Work Standards and Programmed Budgeting for Maintenance Operations

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I am sure that everyone is familiar with Parkinson's Law which states, in effect, that the number of employees increases at a rate which has no relationship to the amount of work to be done. Governmental agencies, in particular, are often accused of applying this law and, we have to admit that some of the examples set by government indicate some validity in the law.

For us, however, as we look at the increased demand for service on the part of the public, as we look at the vacancies in our complement as a result of low national unemployment rate, and as we look at the constantly reduced maintenance budgets, we cannot help but feel that for Parkinson's Law to be correct for maintenance operations, it must work in reverse and could be stated: "As the amount of work increases, the number of men available per unit of work decreases."

Whatever the case, there is no denying the need for use to place greater emphasis on redefining objectives in maintenance and to study, analyze, develop and implement new ways and means to better utilize the human and other resources which are required to achieve these objectives.

This approach, commonly known as management by objectives, has been discussed within the Minnesota Highway Department for quite a number of years. Until recently, however, our maintenance objectives were not divided into countable work units, and we had no established criteria or standards against which actual work performance could be compared. We were on a line item accounting system and were forced to budget entirely on historical data and engineering judgment. In other words, we spent X number of dollars on snow and ice control last year, but last year was a mild winter so therefore, we will need X-plus, say, 20 percent more money for this work next year. The judgment factor is difficult to apply because we must budget on a biennium basis to tie in with legislative sessions.

The last few years, however, have brought new developments in the area of maintenance management. Phrases such as "management by objective," "work standards," "levels of performance," and "program-budgeting" have now come into everyday management conversations.

Two and a half years ago, Minnesota as one result of a department-wide management study performed by consultants, decided to take a new approach to maintenance management. A consultant was retained to direct this new approach—a maintenance work improvement study.

The project could be called a feasibility study because what we were really trying to find out was whether or not certain time-honored principles of industrial engineering, such as work measurement, could be adapted to maintenance operations in an effort to improve the utilization of available manpower and skills. We felt that if these techniques could apply, we could greatly improve our operations through such things as standardization of methods and better planning and scheduling of work, and thereby obtain better control of operations in general.

The management consultants required state personnel to assist in the study. A task force set up for this purpose consisted of five engineers, a shop foreman, a field foreman, a stock supervisor and an administrative analyst—a total of nine people. Two of the engineers were experienced maintenance engineers; the other three were younger engineers with varied background in materials, design and traffic. This task force continued its work following the expiration of the six-month consultant contract.

To begin with, we concentrated on developing work standards which would employ a standard work method, production rates commensurate with this method, optimum crew size and proper equipment for the job. We developed these time standards on various field and shop operations within a pilot district and our central shop.

In order to provide time standards for the activities, work measurement was necessary. A decision was made to use time-study observation, as opposed to some other type of work measurement, as the source for data to be used to develop the time standards.

The time study approach was chosen for various reasons, mainly because of its adaptability to the type of operations involved in field and equipment maintenance. This study technique was used as opposed to "borrowing" standards from other agencies or from equipment manufacturers because standards based on our own operations, using our own personnel, our own methods, our own equipment and our own conditions were desired.

We chose time study rather than historical data to develop standards because we were also interested in methods improvement, and we wanted to be assured that the standards were based on the best methods at the time rather than simply averaging together production rates of existing methods. The study produced time standards covering slightly over 35 percent of our field and equipment shop operations within the first six-month period.

Also, as part of the project, a daily scheduling and reporting form for the maintenance men was developed. The scheduling portion of this form led to magnetic scheduling boards which are being used in our larger maintenance stations. The scheduling procedure has been one of the major benefits of the program in that we are saving a significant amount of time by scheduling men and equipment in advance. Previously, in most cases, our men did not know what they were going to be doing that day until they reported for work.

Before the six-month study was actually completed, we began implementing the system statewide. The study had proved that it was feasible to apply this approach to maintenance operations. Since the standards were to be an indication of better methods, optimum crew size, etc., the standards did, in fact, provide for some standardization. The standards provided production rates that could be used for planning and scheduling. The work reporting system provided for better control in that we had recorded the operation, where it was done, how it was done, who dit it, how the time was distributed, and how much was accomplished.

Weekly reports were developed for all levels of maintenance management. These reports give the performance, coverage by standards and percent of productive work. Lower level reports break down unproductive work into hours spent on travel, safety, delays, supervision and meetings.

We would be the last, however, to deny that we ran into some problems during this study but we also experienced a great deal of success and the successes outnumbered the problems. Within nine months after the beginning of the project, a new type of reporting system and a new technique of scheduling and planning was in operation statewide.

Our progress in this work had been slowed by lack of personnel until only recently. At present we have a permanent staff of 15 employed on the project, including nine time-study men. We have raised our coverage of standard operations but we have a long way to go to reach our goal of 80 percent. We have been concentrating on improving what we have developed thus far rather than stressing increased coverage. We have redesigned every form we initially developed during the study. We have spent a great deal of time training personnel for industrial engineering technician work. Our most pressing area of endeavor at present, is to transform the vast amount of pertinent data now being recorded into usable summaries using data-processing methods. Only then will we realize the full benefit of this program.

One factor which we have found to be an absolute requirement for the success of a program such as this is the cooperation and backing of management, from the foreman up. It is absolutely necessary to explain the program, what it is, what it is intended

to do and why it is being done. The maintenance workers and their immediate supervisors must thoroughly understand the scheduling and reporting system and what is expected of it. It has been our experience that these precautions will limit problems due to misinformation, fear, mis-use and lack of cooperation.

We have received, what I consider, less than expected resistance but it has probably been the result of taking action from the very beginning to circumvent any trouble through keeping the men aware at all times of our intent, progress and results. This is extremely important.

Before the maintenance work improvement study was actually completed, our thoughts began to turn toward a sister project: research in program budgeting and development of a top management reporting system. Although there were similarities between the two projects, they were conducted separately because the improvement study was maintenance oriented while the second study was geared to encompass the entire Highway Department.

The program-budgeting and management information study was initiated in February 1967 with two primary objectives in mind: (a) the department desired to transform its budget into a significantly more effective tool and (b) it wanted to improve the availability of information for top management decision-making and cost control. The two objectives were combined into one project because an effective reporting system is essential to capture the benefits of an improved budgeting system.

This project was in keeping with the Bureau of Public Roads' desire to have research performed on structuring program-budgeting and information systems to improve highway administration in the United States. The study was, therefore, partially financed with Federal funds.

To further emphasize this trend toward program-budgeting, attention is called to NCHRP Project 19-2 scheduled to be placed under contract later this year: "Develop Performance Budgeting System to Serve Maintenance Management." This study is designed to accomplish essentially the same thing in the field of maintenance on a national level as we are attempting to do on the state level. It is anticipated that Minnesota's study will yield new knowledge and methods of applying program-budgeting to the entire field of highway administration.

In order to obtain the forementioned objectives, we divided our study into four major phases of effort.

Phase I—Steps were taken to develop a concept of program-budgeting appropriate for the Department of Highways. During this phase, necessary liaison with the Commissioner and officials of the department led to identification of major programs and work activities of the department and their relationship to one another. In addition, units of work output were identified and major costs associated with each program were determined. We then devised budget documents necessary for the department's internal budget in a format suitable for presentation to the Legislature.

Phase II—Steps were taken to develop a concept for reporting data to top management. First, the type of reporting best suited for the Department was determined. Next, the management information requirements of the Commissioner, the Deputy Commissioner and the five assistant commissioners were defined. During this step, the format and frequency of reports were determined.

Phase III—Appropriate procedures for the program-budgeting system were developed. The timetable for preparation of the department's budget was established as well as the design of the budgeting request forms. Procedures were developed to provide for budget request review, revision and approval. Items that should be included in each chapter of a budget manual were identified so that the budget and financial planning office could prepare an effective manual outlining the program budgeting process.

Phase IV—The actual system for reporting data to management was designed. This phase provided for a listing of accounts to meet internal and external requirements. The method and frequency for collecting and processing source data were then developed. In addition, data-processing output forms were developed to provide necessary information for the various levels of management. To complete this phase, the comprehensive systems design manual was prepared.

Throughout the entire course of the study, considerable emphasis has been placed on continually consulting with all levels of Highway Department management, particularly the Commissioner and his staff. In addition, a number of meetings have been held with the Governor, members of the Highway Legislative Interim Commission, the State Commissioner of Administration and representatives of the Bureau of Public Roads. These contacts alerted the study team to required budgeting information and assured them that their revised procedures would meet these needs.

The Governor and his Commissioner of Administration have expressed a strong interest in this subject and have announced as their goal the indoctrination and installation of program-budgeting methods in all departments of state government.

Concurrently, the Governor, through his state planner, has strongly oriented his near and far term overall state planning to automation and the concept of planning programs on a program basis. This latter effort on the part of the state planner is currently awaiting approval of a rather comprehensive program to be partially funded with Federal money.

In summary, I assure you that the transition to this new system was not as simple as this presentation may make it appear. On the other hand, we have found the program budget to be a management tool that can improve management's long-range planning, fiscal budgeting, performance evaluation, and decision-making. The program-budget achieves these benefits in the following ways:

- It reflects the objectives, goals, and policies of our organization;
- It indicates approved plans and work programs geared to meeting these goals and objectives;
- It provides a financial picture that indicates the cost as related to expected results in carrying out the work programs; and
- It presents results reflecting work output and cost.

In this paper, I have mentioned forms, standards, scheduling techniques, reports and budgeting several times. Examples of forms and other controls are given in Appendices A through I.

Appendix A

Maintenance Standards Manual—Field (5-792)

The Maintenance Standards Manual—Field is a loose-leaf manual which includes the work time standards for field maintenance operations for the Minnesota Highway Department.

All field maintenance operation standards have been divided into sections according to the cost control numbers listed under the subactivities (see Appendix I for example). The standards within each section are assigned an operation number for reporting purposes.

A summary of pertinent information regarding the standards for snow and ice control are given on the sample index sheet 5-792.42-00.

A description of each operation which has been standardized is given on standards sheets in each section of the manual. A sample from section 42, Snow and Ice Control, is shown on sheet 5-792.42-01.

The information in this manual is used basically to plan daily and longer range activities. The standards are based on time study work measurement. The figures in this manual are also used to develop performance reports.

42 - SNOW AND ICE

Operation No.	Operation Description	Crew Size	Units Per Crew Hour	Unit of Measure	Standard Man Hours Per Unit
42-01	Snow Removal - Truck Plow				
A		2	17.7	Lane Mile	0.11
B		1	14.2	Lane Mile	0.07
42-02	Snow Removal - Motor Grader	1	5.2	Lane Mile	0.19
42-04	Snow Removal, Shoulders - Truck Plow and/or Wing				
A		2	14.0	Shldr. Mile	0.13
B		1	12.9	Shldr. Mile	0.08
42-05	Snow Removal, Shoulders - Motor Grader	1	7.1	Shldr. Mile	0.14
42-06	Snow and Ice Removal - Motor Grader	1	7.7	Lane Mile	0.13
42-07	Snow and Ice Removal - 10 Ton Truck	2	6.0	Lane Mile	0.32
42-08	Crush Ice - 10 Ton Truck	2	11.0	Lane Mile	0.17
42-09	Snow Removal - Bridge				
42-10	Snow Removal - Rotary Plow	2	3.0	Mile	0.71
42-11	Snow Removal - Crossovers	1	5.9	Crossover	0.17

OPERATION.	SNOW REMOVAL - TRUCK PLOW	OPERATION NUMBER: 42-01
Description·	Load sand and chemicals. Plow snow from roadway, use wing plow and chemicals if necessary Make equipment adjustments and change cutting edges as required. This standard is not to be used for shoulder plowing (see Standard 42-04).	
Reference·	Maintenance Manual 5-791.360, 362 and 364	
Equipment:	Section truck with plow, wing (optional) and sand spreader. Wrenches (for cutting edges)	
Material.	Sand and chemicals for ballast or spreading Spare cutting edges	

Method.	A	B
Basic Crew:	Two	One
Unit of Measure:	Lane Mile	Lane Mile
Man Hours Per Unit:	0.11	0.07
Crew Hours Per Unit·	0.06	0 07
Units Per Crew Hour.	17.7	14.2

OPERATION:	SNOW REMOVAL - MOTOR GRADER	OPERATION NUMBER: 42-02
Description.	Plow snow from roadway using wing plow when necessary. Make equipment adjustments and change cutting edges as required. This standard is not to be used for local cleaning operations or shoulder plowing.	
Reference.	Maintenance Manual 5-791.360, 362 and .364	
Equipment:	Motor Grader equipped with wing plow. Wrenches (for cutting edges)	
Basic Crew.	One	
Unit of Measure:	Lane Mile	
Man Hours Per Unit:	0.19	
Units Per Man Hour:	5.2	

Appendix B

Maintenance Standards Manual—Shop (5-793)

The Maintenance Standards Manual—Shop includes the work time standards for equipment shop maintenance operations.

Included in this appendix are sample sheets from the manual. Sheet 5-793.00-02 is the preface to the manual and explains the purpose and basis for the shop standards.

Sheet 5-793.01-00 is a sample index sheet of the inspection, lubrication and service section. In cases where a standard has not yet been written due to insufficient time study analysis, the standard manhours column is left blank. If an operation does not apply to a particular classification of equipment, a dash (-) has been entered.

Sheet 5-793.01-01 shows sample shop standards.

PREFACE

The Maintenance Standards - Shop Manual has been prepared to assist the shop foremen in the scheduling and reporting of shop operations. The time standards in this manual are based solely on time studies that were conducted in all of the seventeen shops. The standards attempt to represent the most efficient methods observed in actual shop operations. The standards reflect the time it should take for a qualified operator with normal skill and expending normal effort to do a particular job under normal conditions and surroundings during a full eight hour day. Sufficient time is allowed to complete an operation without any sacrifice in the quality of workmanship.

The standards include allowances for personal and rest time. These allowances are quite liberal and even the least fatiguing jobs are allowed more than twice the time set for the morning and afternoon breaks by department policy. It has been determined by industrial engineering experience that these allowances are not only fair, but necessary for maximum efficiency on the job.

It is expected that there will be variations in the types and availability of shop tools and equipment from shop to shop as well as differences in the shops themselves. These variations will cause corresponding variations in the performance of the area shops. Variations will also occur due to the differences in pace among the mechanics. One may expect higher performance from experienced mechanics than from apprentices because of differences in familiarity with the operations.

The standards listed in this manual are based on an average of observations in many shops, on many types and ages of units and under varying working conditions; therefore, there is no warrant for classifying any of the standard operations as non-standard based on the variations discussed in the previous paragraph. The only work to be labeled non-standard is work not yet included in the manual, extensive (longer than normal) diagnosis time and work not directly related to normal shop activity. There is some work that will not be standardized since it is performed too infrequently or the time required for the operation varies too much to justify writing a standard.

The standards can be used to schedule operations. If the foreman knows that a certain operation is to be performed on a given number of units, he can compute from the standard the total number of hours required to complete the job. The number of men required to complete inspections on all units in a district can be computed in the same manner. The standards can also be compared to the work output to develop more efficient shop operations. It should be remembered, however, that quantity must not be substituted for quality and that very high performance may indicate a lowering of quality standards rather than improved efficiency. Similarly, low performance may indicate that more than necessary emphasis is being placed on quality.

The standards should not be used to compare the work of individual mechanics as the standards are not intended to be a rating guide for merit. The differences in the shops referred to above make fair ratings of individuals difficult if not impossible.

Revisions and supplements for this manual will be issued periodically. As the standards are used, all employees are encouraged to offer suggestions for their improvement. Any information concerning obsolete methods, discrepancies, deletions or additions should be forwarded to the Maintenance Standards Engineer on the form provided on the following sheet.

01 - INSPECTION, LUBRICATION SERVICE

Operation No.	Operation Description	Standard Time Man Hours Per Unit A	B	C	D	E	F
01-01	Lubrication and Service (with Grease Fittings)	1 2	1.3	2.2	0.4		
-02	Lubrication and Service (with Grease Plugs)	1.3	—	—	—	—	—
-03	Lubrication and Service (without Greasing)	1.1	—	—	—	—	—
-04	Wash Unit	0.7	0.7	1.2			
-05	Clean Unit Complete (for Inspection)				1.0		
-06	Steam Clean Unit Complete						
-07	Clean Engine in Chassis			0.6			
-08	Clean Engine Out of Chassis						
-09	Daily Service	0.4	0.4	0.4			
-10	Engine Tune Up	2.1			1.4		
-11	Preventive Maintenance Inspection	4.0	4.1	5.5			
-12	Annual Maintenance Inspection				8.2		
-13	Road Test	0.4	0.4	0.4			
-14	Air Cleaner (Dry), Service	0.1	0.1	0.1			
-15	Air Cleaner (Oil Bath), Service		0.2	0.2			
-16	P.C.V. Valve, Service		0.3	0.3			
-17	Transmission (Manual), Drain and Refill	—					
-18	Transmission (Automatic), Drain and Refill	0 2	0.2				
-19	Transmission and Torque Convertor (Automatic), Drain and Refill	0.7	0.7				
-20	Differential, Drain and Refill	0.4	0.4	0 4			
-21	Transmission Drop Gear Case, Drain and Refill						
-22	Transfer Case, Drain and Refill						
-23	Strip for Trade (Central Shop)	0.5	0.5				
-24	Strip for Trade (District)						
-25	Strip Patrol Car for Trade (Central Shop)	2.9	—	—	—	—	—

A - Cars, B - Pickups or Carryalls, C - Trucks, D - Tractors, E - Motor Graders, F - Four Wheel Drive Loaders

OPERATION:	**LUBRICATION AND SERVICE (WITH GREASE FITTINGS)**				**OPERATION NUMBER: 01-01**	
Description:	Change oil, filter, general inspection and service, lubricate as required. For a complete description, see Maintenance Manual 5-791.416 or Lubrication and Service Instructions, Form No. 17234.					
Classification:	A	B	C	D	E	F
Man Hours Per Unit:	1.2	1.3	2.2	0.4		
Units Per Man Hour:	0.8	0.7	0.5	2.5		

OPERATION:	**LUBRICATION AND SERVICE (WITH GREASE PLUGS)**				**OPERATION NUMBER: 01-02**	
Description:	Change oil, filter, general inspection and service, install and remove grease fittings, lubricate as required. Use manufacturers' recommended lubrication interval. For a complete description, see Maintenance Manual 5-791.416 or Lubrication and Service Instructions, Form No. 17234.					
Classification:	A					
Man Hours Per Unit:	1.3					
Units Per Man Hour:	0.8					

OPERATION:	**LUBRICATION AND SERVICE (WITHOUT GREASING)**				**OPERATION NUMBER: 01-03**	
Description:	Change oil, filter, general inspection and service, lubricate as required except sealed lubrication fittings. For a complete description, see Maintenance Manual 5-791.416 or Lubrication and Service Instructions, Form No. 17234.					
Classification:	A					
Man Hours Per Unit:	1.1					
Units Per Man Hour:	0.9					

OPERATION:	**WASH UNIT**				**OPERATION NUMBER: 01-04**	
Description:	Wash exterior, clean interior, clean windows.					
Classification:	A	B	C	D	E	F
Man Hours Per Unit:	0.7	0.7	1.2			
Units Per Man Hour:	1.5	1.5	0.8			

OPERATION:	**CLEAN UNIT COMPLETE (FOR INSPECTION)**				**OPERATION NUMBER: 01-05**	
Description:	Wash complete unit including underside with solvent and Graco cleaner or equivalent in preparation for inspection.					
Classification:	A	B	C	D	E	F
Man Hours Per Unit:	1.0			1.0		
Units Per Man Hour:	1.0			1.0		

Appendix C

Field Daily Schedule and Report (Form 17223)

This form is used by all field maintenance personnel and is a daily report of all operations performed, locations, crew members assigned and equipment utilized. In addition, all manhours are reported in the proper columns along with work units done.

The form is used as a schedule by preparing columns I through V prior to performing the work. The remainder of the form is completed after the work is performed. (In areas where work is scheduled on magnetic wall boards, this form is used only as a report.)

A separate form is made out daily for each reporting station. All operations performed are reported separately on the sheet. At least eight hours are accounted for each day per employee.

Columns M and N are completed by the office staff, obtaining proper standards hours from the Maintenance Standards Manual—Field (5-792). The totals are carried forward to the Weekly Performance Worksheet (Form 19190) for analysis.

After the office work is completed, this form is returned to the originating station for filing as a diary.

Form 17223 (7-64) MINNESOTA HIGHWAY DEPARTMENT — MAINTENANCE OPERATIONS

FIELD DAILY SCHEDULE AND REPORT

TRUCK STATION, CREW OR SUB AREA _____ PREPARED BY _____ DAY OF WEEK _____ DATE _____

I OPERATION DESCRIPTION	II OPER NUMBER	III CONTROL SECTION TRUNK HIGHWAY AND SPECIFIC LOCATION	IV CREW ASSIGNED	V EQUIP UNITS AS SIGNED	VI ACTUAL MAN HOURS: Standard Work (A)	Wrg. Std Work (B)	Travel (C)	Safety (D)	Delays (Explain on Back) (E)	Supervision (F)	Warnings (G)	Vacation (H)	Sick Leave (J)	C.O. Comp. (K)	WORK UNITS DONE (L)	Office Use Only: Std Man Hrs Per Work Unit (M)	Std Man Hrs (L x M) (N)
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
WEATHER CONDITIONS				TOTALS													

ITEM NO.	EXPLAIN ALL DELAYS, CONTRIBUTING CIRCUMSTANCES AND ANY OTHER NOTES BELOW (MAKE REFERENCE TO ITEM NUMBERS GIVEN ON FRONT SIDE)

SPECIAL INSTRUCTIONS

1 This report shall be prepared daily Reports for a week's period, Wednesday through and including Tuesday, shall be submitted to the Area Office on Wednesdays

2 Men loaned out will be entered only as to name, location and assigned equipment taken with him Also make an entry explaining what reporting station he is loaned out to Men borrowed shall be entered just as permanently assigned personnel

3 Travel time between major job sites as well as travel time to and from job site shall be charged to Column C Travel at the job site shall be charged to Columns A or B

4 Time spent flagging and moving temporary barricades and signs for safety purposes will be charged to Column D

5 Delays over 30 minutes are charged to Column E Delays under 30 minutes can be included in Columns A or B

6 Time spent by a Sub Area foreman or intermittent foreman in a supervisory capacity will be charged to Column F

7 All entries must be complete and accurate Special attention must be given to the entries of control section numbers and work units done These are essential for cost accounting purposes

8 Following processing of the forms by the office this form will be returned to the originating section to be filed as a diary

Appendix D

Weekly Performance Worksheet (Form 19190)

This form serves as a worksheet in computing percent productive work, performance and coverage of field, shop and traffic maintenance operations. Entries for columns A through N are carried forward from Form 17223 and Form 1745. The data are summarized as shown in boxes P through V.

Following the transferring of the weekly totals and summary information from this form to Form 19189, the worksheet is given to the subarea foreman for his records.

Form 19190 (4-68) MINNESOTA HIGHWAY DEPARTMENT MAINTENANCE OPERATIONS

WEEKLY PERFORMANCE WORKSHEET

☐ Sub Area, ☐ Shop, ☐ Station or ☐ District Crew _____ Maint Area _____ Week Ending _____

DAY OF WEEK	DATE	ACTUAL MAN HOURS										STD MAN HOURS
		STD WORK	N STD WORK	TRAVEL	SAFETY	DELAY	SUPER-VISION	MEET-INGS	VACA-TION	SICK LEAVE	COMP TIME	
		A	B	C	D	F	F	G	H	J	K	N
Wednesday												
Thursday												
Friday												
Saturday												
Sunday												
Monday												
Tuesday												
SUBTOTALS		A	B	C	D	E	F	G	H	J	K	N

COMMENTS

SUMMARY

Total Productive Work Hrs A+B	Total Incidental Work Hrs C+D+F+E+G	Total Leave Pay Hours H+J+K	Total Hours Reported P+Q+R
P	Q	R	S

% Productive Work P (P+Q)	% Performance N - A	% Coverage A - P
T	L	V

Appendix E

Weekly Performance Report (Form 19189)

All the data tabulated on Form 19190 (Appendix E) for an entire maintenance area are tabulated and summarized on this report. This report is submitted to the Area Maintenance Engineer, the Office of Maintenance Standards and other interested people. It serves as a management tool in that it provides information such as percent productive work, percent performance as compared to standards and percent of work performed which was covered by standards.

The Office of Maintenance Standards summarizes these reports and prepares a statewide analysis for top management personnel.

Form 19189 (4-68)

MINNESOTA HIGHWAY DEPARTMENT MAINTENANCE OPERATIONS
WEEKLY PERFORMANCE REPORT

Distribution
- ☐ Original to Area Maintenance Engr
- ☐ Copy to Maintenance Stds Rm 316
- ☐ Copy to District Engineer
- ☐ Copy to District Foreman

MAINT AREA _____ WEEK ENDING _____

	SUBAREA DISTRICT CREW OR TRUCK STATION	PROD WORK HRS		INCIDENTAL WORK HOURS					LEAVE PAY HOURS			Std Man Hours	TOTAL HOURS				% Prod Work	% Perf	% Cov
		Std Work	N Std Work	Travel	Safety	Delay	Supervision	Meetings	Vac	Sick Leave	Comp Time Taken		Prod Work	Incidental Work	Leave Pay	Total Hours Reported			
		A	B	C	D	E	F	G	H	J	K	N	P	Q	R	S	T	U	V
SUBAREA MAINTENANCE SUBTOTALS	1																		
	2																		
	3																		
	4																		
	5																		
	6																		
	7																		
	8																		
	9																		
	10																		
	11																		
	12																		
	13																		
	14																		
SUMMARY	ROAD MAINTENANCE																		
	EQUIPMENT MAINTENANCE																		
	TRAFFIC SERVICES																		

FORMULAS

P = A+B
Q = C+D+E+F+G
R = H+J+K
S = P+Q+R

$T = \frac{P}{P+Q}$
U = S / A
V = A / P

COMMENTS

Appendix F

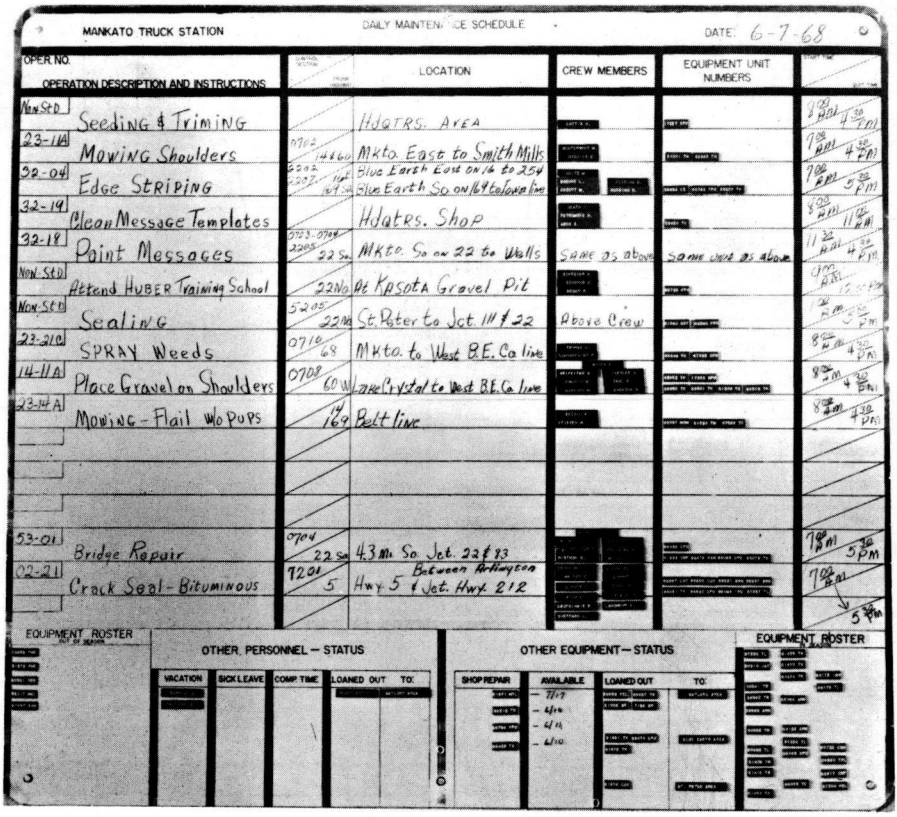
Daily Maintenance Scheduling Board

To facilitate scheduling of field maintenance operations, a number of the Department's larger reporting stations have prepared magnetic scheduling boards. An example of a typical board designed for a 46-man station is attached. The boards are made of sheet steel (approximately $\frac{1}{16}$ in. thick) which is covered with white adhesive backed material. Contrasting lines and column headings are placed on the board. The board is then covered with a sheet of clear acetate.

Entries are made for operations and location using grease pencil which can be easily erased with a clean cloth. For the other entries (employee and equipment assigned), labels are made using $\frac{1}{2}$-in. magnetized rubber strips. These labels adhere magnetically wherever placed on the board. Only one label is made for each man and piece of equipment. This avoids forgetting to schedule a man or scheduling a certain piece of equipment to more than one job at one time. Labels for equipment not in use but available are placed in the equipment roster boxes, depending on whether it is in or out of season.

Other designs and materials can and have been used in some of the board designs. For instance, blackboard paint and chalk can be used instead of the grease pencil approach.

Whatever the design, the function of the board remains the same. A supervisor can easily schedule and organize his operation in a manner which takes very little time. Verbal orders are necessary only in special cases as the employees merely look at the scheduling board to find out what job they have been assigned to. Scheduling is done the night before and changes resulting from weather condition changes overnight can easily be made in the morning.



Appendix G

Shop Order and Record (Form 1745)

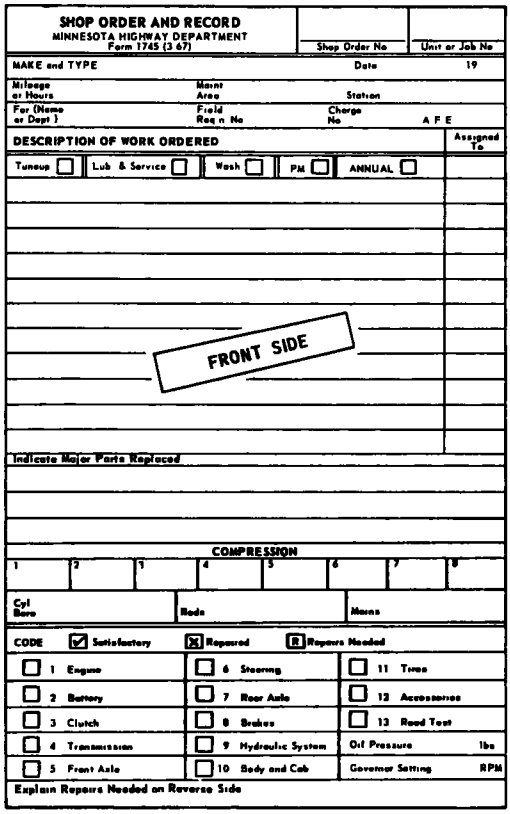
The Shop Order and Record is designed to be used to assign and record all shop work performed on equipment. The card is printed in each of two colors; buff for regular shop work and pink for the Preventive Maintenance and Annual Inspections. This facilitates filing all cards together and still being able to locate with ease records of special inspections or overhauls.

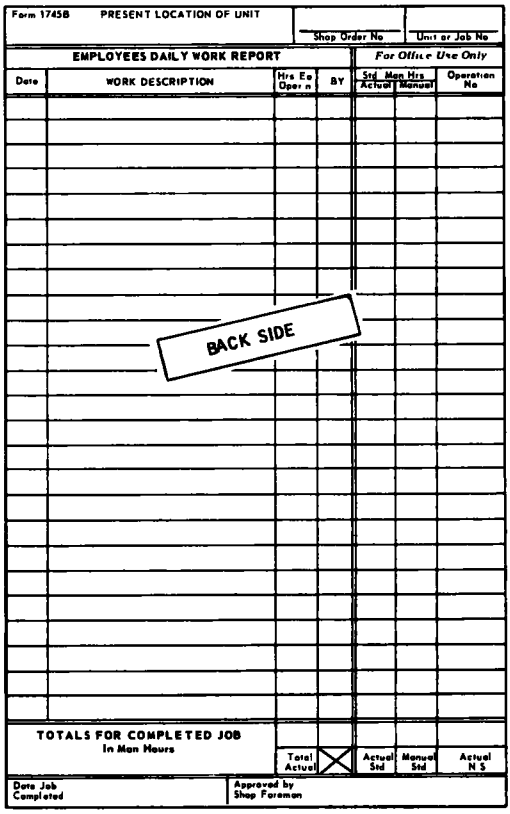
Upon receipt of a Unit Service Request from the Unit Service Book (Form 1743), the shop foreman will prepare the upper portion of a Form 1745. Shop order cards will be numbered consecutively. Descriptions of work ordered will be entered and assigned to mechanics in the spaces provided. The card will then be placed in the assignment box opposite the mechanic's name who is assigned to work on the unit.

The mechanic, following completion of the work, will properly record each operation performed by him on the back side of the card along with date, hours spent on each operation and initials.

Spaces are provided on the front of the card for major parts replaced, compression readings, etc. Notes are made where indicated on the card when a need for further repairs is uncovered.

Upon completion of all assigned work on the card, it is turned in to the shop foreman who approves the work by signing the card, sees that proper entries are made in the unit service book and arranges for placing the unit back into service.





The shop foreman or his delegate then applies standard times (Manual) along with standard operation numbers in the proper columns on the back. This information is obtained from the Maintenance Standards Manual—Shop (5-793). Columns are totaled and carried forward onto analysis sheets by office personnel for use in cost accounting and shop performance evaluation.

Before filing the cards into the shop foreman's unit file, proper entries (if needed) are made in the visual Equipment Inspection Schedule and Record card system, Form 17243.

Appendix H

Equipment Inspection Schedule and Record System (Form 17243)

Preventive maintenance inspections, lubrication and service inspections, tune-ups, etc., performed on all motorized equipment are recorded and scheduled on Form 17243 in a visual file. This file is located in the shop foremen's office.

Using a code letter (like L for Lube and Service) an entry is made on the unit card in the date box corresponding to when the service was performed. The mileage reading is entered following the letter code. Each unit has its own card on file. Each card lasts one year although we are now printing both sides of the card so it will last 2 years.

The title card (Form 17243A) is designed to be inserted on top of Form 17243 in the files. This title card will remain in the file for the life of the unit (it will not be replaced every year as Form 17243). This eliminates the need for re-writing the items such as "Make and Type," "Assigned to," "Located at," etc., which generally do not change every year. Space is also provided to enter years of major overhauls.

A unique feature of this system is the scheduling system which this card and filing system provides. Since this is a visual file, colored signals are placed in the proper position over the "month" spaces to indicate when the next inspection, service, etc., are expected to be due. Simply by glancing at a drawer full of these cards, the shop foreman can pick out which units are overdue, which ones are due and which ones are not due yet for preventive maintenance work. Whenever a service is performed, rescheduling is done by moving the proper signal forward.

As a result of this system, the shop foreman has at his fingertips, a complete record of recent inspections and services, a historical account of major overhauls since the unit was purchased and a scheduling system which he can use to plan and control his shop operations. The cards are versatile in that some shop foremen keep track of additional items on the cards such as wheel bearing packing, replacing antifreeze, etc.

Form 17243 EQUIPMENT INSPECTION SCHEDULE AND RECORD MINNESOTA HIGHWAY DEPARTMENT

DAY / MO.	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	DAY / MO.
JAN																																JAN
FEB																																FEB
MAR																																MAR
APR																																APR
MAY																																MAY
JUN																																JUN
JUL																																JUL
AUG																																AUG
SEP																																SEP
OCT																																OCT
NOV																																NOV
DEC																																DEC

CODE		COLOR
LUBE & SERV	L	
TUNE UP	T	
PM INSP	PM	
UNIT NUMBER	CLASS	YEAR

REMARKS

CODE		COLOR	INTERVAL
LUBE & SERV	L		
TUNE UP	T		
PM INSP.	PM		
UNIT NUMBER	CLASS		

MAKE AND TYPE

ASSIGNED TO

LOCATED AT

DATE OF OVERHAULS (YEAR)

VALVES	CLUTCH
RINGS	TRANS
MAINS	DIFF
ROD BRGS	BRAKES

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

Form 17243A TITLE CARD - EQUIPMENT INSPECTION SCHEDULE AND RECORD

(to be placed over lower portion of Form 17243)

Appendix I

Maintenance Program in the Program Budget System

This sample sheet illustrates part of the Maintenance Program and its various levels of effort, outputs and applicable coding.

The levels of effort are indicated in the alignment and relationship under the column headed Sub-program, Activity, Sub-activity, etc. The work output unit to be recorded and summarized accordingly is indicated under the Work Output Unit Identification column. The cost dollars associated and collected for these work output units produces the Performance Measurement Units, as depicted within that column. The process of charging both dollars and output efforts into the system is accomplished by the Program Budget Code, as outlined therein.

PROGRAM BUDGET
MAINTENANCE

PROGRAM BUDGET CODE	SUB-PROGRAM	ACTIV-ITY	SUB-ACTIV-ITY	WORK OUTPUT UNIT IDENTIFICATION	PERFORMANCE MEASUREMENT UNIT IDENTIFICATION
XXXX	Program Administration				
3198		Administration			
3199		Fringe Benefits			
3195		Safety, Civil Defense and Training			
3510		Road Permits and Regulations			
XXXX	Field Operations Sub Program				
3201		Sub Program Administration			
XXXX		Roadway Surface			
3212			Surface Repair (01, 02, 62, 63, 65, 66)	Lane miles serviced	Cost per lane mile
3213			Crack and Joint Filling (61)	Lineal feet filled	Cost per lineal foot
3214			Mudjacking (64)	Square yards repaired	Cost per square yard
3220		Shoulder and Approach (14, 62)		Shoulder miles repaired	Cost per shoulder mile
XXXX		Roadside Maintenance			
3232			Drainage Maintenance (22, 67)	Ditch miles cleaned	Cost per ditch mile
3233			Slope Repair (21)	Road Miles repaired	Cost per road mile
3234			Mowing, Weed and Brush Control (23)	Acres worked	Cost per acre