

CONCLUSIONS

The improvements to the Orange County MOPSS have been implemented, and the system is being monitored and updated by the EMA staff. The consultant has been retained to provide guidance in scheduling and annual updates. It has been determined that the modified system will remain dynamic and responsive to needs. The system will be updated annually to account for changes in costs, operating procedures, and technology.

Important management tools that the system provides, but which are not documented in this report, are

- Guidelines for work activity,

- Performance-based budgeting,
- Distribution of work,
- Leveling manpower,
- Work control methods, and
- Use of equipment.

The Orange County MMS provides up-to-date information rapidly so that managers can make timely decisions. Orange County is convinced that the revised system fully meets the objectives established 8 years ago for a maintenance management system.

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Modernizing Pennsylvania's Maintenance Management System

PHILIP W. AMOS

ABSTRACT

Pennsylvania's maintenance management system (MMS) was developed in the early 1970s and was operating statewide in 1975. When the system was developed it was state of the art, but computer technology has advanced significantly since that time. Thus the staff of the Pennsylvania Department of Transportation has been prompted to review and update its procedures for handling information. The primary objective for many modifications is to make the information collected available promptly to the field offices. On-line Flash reports have been developed. Each organization manager inputs the parameters for the information desired and receives a report on the screen of the organization's terminal that was generated in the central office computer. If the manager wishes a hard copy the report may be printed at the organization's printer. For example, a manager may obtain information on activities performed by each foreman so that the foreman's recent jobs may be reviewed and evaluated; or ask for information by Legislative Route to show what activities were performed and how many dollars were spent to maintain that highway. Recently reports have separate entries for units of work and the dollars spent by contractors and the activities performed by department forces.

of the art, but computer technology has advanced significantly in the last 8 years. This advancement has prompted the Pennsylvania Department of Transportation (PennDOT) to review and update the handling of information within the computerized MMS as well as to review the overall objectives of the system.

The rewriting of the programs for the computerized system is to be completed within the next 2 years. These revisions will clean up the patches in the system and integrate the data bases for MMS, the equipment management system, and the automated inventory system.

MODERNIZATION

The primary objective of the most recent improvements to PennDOT's MMS was to make the production and equipment information available to field offices as quickly as possible. Field personnel collect and enter the data so they should have access to the data as soon as the computer data bases are updated. The file containing the activity units and the personnel and equipment costs for that activity is updated daily.

To provide this information, on-line reports were developed. Because the computer responds instantly to on-line requests, these reports were named "Flash" reports in the central office at Harrisburg. By inputting certain parameter codes, the manager can select one of 10 reports and receive it at the screen on the county terminal. If a hard copy of the report is desired it may be printed out on the local printer. The following reports are available:

1. Activities on a selected Legislative Route (Figure 1),

Pennsylvania's maintenance management system (MMS) was developed in the early 1970s and became operational in 1975. The system at that time was state

HMFLASH
 ALL DATA HAS BEEN PRINTED
 FUNCTION LR (HI = RETURN)
 ORG 085 FORE
 FROM 11 03 83 TO 01 20 84
 LR 22006 SPUR

LR	S	DATE	ACT	ORG	FR	PROD UNITS	CONTRACTOR	DESCRIPTION
22006	1103	711122	085	43	0.0	TONS		ROADS-PAVED PATCHING-ME
22006	1103	711329	085	23	60.0	MAN HRS		DRAIN ACTIVITIES OTHER
22006	1104	711329	085	23	52.5	MAN HRS		DRAIN ACTIVITIES OTHER
22006	1109	711122	085	43	64.0	TONS		ROADS-PAVED PATCHING-ME
22006	1109	711122	085	43	0.0	TONS		ROADS-PAVED PATCHING-ME
22006	1209	711227	085	12	600.0	GALS		SHLD PVD SK PATCH LIQUI
22006	1209	711229	085	12	19.0	MAN HRS		SHOULDERS-PAVED OTHER
22006	1213	711314	085	33	35.0	FEET		CLEAN PIPES AND CULVERT
22006	1214	711339	085	12	38.0	MAN HRS		ROAD SEC RESTORE OTHER
22006	1215	711311	085	33	8.0	EACH		DRAIN CLEAN-INLET ENDWA

FIGURE 1 Report for a selected Legislative Route.

2. Activities on a selected Legislative Route performed by a selected foreman (Figure 2),
3. All activities performed by a selected foreman (Figure 3),
4. All production units for a selected activity (Figure 4),
5. Daily production inquiry and correction (Figure 5),
6. Status production report for one organization for selected activities (Figure 6),
7. Status production report for one activity for selected organizations (Figure 7),
8. Monthly work planned by department force and by contract for a selected activity (Figure 8),
9. Work plan inquiry and update (Figure 9), and
10. Year-to-date production inquiry and update (Figure 10).

Some examples of these reports and their uses may be of interest.

Work activity by foreman (Figure 11). The man-

ager inputs the organization code and the foreman number; the report is generated showing the date, the Legislative Route, the work units completed; and the efficiency of the crew is compared with a statewide standard for each activity performed.

Because this file is updated daily, a manager may easily identify the jobs done by each foreman. The manager may quickly review the efficiency of the foremen since the last monthly report or select several foremen or work sites for field review. The manager's evaluation of the performance of the foreman and his crew is based on the field review.

Work performed on a Legislative Route (Figure 12). The manager inputs the Legislative Route and the beginning and end dates of the period in which he is interested. The report shows the activity, the date performed, the foreman who performed the work, and the units of work done.

This report shows the work done, and gives an indication of the dollars spent, on that highway. This information is also available to the district and central office through the computer system.

HMFLASH
 ALL DATA HAS BEEN PRINTED
 FUNCTION LF (HI = RETURN)
 ORG 085 FORE 23
 FROM 11 03 83 TO 01 20 84
 LR 22006 SPUR

LR	S	DATE	ACT	ORG	FR	PROD UNITS	CONTRACTOR	DESCRIPTION
22006	1103	711329	085	23	60.0	MAN HRS		DRAIN ACTIVITIES OTHER
22006	1104	711329	085	23	52.5	MAN HRS		DRAIN ACTIVITIES OTHER

FIGURE 2 Report of activities on a selected Legislative Route by a selected foreman.

HMFLASH
 REPORT CONTINUED ON NEXT PAGE
 FUNCTION PF (HI = RETURN)
 ORG 085 FORE 23 ACTIVITY
 FROM 11 03 83 TO 01 20 84
 METH

FORE	DATE	PROD UNITS	PROD HRS	SUPT HRS	ACTIVITY	% EFF
23	11/09/83	15.0 EACH	30.0	0.0	711-311	82.5
23	12/05/83	16.0 EACH	25.5	0.0	711-311	103.5
23	12/06/83	15.0 EACH	30.0	0.0	711-311	82.5
23	12/14/83	17.0 EACH	37.5	0.0	711-311	74.8
23	12/20/83	11.0 EACH	22.5	0.0	711-311	80.6
TOTAL		74.0 EACH	145.5	0.0	711-311	83.9
23	12/08/83	1200.0 FEET	37.5	0.0	711-312	118.4
23	01/06/84	700.0 FEET	44.0	0.0	711-312	58.8
TOTAL		1900.0 FEET	81.5	0.0	711-312	86.2
23	12/16/83	35.0 FEET	67.5	0.0	711-314	5.8
TOTAL		35.0 FEET	67.5	0.0	711-314	5.8
23	11/03/83	60.0 MAN HRS	60.0	0.0	711-329	0.0
23	11/04/83	52.5 MAN HRS	52.5	0.0	711-329	0.0
23	11/10/83	37.5 MAN HRS	37.5	0.0	711-329	0.0
23	11/16/83	52.5 MAN HRS	52.5	0.0	711-329	0.0
23	11/17/83	52.5 MAN HRS	52.5	0.0	711-329	0.0

FIGURE 3 Production report for a selected foreman.

HMFLASH
 REPORT CONTINUED ON NEXT PAGE
 FUNCTION PA (HI = RETURN)
 ORG 085 FORE ACTIVITY 711 121 METH
 FROM 11 03 83 TO 01 20 84

FORE DATE	PROD UNITS	PROD HRS	ACTIVITY	% EFF
43 11/03/83	0.0 TONS	10.5	711-121	0.0
06 11/04/83	4.5 TONS	60.0	711-121	74.5
12 11/04/83	3.0 TONS	52.5	711-121	56.8
21 11/04/83	4.5 TONS	37.5	711-121	119.2
42 11/04/83	14.0 TONS	60.0	711-121	123.6
12 11/07/83	3.0 TONS	45.0	711-121	66.2
12 11/10/83	1.5 TONS	21.0	711-121	71.0
22 11/16/83	6.0 TONS	45.0	711-121	132.5
32 11/17/83	4.5 TONS	45.0	711-121	99.4
21 11/21/83	8.0 TONS	45.0	711-121	176.7
01 11/22/83	0.0 TONS	7.0	711-121	0.0
21 11/22/83	4.0 TONS	33.0	711-121	120.4
21 11/23/83	4.0 TONS	45.0	711-121	88.3
32 11/29/83	2.0 TONS	37.5	711-121	53.0
32 11/30/83	2.0 TONS	37.5	711-121	53.0
32 12/01/83	2.0 TONS	45.0	711-121	44.1

FIGURE 4 Production report for a selected activity.

HMFLASH
 REPORT CONTINUED ON NEXT PAGE
 FUNCTION PC (HI = RETURN)
 ORG 085 FORE ACTIVITY 711 121 METH
 FROM 11 03 83 TO 01 20 84

OPTION (I = INQUIRY; U = UPDATE)

REFERENCE NUMBER	"X"	ID	ORG	MM	DD	YY	SF	PGE	PGS	SUBMITTING FOREMAN	
831104	13313718	1	()	TI	085	11	03	83	02 043	500	HEBERLE J
831104	13423729	2	()	TI	085	11	03	83	02 057	500	HEBERLE J
831107	11002340	1	()	TC	085	11	04	83	06 001	001	NOLL ME
831109	12081337	1	()	TC	085	11	04	83	12 001	002	LITTLE C

CONTRACTOR	CONTR#	SYS	WD/LR	SP	PH	SEC	ORG	ACTIVITY	P	METH	CF	MFC
	000000		44444		9		085	711 121	2	01	43	C
	000000		44444		9		085	711 121	2	01	43	C
	000000		22019		9		085	711 121	2	01	06	B
	000000		139	3	9		085	711 121	2	01	12	B

PRDHRS	PRUNITS	\$FRSL	\$RNTEQ	\$DPTEQ	TRVHRS	TRVMI	SFTY	OTHR	HAUL
7 5	0 0	113	0	110	0 0	0 0	0 0	0 0	0 0
3 0	0 0	38	0	44	0 0	0 0	0 0	0 0	0 0
30 0	4 5	423	0	191	0 0	0 0	0 0	0 0	0 0
45 0	3 0	604	0	294	0 0	0 0	0 0	0 0	0 0

FIGURE 5 Production inquiry and correction report.

HMFLASH
 FUNCTION SA (HI = RETURN)
 ORG 085
 FROM 11 03 83 TO 01 20 84

	ACTIVITY 711 121	ACTIVITY 711 122	ACTIVITY 711 131	ACTIVITY 711 215	ACTIVITY	ACTIVITY	ACTIVITY
ANN PLN	1500.0	3375.0	5000.0	165.0			
YTD PLN	675.0	1800.0	.0	65.0			
YTD ACT	638.5	1980.0	.0	121.7			
JAN PLN	40.0	.0	.0	.0			
JAN ACT	17.5	.0	.0	.0			
DAYS ACT	116.5	64.0	.0	.0			
% ANN PLN	42.5 %	58.6 %	0.0 %	73.7 %	%	%	%
% YTD PLN	94.5 %	110.0 %	0.0 %	187.2 %	%	%	%

***** L E G E N D *****
 PLN = PLANNED PRODUCTION ACT = ACTUAL (REPORTED) PRODUCTION
 ANN = ANNUAL (FISCAL YEAR) YTD = YEAR TO DATE (JUL - DEC)
 % ANN PLN = % YTD ACT / ANN PLN JAN = LATEST MONTH REQUESTED
 % YTD PLN = % YTD ACT / YTD PLN DAYS = 11/03/83 - 01/13/84

FIGURE 6 Status report for selected activities of one organization.

HMFLASH

FUNCTION SO (HI = RETURN)
 ACTIVITY 711 121
 FROM 11 03 83 TO 01 20 84

	ORG 081	ORG 082	ORG 083	ORG 084	ORG 085	ORG 086	ORG 087
ANN PLN	700.0	1100.0	300.0	3700.0	1500.0	.0	6000.0
YTD PLN	350.0	475.0	120.0	1775.0	675.0	.0	3450.0
YTD ACT	347.2	421.0	142.9	2339.8	638.5	.0	2956.0
JAN PLN	25.0	25.0	.0	100.0	40.0	.0	300.0
JAN ACT	8.3	10.0	- 1.0	23.5	17.5	.0	42.0
DAYS ACT	28.8	103.0	17.5	100.1	116.5	.0	269.0
% ANN PLN	49.6 %	38.2 %	47.6 %	63.2 %	42.5 %	0.0 %	49.2 %
% YTD PLN	99.2 %	88.6 %	119.0 %	131.8 %	94.5 %	0.0 %	85.6 %

***** L E G E N D *****
 PLN = PLANNED PRODUCTION ACT = ACTUAL (REPORTED) PRODUCTION
 ANN = ANNUAL (FISCAL YEAR) YTD = YEAR TO DATE (JUL - DEC)
 % ANN PLN = % YTD ACT / ANN PLN JAN = LATEST MONTH REQUESTED
 % YTD PLN = % YTD ACT / YTD PLN DAYS = 11/03/83 - 01/20/84

FIGURE 7 Status report for one activity of selected organizations.

HMFLASH

FUNCTION WA (HI = RETURN)
 ORG 085 ACTIVITY 711 121
 FY 83

	<-----TOTAL----->		<---DEPARTMENT--->		<---CONTRACTOR--->		
	PLANNED	ACTUAL	PLANNED	ACTUAL	PLANNED	ACTUAL	
JUL	210.0	198.5	210.0	198.5	0.0	0.0	JUL
AUG	125.0	43.0	125.0	43.0	0.0	0.0	AUG
SEP	110.0	88.5	110.0	88.5	0.0	0.0	SEP
OCT	110.0	177.5	110.0	177.5	0.0	0.0	OCT
NOV	60.0	89.0	60.0	89.0	0.0	0.0	NOV
DEC	60.0	42.0	60.0	42.0	0.0	0.0	DEC
JAN	40.0	17.5	40.0	17.5	0.0	0.0	JAN
FEB	40.0	0.0	40.0	0.0	0.0	0.0	FEB
MAR	100.0	0.0	100.0	0.0	0.0	0.0	MAR
APR	275.0	0.0	275.0	0.0	0.0	0.0	APR
MAY	185.0	0.0	185.0	0.0	0.0	0.0	MAY
JUN	185.0	0.0	185.0	0.0	0.0	0.0	JUN
JUL-JUN	1500.0	656.0	1500.0	656.0	0.0	0.0	JUL-JUN

FIGURE 8 Work plan report for selected activity.

HMFLASH

WORK PLAN DATA IS READY FOR UPDATING
 FUNCTION WC (HI = RETURN)
 ORG 085
 FY 83

OPTION ?? IP = INQUIRE PLN; UP = UPDATE PLN; IA = INQUIRE ACT; UA = UPDATE ACT

	ACTIVITY 711 121		ACTIVITY 711 215		ACTIVITY 711 131		
	DEPT	CNTR	DEPT	CNTR	DEPT	CNTR	
JUL	210 0	0 0	50 0	0 0	0 0	0 0	JUL
AUG	125 0	0 0	0 0	0 0	0 0	0 0	AUG
SEP	110 0	0 0	0 0	0 0	0 0	0 0	SEP
OCT	110 0	0 0	15 0	0 0	0 0	0 0	OCT
NOV	60 0	0 0	0 0	0 0	0 0	0 0	NOV
DEC	60 0	0 0	0 0	0 0	0 0	0 0	DEC
JAN	40 0	0 0	0 0	0 0	0 0	0 0	JAN
FEB	40 0	0 0	0 0	0 0	0 0	0 0	FEB
MAR	100 0	0 0	0 0	0 0	0 0	0 0	MAR
APR	275 0	0 0	0 0	0 0	1500 0	0 0	APR
MAY	185 0	0 0	50 0	0 0	3500 0	0 0	MAY
JUN	185 0	0 0	50 0	0 0	0 0	0 0	JUN
JUL-JUN	1500 0	0 0	165 0	0 0	5000 0	0 0	JUL-JUN

FIGURE 9 Work plan inquiry and update.

HMFLASH

FUNCTION YC (HI = RETURN)
 ORG 085 FORE ACTIVITY 711 121 METH

FY 83
 OPTION ? (I = INQUIRE; U = UPDATE; A = ADD)

ORG	ACTIVITY	MD	FM	MFC	I	MON	YTD-UNITS	MO	MO-UNITS	MO	MO-UNITS	MO	MO-UNITS
085	711121	01	00	B	P	JAN	3 5						
085	711121	01	01	C		JAN	0						
085	711121	01	06	B		JAN	12 0						
085	711121	01	06	D		JAN	3 0						
085	711121	01	12	B		JAN	6 0						
085	711121	01	12	C		JAN	2 0						

PRODHOURS	\$PERSNL	\$RENTEQ	\$DPTEQ	TRVLHRS	TRVLM	SFTYHRS	OTHRHRS	HAULHRS
85 0	1136	0	544	0	0	0	0	0
10 0	151	0	144	0	0	0	0	0
178 5	2575	0	1070	0	0	0	0	0
17 5	261	0	134	0	0	0	0	0
109 5	1454	0	836	0	0	0	0	0
42 0	583	0	308	0	0	0	0	0

FIGURE 10 Year-to-date production inquiry and update.

HMFLASH
 REPORT CONTINUED ON NEXT PAGE
 FUNCTION PF (HI = RETURN)
 ORG 085 FORE 23 ACTIVITY METH
 FROM 10 03 82 TO 12 30 83

FORE	DATE	PROD UNITS	PROD HRS	SUPT HRS	ACTIVITY	% EFF
23	11/09/83	15.0 EACH	30.0	0.0	711-311	82.5
23	12/05/83	16.0 EACH	25.5	0.0	711-311	103.5
23	12/06/83	15.0 EACH	30.0	0.0	711-311	82.5
23	12/14/83	17.0 EACH	37.5	0.0	711-311	74.8
23	12/20/83	11.0 EACH	22.5	0.0	711-311	80.6
TOTAL		74.0 EACH	145.5	0.0	711-311	83.9
23	12/08/83	1200.0 FEET	37.5	0.0	711-312	118.4
TOTAL		1200.0 FEET	37.5	0.0	711-312	118.4
23	12/16/83	35.0 FEET	67.5	0.0	711-314	5.8
TOTAL		35.0 FEET	67.5	0.0	711-314	5.8
23	11/01/83	51.5 MAN HRS	51.5	0.0	711-329	0.0
23	11/02/83	52.5 MAN HRS	52.5	0.0	711-329	0.0
23	11/03/83	60.0 MAN HRS	60.0	0.0	711-329	0.0
23	11/04/83	52.5 MAN HRS	52.5	0.0	711-329	0.0
23	11/10/83	37.5 MAN HRS	37.5	0.0	711-329	0.0
23	11/16/83	52.5 MAN HRS	52.5	0.0	711-329	0.0

FIGURE 11 Sample production report for a selected foreman.

HMFLASH
 ALL DATA HAS BEEN PRINTED
 FUNCTION LR (HI = RETURN)
 ORG 085 FORE
 FROM 10 03 82 TO 12 30 83
 LR 22006 SPUR

LR	S	DATE	ACT	ORG	FR	PROD UNITS	CONTRACTOR	DESCRIPTION
22006	1101	711329	085	23	51.5 MAN HRS		DRAIN ACTIVITIES OTHER	
22006	1102	711329	085	23	52.5 MAN HRS		DRAIN ACTIVITIES OTHER	
22006	1103	711122	085	43	0.0 TONS		ROADS-PAVED PATCHING-ME	
22006	1103	711329	085	23	60.0 MAN HRS		DRAIN ACTIVITIES OTHER	
22006	1104	711329	085	23	52.5 MAN HRS		DRAIN ACTIVITIES OTHER	
22006	1109	711122	085	43	64.0 TONS		ROADS-PAVED PATCHING-ME	
22006	1109	711122	085	43	0.0 TONS		ROADS-PAVED PATCHING-ME	
22006	1209	711227	085	12	600.0 GALS		SHLD PVD SK PATCH LIQUI	
22006	1209	711229	085	12	19.0 MAN HRS		SHOULDERS-PAVED OTHER	
22006	1213	711314	085	33	35.0 FEET		CLEAN PIPES AND CULVERT	
22006	1214	711339	085	12	38.0 MAN HRS		ROAD SEC RESTORE OTHER	
22006	1215	711311	085	33	8.0 EACH		DRAIN CLEAN-INLET ENDWA	

FIGURE 12 Sample Legislative Route report.

Higher management can ascertain whether the county organization is spending its resources on the high-ways with the highest priority.

This report also may be used in public relations: In discussions with residents it helps to know exactly what has been done to improve that highway; and the report is useful in discussing complaints made by users or the highway. The input will be expanded to include highway section number

so that the data will be more site specific and will be more useful in tort liability cases.

Work status report (Figure 13). The manager inputs his organization, the beginning and end dates of the period in question, and the activities in which he is interested. The report shows the annual plan, the monthly plan, the actual work units completed year-to-date and this month within the date parameters requested, and total year-to-date work

HMFLASH

FUNCTION SA (HI = RETURN)
 DRG 085
 FROM 10 03 83 TO 12 30 83

	ACTIVITY 711 121	ACTIVITY 711 122	ACTIVITY 711 124	ACTIVITY 711 215	ACTIVITY 711 131	ACTIVITY 711 221	ACTIVITY 712 522
ANN PLN	1500.0	3375.0	10000.0	165.0	5000.0	180.0	50000.0
YTD PLN	615.0	1800.0	10000.0	65.0	.0	100.0	5000.0
YTD ACT	596.5	1980.0	113932.0	121.7	.0	151.0	.0
DEC PLN	60.0	.0	.0	.0	.0	.0	12500.0
DEC ACT	42.0	.0	.0	.0	.0	.0	13515.0
DAYS ACT	131.0	64.0	.0	.0	.0	15.5	13515.0
% ANN PLN	39.7 %	58.6 %	104.5 %	73.7 %	0.0 %	83.8 %	0.0 %
% YTD PLN	96.9 %	110.0 %	104.5 %	187.2 %	0.0 %	151.0 %	0.0 %

***** L E G E N D *****
 PLN = PLANNED PRODUCTION ACT = ACTUAL (REPORTED) PRODUCTION
 ANN = ANNUAL (FISCAL YEAR) YTD = YEAR TO DATE (JUL - NOV)
 % ANN PLN = % YTD ACT / ANN PLN DEC = LATEST MONTH REQUESTED
 % YTD PLN = % YTD ACT / YTD PLN DAYS = 11/01/83 - 12/30/83

FIGURE 13 Sample report for selected activities.

units without considering that date. The percentage of the plan completed is also included.

This report allows the manager to compare actual work accomplished with the plan and decide what resources are required to complete the original plan. Up to seven activities may be shown on the one report. Although the Flash reports have proved to be very successful and many managers are using them frequently, there is still a need to access additional information and to manipulate it in other ways.

To ease some of the reporting difficulties, the production hours and the support hours have been combined. The production hours were those hours the crew spent performing the activity, whereas the support hours were those hours used to travel, direct traffic, and haul materials. This combination required that "standard" hours be changed to include support hours, so that the efficiency of a crew, as measured by production hours, cannot be manipulated by moving production hours to support hours.

The department provides two software packages to the counties: (a) MARK IV system from Informatics, Inc. and (b) a departmental reporting system (ADRS) from IBM. Mark IV provides the counties with the capability to access most of the central office information on production and costs, extract the desired data, massage it, and print a report. ADRS provides the county with the capability to build data files on the mainframe that are of interest only to that county. ADRS files are protected by the users password.

CONTRACT WORK UNITS

Each county develops a monthly work plan that is retained in the central computer. The primary concern has been that each county meet its production goals no matter who does the work.

Now the plan is being designed to show the work to be done by department forces and work to be done by outside contractor. (All production and cost reports are now broken down into contractor and department force activities.) This allows for better evaluation of the efficiency of department forces and allows the manager to distribute manpower and equipment more effectively.

THE FUTURE

The efficiency of county garages is of utmost concern to the department. Should the major equipment repair be done by the department or should it be done by a contractor? The first step in analyzing this problem was to develop a new work order form, which specifies the job to be done and the estimated time to complete the job. The follow-up on this work order form is now a manual procedure. The intent is to file these data in the central computer so that the time to perform like activities in different garages can be compared.

The next step will be to determine the efficiency of each garage. After this evaluation, action will be taken to either continue major repairs of equipment or contract them out.

The equipment management system, the automated inventory system, and the MMS were developed at different times, so each is an independent computer system. Within the next 2 years the department will develop an integrated data base for the three systems with a common input form that shows the man-hours spent on the activity, the materials used, and the equipment used. This combined form will allow the foreman to code all his information for 1 day on one form. PennDOT is in the process of hiring a consultant to update the three systems, and the screen format is to be changed to handle these data.

MICROCOMPUTERS

Each district organization now has a microcomputer that is capable of going on-line to the central computer. It is expected that the field offices will build an annual work plan on the microcomputer; the cassette may then be read by the central computer. The microcomputer will assist in building the plan by using formulas based on established work standards to calculate the manpower and equipment required to carry out the plan for each activity. Any change in work units for an activity would immediately result in a recalculation of resource requirements. For example, although the work plan is to be built on a monthly schedule, it may be broken down to a weekly or daily schedule at the manager's discretion.

The pilot program was developed in one district. It has been installed statewide. The MMS coordinator is able to build the county annual work plans within the limits of the county's personnel and equipment resources. Only after these plans are fully developed is the plan input to the files on the mainframe.

CONCLUSION

Productivity and efficiency appear to be tied to the

availability of data to substantiate daily decision making and daily plans and in giving proper direction to the work force. The telecommunications network in Pennsylvania is being systematically upgraded to provide managers with the information required to manage operations in an efficient manner.

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Second-Generation Highway Maintenance Management Systems

MARTIN C. RISSEL

ABSTRACT

Highway maintenance management systems are composed of six interrelated system elements: planning, budgeting, scheduling, performing, reporting, and evaluating. Improvements must be made in all of these elements to develop a second-generation maintenance management system, which is a far more effective and responsive management tool. When highway maintenance management systems were first developed, it was established that they were being designed for managing maintenance to avoid the implication that they were an accounting system or could be used for one. The rigid adherence to this precept, although it eliminated some possible problems, also created deficiencies. The need for this separation was also brought about by the relatively unsophisticated state of computer technology at the time when maintenance management systems were first designed. Advances in computer technology and data management now permit the convenient and efficient transfer of data between systems. The elimination of deficiencies common to early system designs through the use of these advances is the source of opportunities for the development of second-generation maintenance management systems. Some of the advantages that can be attained are a reduction in the number of forms completed in the field and the amount of information on them, greatly simplified means of collecting accurate costs when required for invoicing, labor costs that may be reconciled exactly with those obtained from a payroll system, equipment costs that exactly reflect rental rates from the equipment management system, the elimination of the necessity of recording management information on equipment reports and salary vouchers, improved accuracy of material

costs, and improved costs and procedures for the development of performance budgets.

Highway maintenance management systems (MMSs) were first developed in an attempt to provide the same advantages to those responsible for maintaining highways as had been available for many years to those managing highway construction programs. The basic concepts and the system elements were identical to those used for managing any complex undertaking regardless of the field of endeavor. These system elements and their relation can conveniently be shown on a simple diagram (Figure 1).

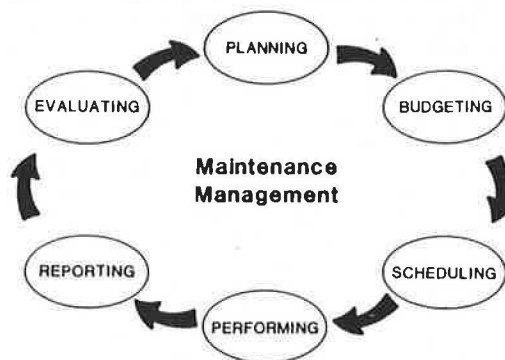


FIGURE 1 Relation of system elements.

Before a means by which an MMS can be upgraded to a second generation is developed, a review of the elements of a typical system and the part each one plays in its successful operation is necessary. Each system element must operate satisfactorily to make a complete system that will offer all the benefits that such a system should provide. The expense and effort of a system's acquisition and operation must also be justified.