS.

Job Order Form

The job order form (Figure 1) is one of the primary documents for EMS; it provides basic information. The job order number is a preprinted number that designates a particular job. This is the number under which all data are stored. The first digit designates the district and the other four are sequential.

Next on the form are the number of the piece of equipment on which work is being done, a short description of the equipment that is being serviced, and the odometer or hour meter reading of the equipment, which is always reported to the nearest whole number.

A vehicle accident number is assigned by the district personnel or the department safety supervisor to aid in capturing department accident costs. The numbers under Work Authorization, Distribution Rule, and Function Code are accounting codes. The organization code of the shop performing the work and the organization code or appropriate accounting code for an outside agency, which indicates to whom the equipment is assigned, are included also. Transaction codes are those that are assigned to aid in distributing the costs correctly in the accounting system.

Under the heading "Dates" are "J.O. Initiated" and "J.O. Complete." "EST. Complete" is reported on the weekly out-of-commission report for information.

The type of service to be done is to be circled, and there is only one per job order. If the need for repair is discovered during or because of periodic preventive maintenance, the basic reason for repair is preventive maintenance.

Under the heading "Date" is listed the date the work is being performed. The section headed "Labor"

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JOB ORDER NUMBER
EQUIPMENT NUMBER
METER READING MILES HOURS
DESCRIPTION
VEH. ACCIDENT NO.
LOCATION: ROUTE
STOCKPILE NUMBER

WORK AUTHORIZATION
DISTRIBUTION RULE
FUNCTION CODE
ORG. REPORTING
ORG/AGENCY ASSIGN.
MILEPOST LIMITS

TRANSACTION CODE:
CAML-- (MAT'L LAB)
CASS-- (SIGN SHOP)
CAJO-- (SHOP J.O.)
CATC-- (SIGNALS)
CAMF-- (MANUFACT)
CASP-- (STKP.PRO.)
CAMT-- (MISC.MICE)
CAUS-- (OF SUPT.)

DATES	TYPES OF SERVICE (CIRCLE ONE)			
J.O. INITIATED	PREV.MAINT.	1	CONVERSION	5
EST. COMPLETE	BREAKDOWN	2	MODIFICATION	6
J.O. COMPLETE	ACCIDENT	3	PRODUCTION	7
	WARRANTY	4	NEW INSTALL.	8

DATE			LABOR				EQUIP. RENTAL	
MO.	DAY	YR.	LAST NAME FIRST TWO	SOC. SEC. NO.	ACT. NO.	HOURS	WORK UNITS COMPLETE	EQUIP. NO.	MILE/HOUR
				/ /					
				/ /					
				/ /					
				/ /					
				/ /					
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WORK DESCRIPTION:

APPROVED BY

REQUESTED BY

DOCUMENT NO.

(STAYS WITH EQUIPMENT)

FIGURE 1 Job order form.

contains name, Social Security number, activity number, and hours for work performed. Under "Last Name" the first two letters of the worker's last name would be given. The Social Security number along with the two-letter abbreviated last name provide a track as to who performs the work. Under "Hours" is given time spent on the activity, which is reported to the nearest whole hour when possible.

The number of work units completed for a particular activity are listed, and under "Equipment Rental" the number of the equipment and the miles or hours that it is used in the repair of another (for example, a transport or a shop truck) are given.

A written description of the work to be done is given on the form. This would be done after consultation with the operator or foreman requesting the job order. The mechanic can also write down additional work performed.

The form is signed by the shop superintendent, foreman, or mechanic who sets up the job order and says that the work will be done. The equipment operator or supervisor who is requesting the work to be done also signs.

This job order is a modification of previous job orders used. It is designed to fill information needs for many different departmental functions.

PM Form

The PM form (Figure 2) is used to provide information about oil changes, lubes, inspections, and

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PREVENTIVE MAINTENANCE
EQUIPMENT MANAGEMENT

EQUIPMENT NUMBER ☐☐☐☐☐ DESCRIPTION _____

METER READING MILES HOURS ☐☐☐☐☐

PM (A) E981 PM (B) E982 PM (C) E983 PM (D) E984 PM (E) E985

DATE			LABOR				WORK UNITS COMPLETE	REMARKS
MO.	DAY	YR.	LAST NAME (1st TWO)	SOC. SEC. NO.	ACT. NO.	HOURS		

COMMENTS _____

PERFORMED BY _____ CKD BY _____

FIGURE 2 PM form.

major PM functions. It lists the equipment number, meter reading, and a description of the equipment (Chevrolet, Ford, etc.).

The form reports who did the labor, the activity number for type of preventive maintenance, the number of hours used to perform the activity, and the work units. It also gives a written description of the work that was done or needs to be done. This form is separate from the job order so a history can be maintained on a specific piece of equipment.

The PM form is intended for all inspections (except a special major inspection) as well as for tire work. The operator fills out this form and keeps a copy for himself. Information from the form updates the PM schedule.

Output

The output from EMS is primarily batch reports of the type shown in Figure 3. They are produced weekly, monthly, quarterly, and yearly. To cut down on paper flow and make the reports more usable, summary and exception reporting is stressed. Depending on their information needs, different levels of management receive different reports. A list of all current reports produced is given as follows:

1. Management level
   a. Equipment rental rate variance report (quarterly): variance in cost and budget based on the actual rental rate;
   b. Rental rate analysis for operating cost (quarterly): calculated rental rate versus the budget rental rate;
   c. Repair frequency--labor (yearly): number of repairs and labor hours expended by class, category, activity, and district;
   d. Repair frequency--cost (yearly): computed repair costs based on labor and parts costs;
   e. Complement list (yearly or as needed): complete list of equipment by district; and
   f. Utilization analysis (yearly or as needed): equipment use by class and district compared against a standard established by the equipment superintendent.
2. District management level
   a. Out-of-commission report (weekly): equipment with open job order and estimated return date;
   b. PM schedule (monthly): list of equipment

DD-0608
HC001 022A

Report Page 01
Date 10/15/80
Time 14 25 50

DISTRICT 1

THE FOLLOWING VEHICLES ARE DUE FOR P.M. TYPE A THIS MONTH:

CLASS	CATEGORY	EQUIP. NUMBER	DESCRIPTION	LAST PREVENTATIVE MAINTENANCE DATE	METER	TYPE	LAST REPORTED METER HEADING	SCHEDULE BASIS	OVERDUE MILE/HR
AA	100	H01720	SEDAN, OLDS CUTLASS	3/03/80	17867	A	23149	6000	____
		1843	SEDAN, FORD	5/15/80	67214	C	73429	6000	215
	200	H04136	PICKUP 1/2 TON CHEV	5/10/78	7950	A	10725	3000	

THE FOLLOWING VEHICLES ARE DUE FOR P.M. TYPE B THIS MONTH:

BA	320	H06160	DUMP TRUCK 4 x 2	6/20/78	73141	A	27150	4000	9

FIGURE 3 PM schedule, October 1980.

for shop foremen that will require preventive maintenance;

c. Fluid use report (monthly): use of engine fluids (fuel, oil, antifreeze, etc.) by class;

d. Equipment maintenance analysis (monthly): total number of repairs (labor, hours, costs, and occurrences) and averages per repair; and

e. Report of downtime activities (yearly): listing of year's downtime by activity code.

3. On request

a. Job order analysis (complete report of the labor and parts expended on a particular job),

b. Most recent preventive maintenance reported (date of most recent work by equipment number),

c. Equipment master list (complete list of equipment by class, category, and district), and

d. Equipment maintenance history (entire maintenance history of a piece of equipment by activity).

The users can also generate their own reports with user-friendly languages. The EMS database and detail record were designed to allow users easy access with their own programs. This allows them to create reports that are timely and relevant. It also reduces the workload for the data processing staff. The master detail file contains the following information:

1. Equipment
   a. Class
   b. Category
   c. Number
   d. Description
   e. Serial number
   f. Model year
   g. Acquisition cost
   h. Acquisition year
2. Assignment
   a. District
   b. Organization
   c. Station
   d. Funding source
3. Preventive maintenance
   a. Schedule
   b. Interval
   c. Prior preventive maintenance
      (1) Date
      (2) Type
      (3) Meter reading
4. Fluid use
   a. Type
   b. Quantity
   c. Cost
5. Maintenance
   a. Usage
   b. Income
   c. Labor
   d. Parts
   e. Commercial repairs
   f. Accidents

BENEFITS OF EMS

Idaho's EMS provides managers with more timely and usable information about their fleet. EMS gives a way of tracking downtime, which may be due to several reasons, chiefly lack of parts or personnel. If one particular brand is consistently down because of lack of parts, this brand can be avoided in the future. For example, it was found that one make of equipment was down over 6 months awaiting a part whereas other makes experienced little or no downtime for that reason.

EMS captures costs. If a chainsaw costs $300 and $480 is spent on repairs and maintenance over one season, EMS provides this information to managers. Managers can track costs for different brands and decide how to spend money for equipment more effectively.

Using information from EMS, managers decided to purchase all trucks larger than pickups with diesel rather than gasoline power. EMS provided information on costs for purchase, maintenance, and operation for both diesel and gasoline trucks over the life of the equipment. This information was persuasive enough to convince the state purchasing agent to allow ITD to specify diesel-powered trucks for bidding purposes.

EMS provides information as to which districts use and need specialized equipment. Districts that show greater use of snow removal equipment get newer equipment and rotate their older, higher-mileage equipment to districts that do less snow removal. The use of specialized equipment such as roadgraders is tracked by EMS. Managers can decide whether to keep specialized equipment on the district's complement or to rent it when needed.

Utilization of other types of equipment is shown by EMS. All types of vehicles appear on the EMS database. After a utilization report was run on sedans, one administrator returned the car assigned to him to the motor pool.

PM information is captured and recorded by EMS. An oil sample is taken at every oil change for each piece of equipment and sent to the chemistry laboratory in Boise, where it is analyzed. The analysis shows any contamination in the oil sample, and engine problems can be pinpointed before they become serious. The analysis can also show whether the oil-change interval should be altered and can indicate which weights of oil are best for different conditions.

PROBLEM AREAS AND CHANGES TO EMS

To correct a problem in obtaining accurate meter readings, ITD implemented an editing procedure that eliminates meter readings that exceed a reasonable range. The acceptable range is between 0 and 600 miles since the last meter reading, and any meter reading that is not within this range is edited out. The meter reading is then corrected and reentered. This procedure assures reasonable meter readings. For accurate instead of merely reasonable meter readings, EMS depends on the districts to edit their data before submitting the readings to EMS.

Some users have had difficulty in assessing EMS. As the users have become more familiar and skillful with proper languages, problems have declined. Training classes have helped users become proficient in accessing the EMS database.

ITD changed from single to dual rental rates. Dual rates capture total equipment cost better than a utilization-based single rate. A fixed ownership rate is carried by the dual-rate system. This ownership rate covers the cost of replacement, storage, and insurance. The operations rate covers the costs of parts, supplies, fuels, maintenance, labor, and all other related costs of operation.

SUMMARY OF IDAHO'S EMS EXPERIENCE

The ITD EMS has helped provide equipment managers with timely, accurate information. Relevant information is presented in summary or exception reports. Users can access the EMS database for special reports. This makes the EMS flexible and responsive.

Problems have occurred in the interface between EMS and other systems. The introduction of TRMS altered much of the data collection for EMS. Data that once came directly from the districts now pass through the TRMS.

ITD is beginning to utilize 4 years of historical data for better equipment management. Idaho's EMS has become an integral part of all the management systems within ITD. ITD strives to keep EMS both useful and timely, providing equipment managers with information they need to achieve the greatest productivity at the lowest cost.

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Some Simple Methods of Maintenance Management Appropriate for Developing Countries

R. ROBINSON and M. S. SNAITH

ABSTRACT

Maintenance management in developing countries is discussed and some objectives for a maintenance management system are given. Two simple management systems appropriate for use in developing countries are described. The first is a manual system based on Transport and Road Research Laboratory Overseas Road Note 1 and the second is microcomputer-based and called System BSM. The methods of operation of these two systems are discussed under the headings of inventory, inspection, maintenance needs, costing, priorities, execution, and monitoring.

The successful introduction of a maintenance management system into a developing country should achieve several objectives. Among these will be the following:

1. The system will provide the means for estimating the actual maintenance budget that is required. This budget will depend on the types of maintenance procedures used, the frequency with which these are carried out, and the size of the management and organizational overhead needed to support the maintenance activity.
2. The system will also provide factual data to support budget requests when these are made to senior roads organization staff or to ministries of finance. These data will be obtained as a result of determining maintenance needs by using quantitative field inspections and monitoring work completed to ensure that it has been carried out in a cost-effective manner.
3. The system will also ensure an equitable distribution of budget over the whole country, recognizing that needs and costs will be different from region to region depending on geographical location, climate, topography, soils, and the particular nature of the network within the region.
4. The system will recommend priorities for work in the event of a shortfall in budget allocation by ranking maintenance activities on different roads. This will depend on the importance of the region in which the road is located, the political or strategic importance of the road in question, the traffic and axle loading, the type of road surface, and the rate of road deterioration that would be caused by deferral of the work. This last item will also depend on the climate, topography, and soil type in the area in which the road is located.
5. The system will contain a mechanism for monitoring the road network to ensure that all planned work is in fact carried out, that it is carried out efficiently, and that the work is achieving the desired results.

A maintenance management system normally contains the following components:

1. Inventory is used as the basic reference for planning and carrying out maintenance operations and inspections;
2. Inspection of road condition should be done by taking physical measurements of defects on the road network in the field;
3. Maintenance needs are determined by comparing the measurements of road condition with predetermined maintenance intervention levels;
4. Costing is applied to the identified maintenance tasks to determine the budget required;
5. Priorities are determined if the budget is insufficient for all of the identified work to be carried out; it is then necessary to determine which work should be undertaken and which should be deferred;