

# **A Scheduling and Performance Evaluation System for Utah's Basic Maintenance Management Units**

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Utah has recently undertaken the development and implementation of a computerized maintenance management system. Components of this system include performance standards, a maintenance management reporting system, planning processes and performance evaluation techniques. However, the computerized system is not designed to schedule the basic management units or provide short-range operating guidance.

This paper presents a technique which we feel allows our maintenance field organizations to formalize scheduling processes and conduct more timely performance evaluations. The scheduling and performance evaluation technique began operating on a statewide basis July 1, 1968, after trial on a more limited scale. We anticipate further revisions in the procedures but are convinced that the general approach will continue to prove itself.

The development of the system required an evaluation of characteristics of our particular organization. The major factors considered important in the development are the following:

- First-line supervisors most of whom have high school education.
- First-line supervisors who have traditionally been working members of the crew.
- Basic management units which are physically separated from each other and from their respective district headquarters by considerable distances.
- Basic management units most of which require a staff of only 4 to 6 men.
- Performance standards which have been and will continue to be developed to provide first-line supervision with operating guidelines.
- First-line supervisors who have traditionally been responsible for need identification, scheduling, and performance of a majority of the maintenance activities.
- A computerized maintenance management information system.

The resulting scheduling and performance evaluation system design has the following characteristics:

1. It is non-computerized.
2. It continues to place considerable managerial responsibilities on the first-line supervisor.
3. It minimizes the time lag between performance and evaluation.
4. It incorporates performance standards.

Although there is a definite tie between the scheduling process and the evaluation process, for discussion purposes they are treated separately.

## SCHEDULING

A flow chart of the scheduling process is shown in Figure 1. Three distinct scheduling relationship phases are apparent: general scheduling, specific maintenance need identification, and resource scheduling.

The general scheduling phase involves the establishment of guidelines for scheduling maintenance activities which, out of necessity or desirability, are best performed during specific times of the year. Figure 2 represents the results of this determination in the form of an annual schedule for major maintenance activities. Its purpose is to provide a general planning framework for the first-line supervisor. Start and completion dates indicated on the schedule are not absolute. The intent is to direct the attention of the first-line supervisor towards those activities and programs which are to receive primary attention during the general periods indicated. It was decided that the distinction between those maintenance activities which are the total responsibility of the first-line supervisor for need identification and scheduling and those activities which require district authorization prior to performance should be made on the annual schedule. This distinction is designated in Figure 2 by the categories "routine shed maintenance activities" and "special shed maintenance activities," respectively.

The specific maintenance need identification phase (Fig. 1) consists of the process during which specific maintenance activities, programs or projects are identified and detailed for future accomplishment. Responsibility for need identification of routine shed maintenance activities falls to the first-line supervisor and is carried out during the weekly inspection tour of his road system. During this inspection particular attention is paid to those activities noted on the annual schedule. Additional guidance is provided by reference to the pertinent performance standards. Figure 3 is a copy of a typical performance standard and illustrates the format developed for use by the first-line supervisors. A pad of the form in Figure 4 is carried by the first-line supervisor for making note of the item requiring attention.

Identification and detailing of special shed maintenance activities and betterment projects is the responsibility of the district-level managers. Scheduling is performed by the first-level supervisors with necessary district coordination. The inspection trips are conducted semiannually by district-level supervisors in the company of the first-line supervisors. Upon completion of the inspection, the first-line supervisor is provided with an itemization of the special maintenance and betterment jobs to be accomplished during the coming six-month period. Figure 5 is an example of a completed itemized special maintenance activities form provided the first-line supervisor. As additional special items arise, they are added to the list.

The resource scheduling phase (Fig. 1) involves the development of a weekly schedule by the first-line supervisor. Items scheduled include those noted for need during the weekly inspection as well as those listed on the itemized special maintenance activities form. Figure 6 is an example of a weekly schedule which indicates what work is to be done, where it is to be done, how much is to be done, what is to be used, when it is to be done, and who is to do it. Alternative activities are listed in anticipation of inclement weather, or other situations which require deviations from the scheduled activities.

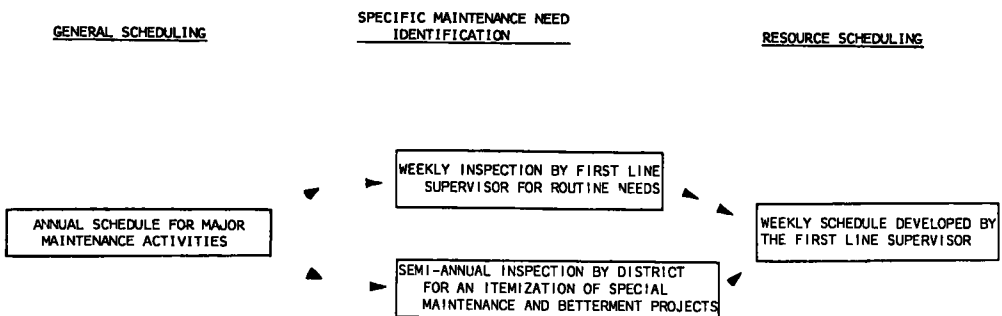
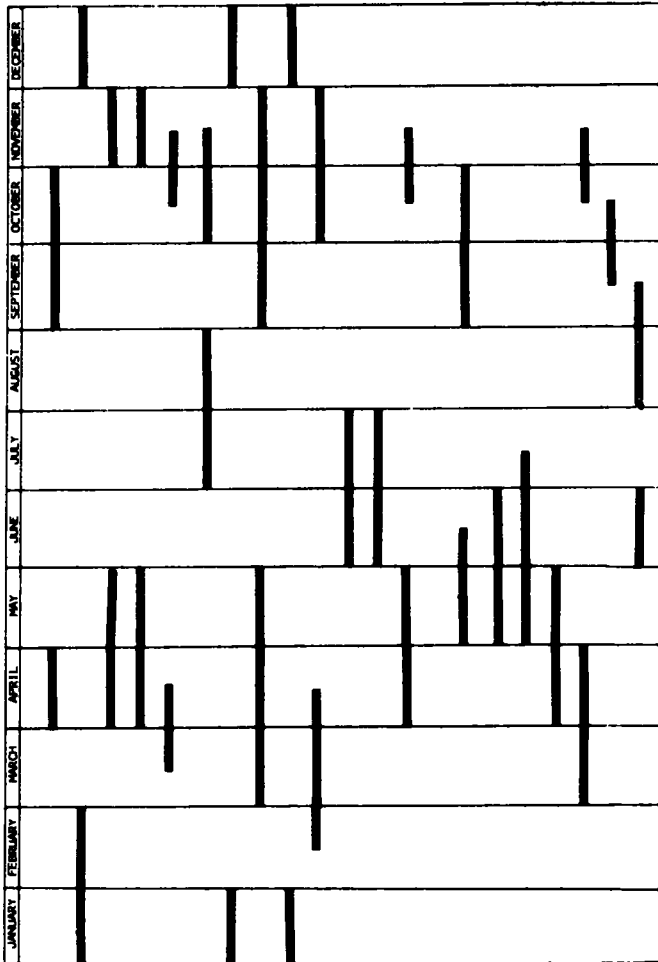


Figure 1. Scheduling process flow chart.

ANNUAL SCHEDULE FOR MAJOR SHED MAINTENANCE ACTIVITIES



NOTE

This schedule indicates those months during which the Shed Foreman should direct his attention to the Maintenance Activities which can be anticipated and should be scheduled and performed weather permitting, during specific months. These activities classified as "Special Shed Maintenance Activities" require District approval prior to the scheduling and performance by Shed Foreman.

• Refer to PERFORMANCE STANDARDS for desired methods and procedures.

Figure 2.

PERFORMANCE STANDARD  
JUNE 1, 1968

ACTIVITY 171-100

ANNUAL SIGN AND POST MAINTENANCE PROGRAM

RESPONSIBILITY - Shed Foreman

DEFINITION - The specifically planned and scheduled annual maintenance of all signs, sign posts and marker posts throughout the State's road system. To include the conduct of a night reflectivity survey, replacement, painting and straightening of signs and or posts as performed as a part of the annual program.

SCHEDULING CONSIDERATIONS - The annual sign and post maintenance program is to be performed during the months of June and July. Surveys of sign, reflector and post replacement requirements should be conducted early enough to provide ordering lead time.

QUALITY AND WORKMANSHIP - During the conduct of the Annual Sign and Post Maintenance Program, the required maintenance should be given to the listed observed conditions.

<u>Required Maintenance</u>	<u>Observed Conditions</u>
1. Paint post in accordance with standard	1. Paint peeling 2. Post superficially scarred or scratched.
2. Replace post	1. Post broken 2. Post unsound 3. Post badly scarred.
3. Replace sign or delineator	1. Sign or delineator damaged 2. Loss of reflectiveness

METHOD AND PROCEDURE -

1. Conduct night survey to determine and mark signs and delineators in need of replacement.
2. Conduct day survey to determine needed sign replacements.
3. Order signs and delineators.
4. Perform replacements, painting and straightening as needed.

CREW ARRANGEMENT - 2 Men, 1 Truck - 0101

EXPECTED PERFORMANCE -

Daily Production - 20-26 sign, marker post or delineator installations.  
Productivity - .6 - .8 man hours/installation

Figure 3.

MAINTENANCE NEEDS	
date <u>June 7</u>	
ACTIVITY DESCRIPTION <u>Mowing</u>	
LOCATION <u>Selma south to Aurora Rd</u>	
ESTIMATE of AMOUNT of WORK <u>56 acres</u>	ADDITIONAL COMMENTS <u>we should get</u>
COMMENTS (priority, scheduling considerations, etc ) <u>- make arrangements to get best way mower</u>	<u>them in the next two weeks</u>
<u>- need to cut weeds before they go to seed - Yegon</u>	
(FRONT)	
	(BACK)

Figure 4.

### PERFORMANCE EVALUATION

The performance evaluation procedure involves a comparison of actual performance with the performance guidelines provided. Indications of actual performance are provided by data from the reporting system and actual field observation. Because the system is to provide performance indicators with a minimum of time lag between performance and evaluation, the reported data are manually tabulated in the district offices by the district maintenance analyst. This manual field evaluation process does not eliminate the need for or desirability of a quarterly, semiannual or annual, computerized summary performance report. The utilization of manually tabulated data enables corrective assistance to be provided on a more timely basis.

Figure 7 is an arrow diagram of the evaluation procedure. The guidelines provided to the first-line supervisors consists of the annual maintenance schedule, performance standards, and an itemized list of special projects (Figs. 2, 3, and 5). Quantitative reflections of actual performance are provided by the maintenance management reporting system every 15 or 16 days. A copy of the period activity record formed used by the reporting system is shown in Figure 8.

In order for the system to direct efforts towards corrective actions, it needs to be able to answer the following questions:

1. What crew arrangements are being used?
2. What productivity rates are being attained?
3. Are the itemized activities being accomplished?
4. Are efforts being directed towards accomplishment of the maintenance activities and programs indicated on the annual schedule?
5. What methods and procedures are being used?
6. What levels of quality and workmanship are being attained?

ITEMIZED SPECIAL MAINTENANCE ACTIVITIES

ACTIVITY NUMBER	ACTIVITY	LOCATION	ESTIMATED AMOUNT OF WORK	MATERIALS REQUIRED	CREW ARRANGEMENT	ESTIMATED CREW DAYS
112-100	SURFACE REPLACEMENT	NORTH OF SALINA	50 YDS	1/2" BITUMINOUS	STANDARD	1
112-200	LEVEL (FOR SEAL)	FAIRVIEW TO MILK BARN	24 YDS	1/2" BITUMINOUS (-) 1 MAN & 1 DUMP	STANDARD	1
112-200	LEVEL	U-11 NORTH OF FT GREEN	1300 YDS	1/2" BITUMINOUS (-) 1 MAN & 1 DUMP	STANDARD	18
191-900	EXTRAORDINARY REPAIR	FAIRVIEW CANYON		AS REQUIRED		
163-900	DRAINAGE REPAIR	WEST OF CHESTER			5 MEN, 1 GRADER, 1	10
153-900	R/W CLEARING	U-11 WEST OF CHESTER			LOADER AND 4 TRUCKS	
153-900	R/W CLEAN, SHAPE AND SEED	U-116 NORTH OF FREEDOM			3 MEN, 1 TRUCK, 1	2
153-900	R/W CLEAN, SHAPE AND SEED	U-11 SOUTH OF FT. GREEN	( IN PROGRESS)		LOADER AND 1 GRADER	
153-900	OPEN SIGHT DISTANCE	STRAIGHT JCT. (89 & U-117)			3 MEN, 1 TRUCK, 1	3
SPEC. AUTH.	RESURFACE	NORTH OF WALES		AS REQUIRED	LOADER AND 1 GRADER	
SPEC. AUTH.	UP GRADING SIGNS	ALL ROADS		AS REQUIRED		
SPEC. AUTH.	GREEN THUMB PROJECT	MAINTI TEMPLE		AS REQUIRED		
	BUILD COLD-MIX STOCKPILE	FOUNTAIN GREEN	1400 YDS		HAUL-4 MEN & 4 TRUCKS	5
	BUILD COLD-MIX STOCKPILES	MT PLEASANT STATION (SHED)	600 YDS.		MIX-1 MAN & 1 GRADER	4
					HAUL-4 MEN, 3 TRUCKS,	
					AND 1 LOADER	1-1/2
					MIX-1 MAN AND 1 GRADER	3

Figure 5.



## SHED SCHEDULE FOR THE WEEK BEGINNING

July 1, 1968

### SCHEDULED ACTIVITIES

Activity Number	Activity Description	Job Location	Planned Amount of Work	Monday	Tuesday	Wednesday	Thursday	Friday	Personnel Assigned	Comments
12-400	SURFACE REPAIRS	7 MI. WEST BURG VILLE RT 77	20cy	5	5				ALL	WATER - 1/2 GAL PER 100 LB. ASPHALT
11-100	25 TON PAVEMENT	RT 661 - 1.9 MI	1cy	3					FAIR PER BURKE	WATER - 1/2 GAL PER 100 LB. ASPHALT
11-500	APPROX. 1000 LITTERS CURB	ALL SYSTEM		1					GLADE	WATER - 1/2 GAL PER 100 LB. ASPHALT
11-200	MOWING	EAST ON RT 667 3/4 MI. S. BURG VILLE		1					NEAL	WATER - 1/2 GAL PER 100 LB. ASPHALT
11-100	GRASS CUTTING	RT. 743	3 1/2						DEE	WATER - 1/2 GAL PER 100 LB. ASPHALT
11-500	ADAMBLE 5026								DEE	WATER - 1/2 GAL PER 100 LB. ASPHALT
11-500	LEAVE					2		2	EARL-BURKE	WATER - 1/2 GAL PER 100 LB. ASPHALT

### ALTERNATE ACTIVITIES

11-200	APPROX. 1000 LITTERS CURB	RT 77 3/4 MI WEST BURG VILLE	20cy	4						WATER - 1/2 GAL PER 100 LB. ASPHALT
11-200	MOWING	RT 667		2						WATER - 1/2 GAL PER 100 LB. ASPHALT
11-500	ADAMBLE 5026			3						WATER - 1/2 GAL PER 100 LB. ASPHALT
11-500	LEAVE			2						WATER - 1/2 GAL PER 100 LB. ASPHALT



**SHED NUMBER 328**

**NOTES:**  
 1. All personnel responsible for the proper setting, setting pattern, and amount of work.  
 2. Work areas should be laid out in advance so that crews will know exactly where work is to be performed.

Figure 6.

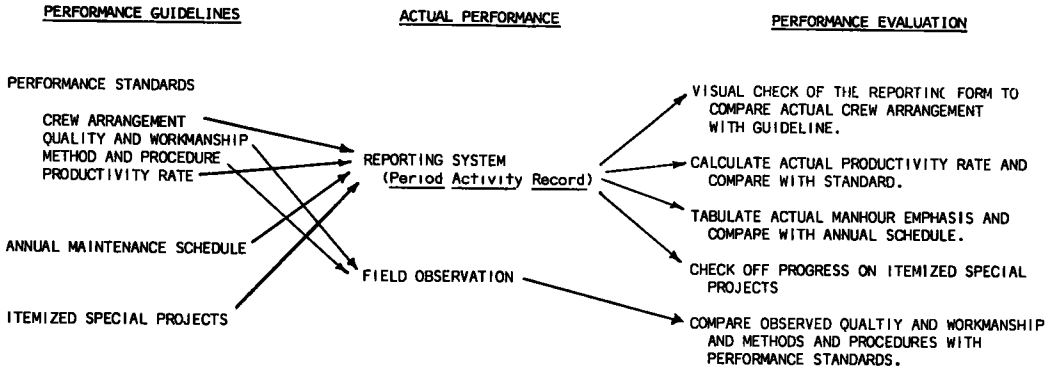


Figure 7. The performance evaluation process.

Answers to these questions, as provided by the reporting system and field observations, are compared with the guidelines in the form of performance standards, annual schedule, and itemized activities. Analytical determinations are made in the following manner.

Crew arrangements on the various activities are determined by a visual inspection of the portions of the period activity record which indicate the number of men and number and types of equipment. It is readily apparent to the district maintenance analyst that the two operations in Figure 9 were staffed with 3 men, 1 truck and 1 loader, and 2 men, 1 truck and 1 loader, respectively.

Productivity rates are manually calculated for each pertinent activity by utilization of the manhour and accomplishment data on the period activity record. Figure 10 is the form used to maintain a cumulative calculation of the rates for each organizational unit. Cumulative data are used in order to compensate for unusual circumstances that may affect the rate for any single period.

Progress with regard to the itemized special maintenance activities is continually maintained by striking them off the list as they are completed.

Conformity with the maintenance effort desires expressed on the annual schedule is determined by the district maintenance analyst through use of the form in Figure 11. The manhours expended during each period on the listed activities are tabulated from the period activity record and posted on the form (Fig. 11). To the extent the major efforts as represented by manhours generally coincide with the shaded periods, the annual schedule is being followed.

Determinations of method and procedure, quality and workmanship require on the spot observations before, during, and/or after the performance of the specific activities. To some extent gross method, quality or procedural deviations will reflect themselves in the productivity rates in the long run. However, when possible, actual observations are desirable.

Substantial deviations from the performance standards and annual schedule or lack of expected progress on the itemized activities without apparent cause are called to the attention of the district maintenance engineer or district maintenance supervisor by the district maintenance analyst. District managers then direct their efforts towards establishing cause and providing corrective assistance as required.



P.A.R.

# PERIOD ACTIVITY RECORD

Man-assignment Unit				Activity				Road Class				Authority Number				Road Section or Project Number				Period ending Year, Month, Day							

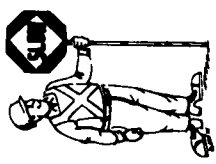
## Comments

Day of the month

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

### RECORD OF LABOR USED

Total Number of Men Used on This Activity		TOTAL	Planned
Regular Hours of Salaried Employees			
Regular Hours of Temporary Employees			
Total Overtime Hours			



### RECORD OF EQUIPMENT USED

Code	Class	Hours or Miles	TOTAL	Planned

### RECORD OF MATERIAL USED

Stockpile Number	Inventory Number	Unit	TOTAL	Planned
Quantity				

### RECORD OF ACCOMPLISHMENT

Measure of Accomplishment	Quantity	TOTAL	Planned

Figure 8.

# PERIOD ACTIVITY RECORD

P.A.R.

Management Unit <b>321</b>	Activity <b>111109</b>	Road <b>7</b>	Authority Number	Road Section or Project Number	Period ending Year, Month, Day <b>68 7 15</b>
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Day of the month

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31														

Comments

## RECORD OF LABOR USED

Total Number of Men Used on This Activity: **3**

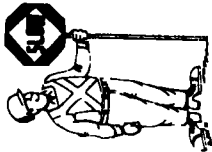
Regular Hours of Salaried Employees: **24**

Regular Hours of Temporary Employees: **2**

Total Overtime Hours: **16**

## RECORD OF EQUIPMENT USED

Code	Class	Hours or Miles	TOTAL	Planned
01 04		7		
09 02		1		
		7		
		1		



## RECORD OF MATERIAL USED

Stock Number	Inventory Number	Quantity	TOTAL	Planned
3316	6-950419	3		
		2		

## RECORD OF ACCOMPLISHMENT

Measure of Accomplishment	Quantity	TOTAL	Planned
Cubic Yds.	3		
	2		

Figure 9.

Calendar Year <u>1968</u> Maintenance Crew Number <u>321</u>				
<u>MAINTENANCE ACTIVITY PERFORMANCE ANALYSIS</u>				
Activity <u>112-200 Level</u> Unit of Measure <u>Cyds</u>				
<u>Period</u>	<u>Cumulative Man Hours</u>	<u>Cumulative Quantity</u>	<u>Productivity Rate</u>	<u>Comments</u>
January 1st	-	-	-	-----
January 2nd	-	-	-	-----
February 1st	-	-	-	-----
February 2nd	-	-	-	-----
March 1st	-	-	-	-----
March 2nd	-	-	-	-----
April 1st	-	-	-	-----
April 2nd	-	-	-	-----
May 1st	<u>124</u>	<u>52</u>	<u>2.4</u>	-----
May 2nd	-	-	-	-----
June 1st	<u>244</u>	<u>198</u>	<u>1.2</u>	-----
June 2nd	<u>481</u>	<u>648</u>	<u>0.7</u>	-----
July 1st	<u>605</u>	<u>795</u>	<u>0.76</u>	-----
July 2nd	-	-	-	-----
August 1st	-	-	-	-----
August 2nd	-	-	-	-----
September 1st	-	-	-	-----
September 2nd	-	-	-	-----
October 1st	-	-	-	-----
October 2nd	-	-	-	-----
November 1st	-	-	-	-----
November 2nd	-	-	-	-----
December 1st	-	-	-	-----
December 2nd	-	-	-	-----

Figure 10.

SUMMARY OF SHED MAINTENANCE EFFORT BY PERIOD  
(IN MAN HOURS)

Shed *Mt. Pleasant*

	JAN.		FEB.		MAR.		APR.		MAY		JUN.		JUL.		AUG.		SEP.		OCT.		NOV.		DEC.	
	1ST	2ND	1ST	2ND	1ST	2ND	1ST	2ND	1ST	2ND	1ST	2ND	1ST	2ND	1ST	2ND	1ST	2ND	1ST	2ND	1ST	2ND	1ST	2ND
ROUTINE SHED MAINTENANCE																								
POTHOLE PATCHING																								
CRACK SEALING																								
GRADE GRAVEL SURFACE																								
GRADE SHOULDER																								
EDGE RUT REPAIR																								
MOWING																								
CUT BRUSH AND REMOVE TREES																								
SPRING-FALL LITTER PICK-UP																								
REST AREA STRUCTURE REPAIR																								
SPRING-FALL DRAINAGE PROGRAM																								
ANNUAL SIGN & POST MAINT. PROG.																								
ANNUAL GUARD RAIL MAINT. PROG.																								
SNOW FENCE, SAND BARREL & DELINEATORS																								
-----																								
SPECIAL SHED MAINTENANCE																								
SURFACE REPLACEMENT																								
SPECIAL LEVELING																								
LEVEL FOR SEAL																								
REPAIR BASE FAILURE																								
RECONDITION GRAVEL ROAD																								
BUILD WINTER STOCKPILE																								
BUILD COLD-MIX STOCKPILE																								
ALL ADMINISTRATIVE ACTIVITIES																								
SPECIAL AUTHORITY WORK																								
ALL OTHER ACTIVITIES																								

	JAN.		FEB.		MAR.		APR.		MAY		JUN.		JUL.		AUG.		SEP.		OCT.		NOV.		DEC.	
	1ST	2ND	1ST	2ND	1ST	2ND	1ST	2ND	1ST	2ND	1ST	2ND	1ST	2ND	1ST	2ND	1ST	2ND	1ST	2ND	1ST	2ND	1ST	2ND
ROUTINE SHED MAINTENANCE																								
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Utah Maintenance Management Project

Figure 11.