EQUIPMENT MANAGEMENT IN NEW YORK STATE

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•DURING the past several years, much has been done to improve highway maintenance programs; at the same time, very little has been done to upgrade equipment programs.

Nothing can more easily frustrate highway maintenance productivity than defective equipment.

Furthermore, the prevalent lack of meaningful equipment data undermines the maintenance engineer's case for reorienting his fleet toward improved productivity.

The current trend is to more technologically advanced equipment. This reinforces the demand for skilled maintenance, diagnosis, repair, and control.

Equipment management is now firmly established as a discipline in itself. The various interrelated elements that make up this discipline are shown at random in Figure 1. Too often, the interaction among these elements is not fully appreciated. When the elements are treated as distinct, self-contained units, maximum productivity becomes elusive.

CASE STUDY

The New York State Department of Transportation has a combined highway maintenance and equipment management budget of $100 million and a fleet investment of $60 million. In 1969 the department initiated an extensive program to improve effectiveness in both areas. In New York State the highway maintenance program and the equipment management program are separate entities; each has its own director who is responsible for its management. The state, furthermore, is divided into 10 regions (equivalent to divisions or districts in most other states), each of which has a regional highway maintenance engineer and a regional equipment manager.

The highway maintenance management study was conducted primarily by in-house personnel. Because of its broad technical scope, the equipment study area was contracted to consultants.

PRE-STUDY EVALUATION

Before the project started, regional highway maintenance engineers cited examples of how their work plans were disrupted by equipment breakdowns. No single factor consistently emerged as the major cause of the work delays. There were, however, several factors that were repeatedly mentioned: lack of parts; state-imposed procurement procedure delays; outdated mechanical knowledge; unqualified operation; and inadequate preventive maintenance.

On a more pervasive scale was the problem of data "pollution." The prevalence of endless computer printouts, derived from error-prone input, clouded all considerations and had unjustly impaired the equipment management program's credibility in essential dealings with its customers (highway maintenance personnel) and with fiscal authorities.

There was no question but that the staff was dedicated and competent. In fact, staff members had previously attempted to improve certain aspects of the operation. However, these efforts did not result in any noticeable effect because the interrelated nature of the problem areas was not understood.

Sponsored by Committee on Maintenance Equipment.

The results of the preliminary evaluation underscored the need for the participation of an unbiased third party—one with the technical expertise and authority to effect better understanding and cooperation among management and related state agencies.

PROJECT OBJECTIVES, STRATEGY, AND ORGANIZATION

A preliminary survey identified the scope of the project. Aside from its technical aspects, the project was required to revise completely the control process and information system to aid operating managers. As has been indicated, the project was also required to reinforce constructive relationships between the equipment management program and the program users, fiscal authorities, and state agencies.

The objectives of the program were to upgrade all policy and practice of the equipment management program and, at the same time, to produce tangible improvements in the daily application of the program. Both objectives were clearly founded on the central issue of effecting significant improvement in the level and quality of service provided to the highway maintenance program. In this respect, no factor was more germane than the time lost to users because of equipment failure. It was, therefore, agreed by all concerned to monitor the primary thrust of the project's progress in terms of downtime. Because the data necessary for downtime measurement had to be gathered manually on a monthly basis, we selected a significant control sample of the 10 types of equipment most critical to highway maintenance work plans. The equipment selected represented approximately 50 percent of the fleet investment and consisted of large dump trucks, small dump trucks, gradalls, graders, shovel loaders, sweepers, mowers, small stake trucks, crawler shovels, and truck cranes.

In the sample, the level of downtime prior to project commencement was found to be 10.5 percent. A goal of 5 percent downtime was set to be achieved by December 31, 1970. Such an improvement would increase total fleet capacity available to users by an extent equivalent to the acquisition of $4 million of new equipment. Because the term downtime has a negative connotation, we decided to use the complement of the above percentages (i.e., a starting base of 89.5 percent and a goal of 95 percent) and to express the indicator as fleet uptime, from which the project derived its name as "project uptime."

We agreed to apply a further challenge that would most likely result in higher shop productivity. To this end, a second indicator, called "mechanic uptime," was established. Of all the hours that direct labor personnel (i.e., mechanics and skilled tradesmen) were available for work, it was found that only 69.5 percent was spent on equipment repair. In this instance, a goal of 85 percent was set to be achieved by December 31, 1970. An extensive training program that was initiated to improve mechanic efficiency made a 100 percent goal impractical.

The challenge presented by the preceding two indicators served to clarify the project strategy. First, all equipment management personnel were required to provide better service to the highway maintenance program. Second, these personnel had to do more with what they already had in terms of manpower. Third, all recommended changes had to result in improved service and productivity.

It is evident that the project thus placed heavy emphasis on implementation and tangible results. The project was extended over a period of 28 months to ensure that the transition was both orderly and effective. The project was organized such that the New York State Department of Transportation was able to make a maximum input. Other input was made by the four consultants. All changes were developed and implemented by task groups that had been carefully chosen and assigned to each program facet. The task groups usually consisted of one consultant and several New York State Department of Transportation personnel. The active participation of department personnel had the intended effect of securing ready acceptance for all suggested changes.

INTERACTION OF PROGRAM FACETS

In some states, including New York, the equipment management organization is not connected with the highway maintenance organization. There are cases, too, where certain facets of the equipment management program, such as procurement and parts service, are undertaken by the highway maintenance organization or by other agencies. Some states prefer centralized control over operations, whereas others favor decentralized control. It is possible to have as many variations as there are personal preferences in organizational control. An approach used in one state could well prove ineffective in another.

People, not organizational structure, determine the success of an operation. Similarly, the system of program control should not dictate organizational strucutre—rather, it should be of such advanced design that it can accommodate any combination of structural preferences. This design constraint was wisely imposed by New York State and was tested during the program. A change of commissioner occurred during "project uptime." The management styles and organizational preferences of the two executives involved could not have been more distinctly different, and yet the change did not affect the new program control system.

The system's flexibility was made possible by the identification of a matrix common to all equipment programs concerned with optimum output in terms of quantity, quality, and cost of service—regardless of organizational structure surrounding them.

An equipment management program consists of 14 essential facets that must work well as an integrated group. The interaction of the facets is shown in Figures 2 and 3.

As shown in Figure 2, an equipment management program includes within its scope a provision for shop facilities, which in turn accommodates preventive maintenance and repair activities. These latter facets are seldom made to interact with one another to the extent that they should. The repair activity too often consists of emergency work. Where such a condition exists it confirms that the preventive maintenance program is not effective. One of the most important roles of a preventive maintenance program is to anticipate major repairs and to schedule them into the shop in such a manner that disruption to user work programs is minimal. Another is to ensure the controlled use of shop capacity, 75 percent of which should be absorbed by such prescheduled repair work.

A production control system is needed to preserve a balance of service orientation. The purpose of the system is to balance the flow of work and the availability of labor and parts. This in turn enables dependable return dates to be promised to the user.

The ability to assume such a commitment requires that the productivity of the labor force be predictable. It follows that this can only be achieved if labor skills are maintained through training. Currency in technological advances and methods of repair must be maintained. If training is ignored, diagnostic capability deteriorates, and unreasonable labor costs and equipment downtimes result. Although training goes a long way toward securing the most flexible labor capacity, the varied mix of job-shop operations for multipurpose fleets will always demand close supervision. This, coupled with a need to balance the levels of field and shop service with the functions of inspection, testing, distribution, and parts supply, calls for clear definition and understanding of individual organization responsibilities. Figure 3 shows the relationship among the facets of the labor element and shows how they interact with the central maintenance and repair activity of a shop.

Parts supply represents the second primary element in the maintenance and repair activity that directly influences the availability and reliability of fleet units. Minimum disruption of user work programs and realistic return dates cannot be expected if parts availability is not under control. Responsiveness in this regard can be maximized by using the least restrictive procurement methods and the most efficient parts inventory control. Figure 3 shows the flow of interaction necessary among the foregoing facets for the most beneficial effect on the maintenance and repair activity.

It is possible to establish repair accrual performance standards (RAPS) for each type of equipment in terms of the cost of labor and parts. These standards are an important requirement for monitoring the cumulative repair history of individual units and for identifying those that deviate unreasonably from the norm. Such units

Figure 1.

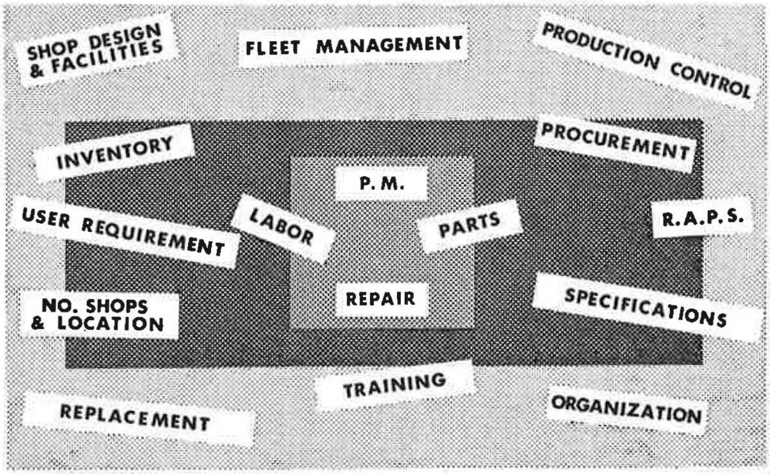


Figure 2.

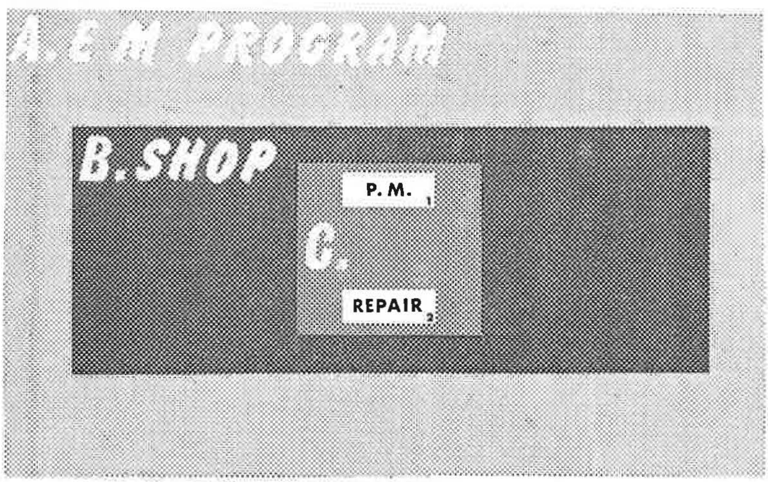
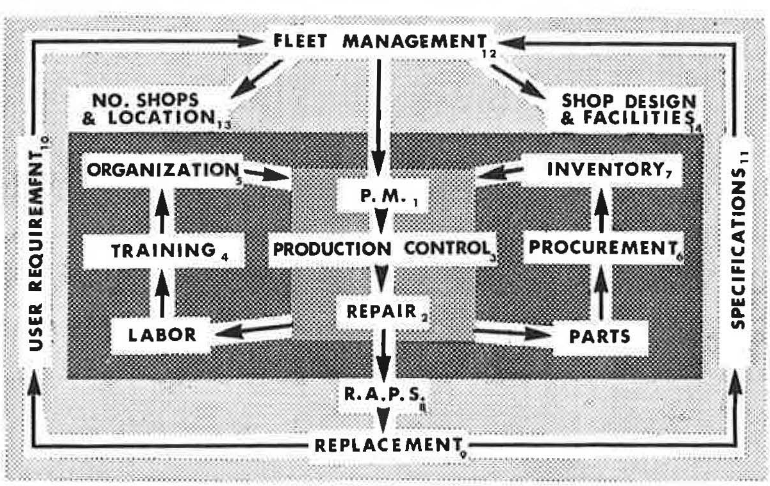


Figure 3.



can disrupt user work programs and cause unacceptable repair costs. Repair history data, derived from work-order activity in shops, also have a direct bearing on replacement decisions. Figure 3 shows the origin and relationship of RAPS and replacement.

As with fleet additions, replacement should not be considered without careful reference to user requirement and the specifications (or more properly, research, development, test, and evaluation) function. Furthermore, the efficacy of these interfaces should be monitored by a fleet management system that can do the following:

1. Recommend which acquisitions, disposals, and interregion transfers are necessary to meet all user requirements and, at the same time, minimize fleet investment;
2. Provide a rapid means of responding to budget cutbacks and for probing the effect of alternate-use criteria on fleet size; and
3. Monitor performance against plan in terms of use, downtime, reserve, transfers, acquisitions, and disposals.

Such a fleet management system becomes the means for expressing the equipment management program interface with the highway maintenance program. It also serves to identify optimum size, mix, and deployment of a fleet.

Fleet size, mix, and deployment have an important bearing on the remaining two facets: number and location of shops and shop design and facilities. Too frequently, shops are improperly designed and located to provide economic service. There is also a tendency for shops to be poorly equipped. Any correction proposed in this general area can involve costly expenditures. Where the foregoing conditions exist, it is not uncommon to find an impasse in understanding between fiscal authorities and operating management. To avoid the folly of pathwork solutions, we must provide fiscal authorities with well-documented criteria and a sound, long-term correction plan.

In contrast to the random sequence of the elements as shown in Figure 1, the foregoing discussion has attempted to order the various facets of the equipment management matrix by identifying their essential relationships. Figure 3 recapitulates the overall flow of these relationships—all irrevocably geared to the central purpose of providing an optimum level, quality, and cost of service to the highway maintenance program.

The following sections discuss in some detail each facet of "project uptime." Also discussed is the program control system that reduced the level of "data pollution" to one document that was available within days of the close of each 4-week reporting period.

PREVENTIVE MAINTENANCE

Preventive maintenance is a much abused term. Like thrift, it is rare to find anyone ready to contest its merit, and yet few can force themselves to practice it. The enthusiastic support that preventive maintenance usually enjoys during the initial justification process soon wanes once it is funded. If preventive maintenance is improperly practiced, it will not decrease the need for emergency repairs. When this occurs, the preventive maintenance area is generally the first function to have its manpower diverted to meet the crisis. Furthermore, fiscal authorities, always hesitant to accede to requests for more manpower, initially fund such programs only partially. Consequently, preventive maintenance tasks usually produce inadequate results, which in turn tend to discourage further funding. Thus, if management does not deploy assigned capacity correctly, programs related to preventive maintenance are likely to show poor results.

The primary objectives of preventive maintenance are to minimize the incidence of unscheduled repair and to govern (i.e., preschedule) the flow of repair work into the shops.

In pursuit of the first objective, preventive maintenance categories, tasks, frequencies, and time standards should be meaningfully established and updated. This requires a thorough grasp of the equipment technology and end-uses involved. As was the case in New York, where funding for preventive maintenance manpower is temporarily restricted, it is important to concentrate the effort on only the most critical types of equipment, which can thus enjoy full benefit from the program. If no other way can we build up confidence in the program to secure sufficient funding.

The second objective seldom receives the emphasis that it should. If this objective is met, there is sufficient time for the user and the shop to decide when a unit may best be withdrawn from service.

PRODUCTION CONTROL

Mechanics have a natural and proper aversion to administrative procedure, but their supervisors should not. Good mechanics are skilled, high-priced tradesmen who deserve quality supervision. In a shop, they collectively represent a valuable resource that requires substantial further investment in support facilities, tools, and inventory. Their work involves drawing out of service expensive equipment that is the backbone of even more costly programs.

In medium- and large-sized shops, the foregoing and the varied nature of job-shop work add up to a convincing case for formalizing the coordination and expediting process. There are innumerable options in choosing a system to meet this need. It can be as basic or sophisticated as circumstances warrant.

Equipment breakdowns, or unscheduled repair, will always be a factor in shop work, but 75 percent of the total load should consistently relate to jobs for which it is possible to establish advance notice. This enables repair work to be arranged in a priority sequence responsive to the needs at hand.

A production control system also ensures efficient assignment of manpower, enables users to be given prior notice of unavoidable delays, and allows essential parts to be pre-assigned.

REPAIR

The New York State Department of Transportation has one central (engine rebuild) facility and 10 regional shops (with an average of 12 bays each). Each regional shop controls about six residency garages each of which has one or two bays. This extensive network of service justifies periodic evaluation against related strata of work load. Although not wholly representative of the pattern currently applicable to New York, Figure 4 shows the type of stratification referred to. Because of the loss of capacity associated with moving units from the field to a shop, the types of work included in levels 4 through 6 (Fig. 4) would appear to be best undertaken at residency facilities that are as near as possible to the highway maintenance work area. Level 3 includes work that should generally be contracted to commercial facilities for various reasons, whereas level 2 includes work that should generally be done at a shop. Finally, level 1 suggests a scope of work that can best be handled by a central facility.

Such a stratification of work load requires that a cost-effectiveness evaluation be made for each type of job. Once the strata are established (Fig. 5), the clarification of needs in many other areas is possible. For example, one would not provide tools, work space, personnel, or training for work classified in level 3.

Time standards for each significant type of work should be developed. In so doing, care should be exercised not to adopt manufacturers' flat rates too readily because state equipment often includes additional devices that sometimes impede access to other components. In any event, flat rates should never be developed without the participation of the people who will be responsible for applying them. Where flat rates do not exist, supervisors should nonetheless be required to set standard times based on their experience and good judgment. The cumulative impact of deviations from standard can be used by management as an indicator of overall shop efficiency and of areas in which training may be deficient.

TRAINING

By virtue of the significant number of man-hours reserved during the project for training, it is evident that New York State recognized the importance of its catch-up

Figure 4.

Figure 5.

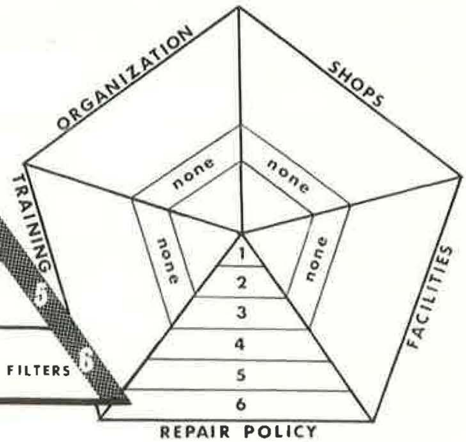
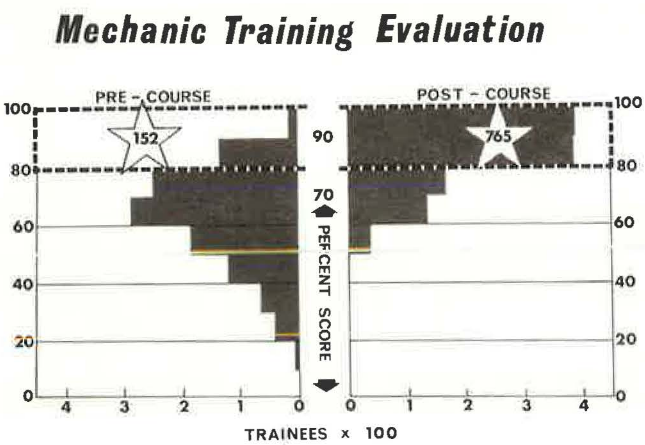


Figure 6.



program to improve the technical knowledge of its mechanic work force. The priority areas, selected by the training task group in consultation with all shop managers, were hydraulics, air brakes, gas engine tune-up, transmissions, diesels, and welding.

With some notable exceptions, many training courses available from manufacturers are, unfortunately, thinly disguised sales promotions. In recognition of this, the New York State Department of Transportation required the consultant to negotiate with more than 10 major manufacturers to tailor each course to the specific needs of New York State. Almost 1,000 course units were delivered as a result, all at convenient locations within the state.

An unusual feature of the program was the manner in which its effectiveness was monitored. Special pre- and post-course tests were developed and given to each trainee. Figure 6 shows that, whereas only 152 trainees returned scores in the 80 to 100 percent range before training, as many as 765 achieved these levels in their post-course tests. On a statewide basis derived from individual scores, the average trainee improved his score by 35 percent. A 25 percent increase in the trainees' technical knowledge would have been normally expected from such a training program.

ORGANIZATION

The realignment of duties to effect a more streamlined organization was one of the two principal concerns of this facet of the project. The second related to the development of a more acceptable and practical basis for each of the many points of interface between equipment management program personnel and highway maintenance program personnel.

PROCUREMENT

The procurement objective was to isolate, develop, and test a practical method by which to overcome costly parts delays within the framework of the state's established procurement procedure.

Of the various methods studied, the task group selected the open-contract approach. In cooperation with the Office of General Services, this approach was tested successfully for a period of 6 months. Such contracts are now being awarded on as many items as possible.

INVENTORY

The purpose of the inventory subproject was to purge all accumulated scrap and obsolete items from inventory as well as to develop and install a system that would ensure the maintenance of parts inventory levels commensurate with the frequency of normal demand.

In addition to the generally accepted requirements for this important facet of shop operations, the system developed and installed by the inventory task group provides for minimum and maximum stock levels. In the case of New York State, the considerable effort that was necessary to clean out parts rooms and to take inventory produced immediate improvements in service. The new system ties in closely with production control, and, although it is still seriously undermanned because of statewide austerity, it has brought about a noticeable drop in downtime caused by parts delays.

REPAIR ACCRUAL PERFORMANCE STANDARDS

A repair accrual performance standard, for a particular type of equipment, is the cumulative standard cost of repair that can be expected to accrue under normal circumstances during useful life. The pattern of such a cost is illustrated by the solid line in Figure 7. RAPS are the foundation on which many important decisions in the New York State equipment management program are made. Although the basic concept of RAPS remains constant, values for the same equipment may vary from state to state because of, for example, differing direct labor rates.

If RAPS serve as the norm, it becomes possible to test the behavior of each comparable unit in a fleet and, by exception, to identify those units that exceed tolerable limits (Fig. 7, dotted line).

REPLACEMENT

Many factors can influence the determination of the economic replacement point of an item of equipment. Among these are age, utilization, repair costs, operating costs, depreciation, and downtime for maintenance. Because of the variety of methods for collecting some of these data, the fluctuating and unpredictable nature of certain factors, and the various accounting theories for treating depreciation and labor cost, it is not surprising that many states take the maximum-age approach to this complex problem. This method is simple, it enables long-range forecasting of replacement requirements, and it avoids the expense of large-volume data collection and processing. The method does, however, have one serious limitation; it treats all items in a group similarly. Units that should be scrapped, for economic reasons, before the prescribed age limit are generally repaired at great cost, and units that can contribute productive service beyond the age limit are arbitrarily disposed of when it falls due. This method imposes the punitive, cumulative cost of double jeopardy, and yet it is in common use among many large fleet operations.

It is possible to operate a replacement system that has most of the desirable qualities of the maximum-age method but none of its hidden and costly drawbacks. In this, both operating costs and preventive maintenance costs are excluded from consideration on the basis that deviations in either should initiate repair action, or modify maintenance frequencies, rather than influence the replacement point. Downtime is a factor that may be considered according to the circumstances and the cost of the equipment involved.

In the case of the New York State fleet, such a system is applied concurrently with the RAPS monitoring process. For this, the method establishes a maximum permissible cost curve (Fig. 8) that, when intersected by the repair accrual of any unit, determines the point at which it should be withdrawn and replaced by another. The system forecasts this intersection in order to accommodate the lead time, which encompasses fiscal approval, procurement procedure, and manufacturers' delivery cycles. In this way, it exerts an influence to keep the fleet purged of units that require unreasonable repair costs and that might disrupt highway maintenance work plans.

FLEET MANAGEMENT

Although the replacement subsystem protects the program from ineffective units, there is an even greater need to ensure that the fleet is of an adequate size and mix to accomplish the highway maintenance program. Because of the absence of meaningful data in this area, many highway departments and their fiscal authorities misunderstand and disagree about fleet management. As long as this vacuum exists, the budget examiner must be expected to harden his position in limiting fleet size. The highway maintenance engineer is then faced with a fleet of improper mix and size and an increased work load.

In New York, this dilemma was avoided by designing a fleet management system that would provide the following:

1. A rapid method by which to translate minimal input data of user requirements into (a) optimum inventory for each major equipment type, (b) transfers from region to region, which are necessary to minimize fleet investment, and (c) the quantity and scheduling of acquisitions to minimize cash flow yet still honor all stated user requirements;
2. A simple and rapid procedure to identify where and when cuts to user work programs can best be made (with a view to doing least harm in the face of budget cutbacks);
3. A monitor of fleet performance every 4 weeks, showing in detail deviations from established plans in terms of capacity consumed; and
4. A method that will economically and rapidly allow either highway maintenance or equipment management to assess the effect that different criteria for use and repair would have on fleet size.

Figure 7.

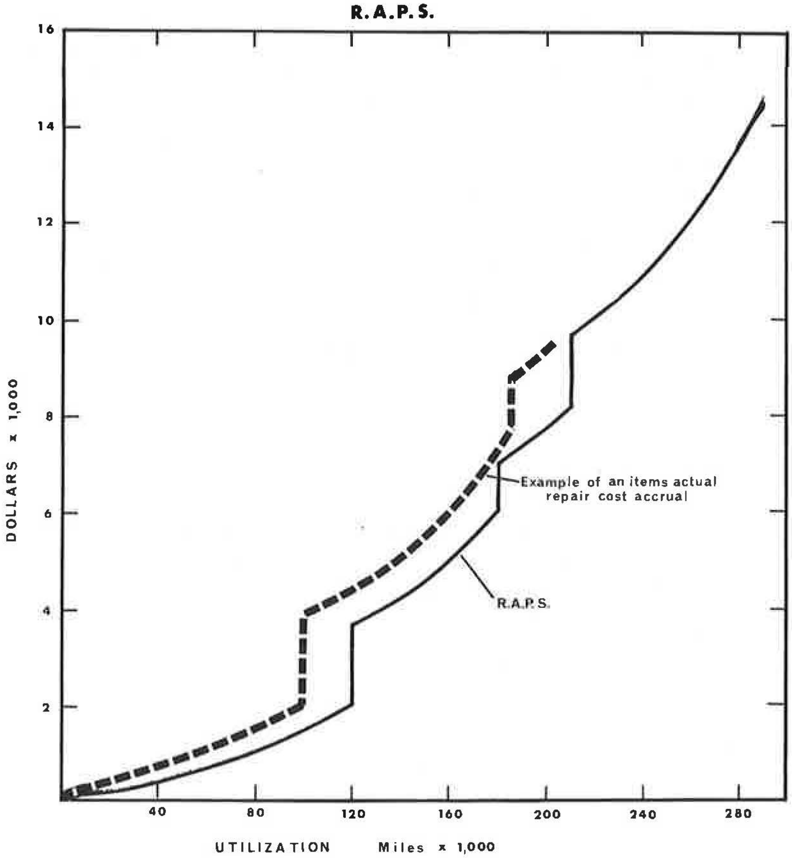
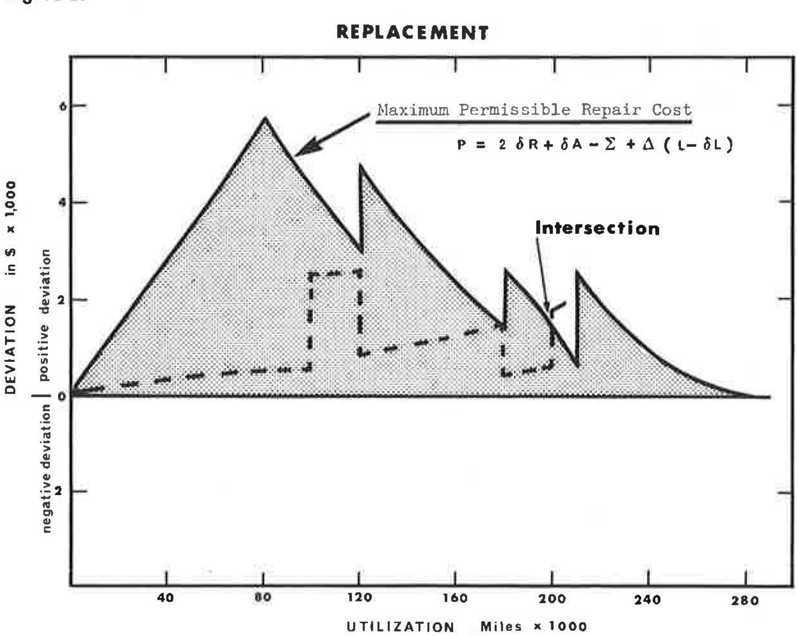


Figure 8.



NUMBER AND LOCATION OF SHOPS

The questions of size and location with regard to building a new shop arise sooner or later in every equipment management program. The investment, in itself, is not minor; if the plans are ill conceived, the shop will generate many punitive costs as the years go by. Any attempt to consider the problem other than in a statewide context produces such an impenetrable fog that a consensus is usually impossible to achieve. As a result, the issue tends to be shelved, and the existing operation of the shop in question becomes increasingly worse with a corresponding effect on the level of service to users of equipment.

In recognition of these difficulties, New York State approached the problem in the following manner: The level of service required from shops is irrevocably tied to the highway maintenance work load. It is possible to define this work load over the next 20 to 25 years with some certainty in terms of future concentrations of density. By using a statewide pattern, it is relatively simple to establish the ideal number and location for all shops in a state. This pattern can then be used as a master plan to provide optimum levels of service to all users and from which a decision concerning any particular shop emerges with clarity.

SHOP DESIGN AND FACILITIES

A most trying aspect of program management in government is the treadmill created by budget cycles. The time left for managing program operations seems to diminish each year as the concern over how tax dollars are spent increases.

A significant part of this time and energy loss can be overcome by using a well-conceived and documented facilities manual. Once the types of facilities and tools that should exist in every shop (Fig. 9) are approved by fiscal authorities, such a manual serves as a catalog for the gradual upgrading of facilities. The only problem then remaining for the budget process to resolve is whether the payback in relation to other demands justifies a priority claim on available funds.

PROGRAM CONTROL SYSTEM

Another important accomplishment made by New York State is represented by the advanced and sophisticated program control system it has installed. The words advanced and sophisticated suggest complexity; however, quite the opposite is true in this case. Data on program performance, in terms of quantity, quality, and value indicators, are now published every 4 weeks on a single-report format (Fig. 10a) common to all levels of management from shop supervisor to commissioner. Furthermore, most managers are concerned with only 1 page of that format, which includes plan, actual, and deviation data for the current period and the year to date. Reports are now also timely and accurate. Program personnel brought an input error rating of 40 percent down to a consistent statewide average of 4 percent. Reports are now required to be in the hands of front line supervisors no later than the morning of the eleventh working day after the close of a period.

Another unusual feature of the control system is that each supervisor or manager is required to identify the cause of any major deviation and also the action he proposes to take to correct it. He is allowed 2 days to forward this to his superior.

The system was designed such that managers should not have to use pencil and paper to figure out what went wrong with their operation. In case of need, however, a second level of reports is provided (Fig. 10b). These were designed, principally to be used for planning purposes, because a competent manager should not have to refer to an information system to learn about major problems within his operation.

CONCLUSION

It would be wrong to conclude that the New York State equipment management program is now perfect in every way. However, it came a long way during the 28 months of the project, and its path to even greater achievement is clearly drawn. By December 31, 1970, it managed to improve its fleet "uptime" from 89.5 percent to more

Figure 9.

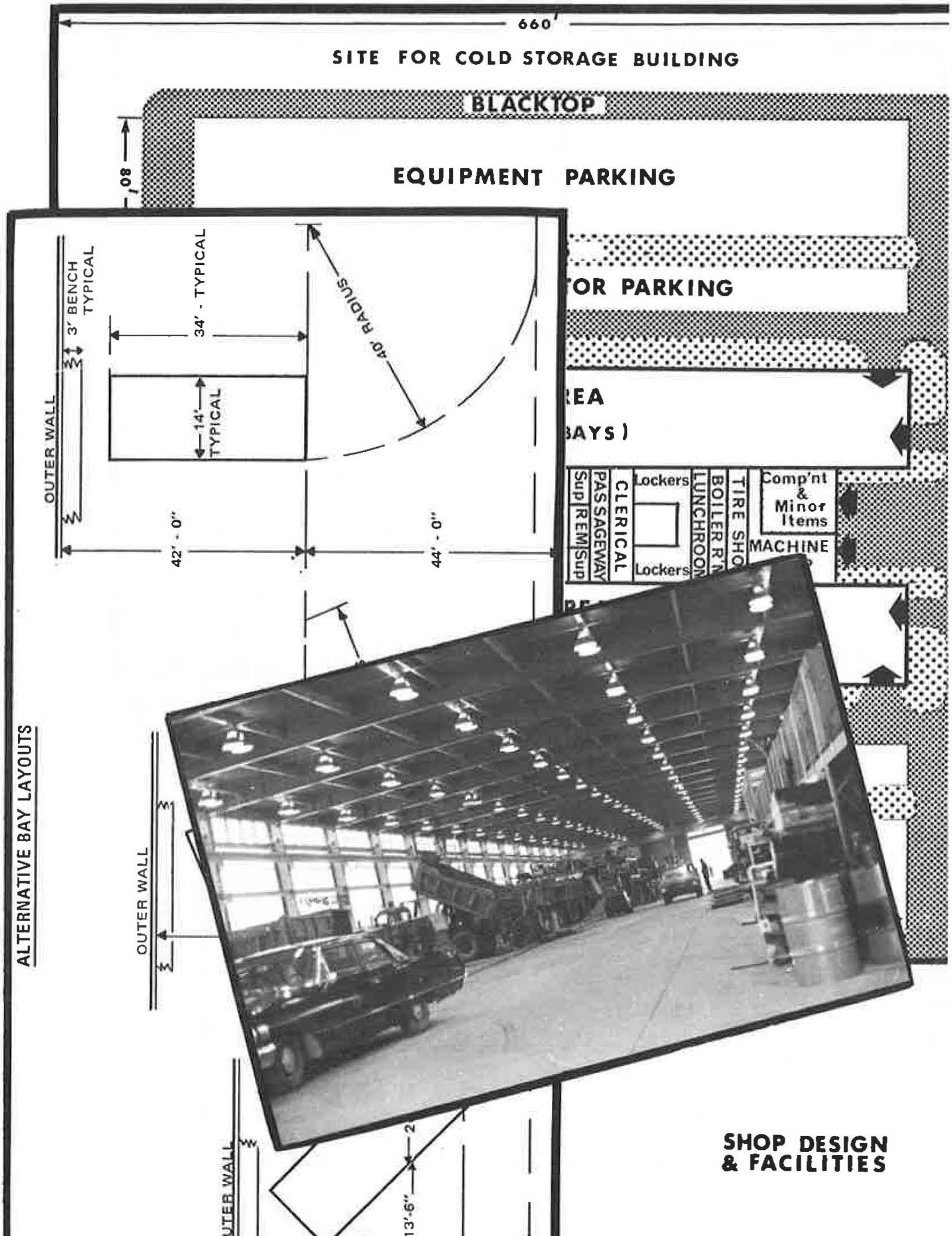
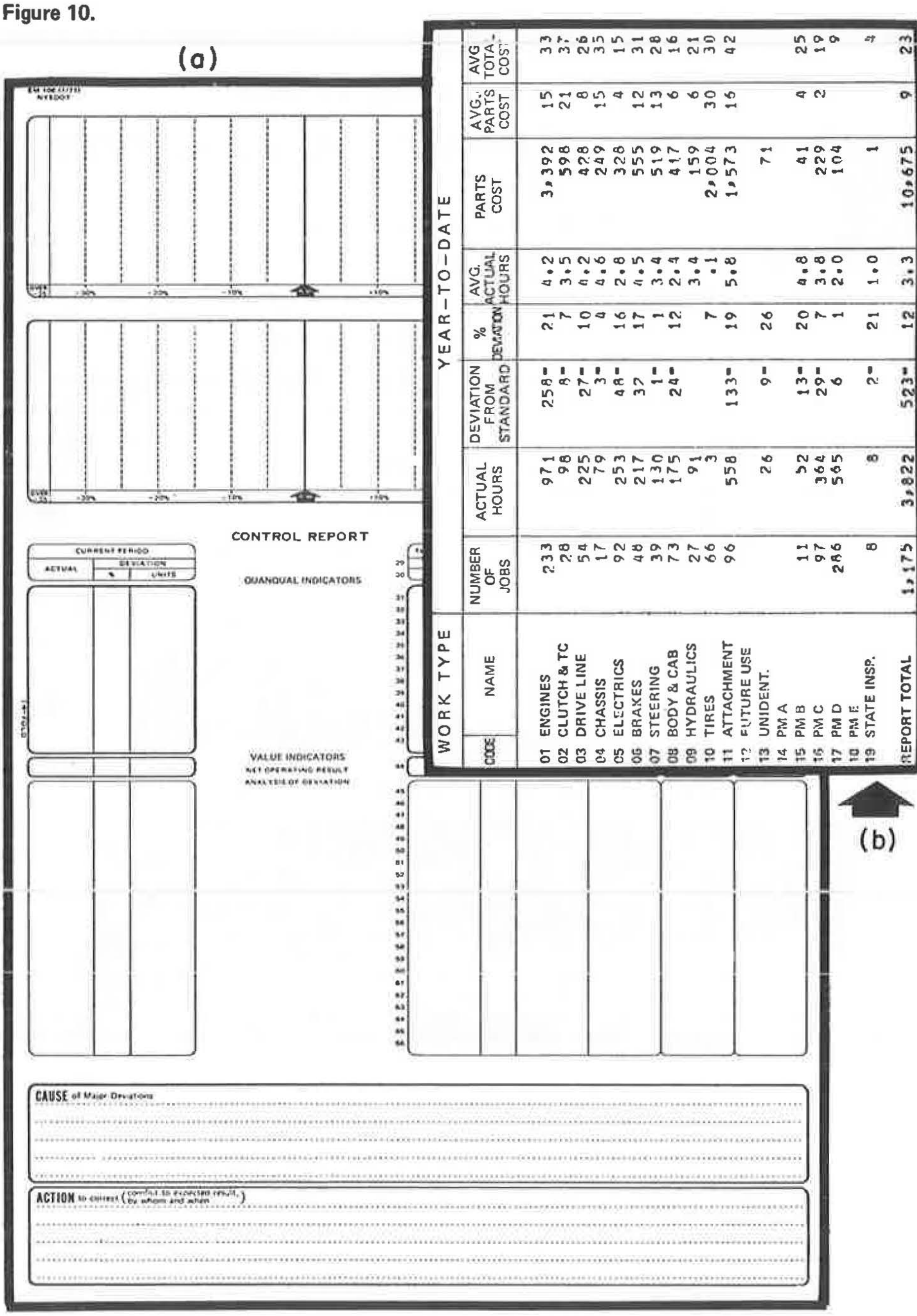

660'
SITE FOR COLD STORAGE BUILDING
BLACKTOP
EQUIPMENT PARKING
80'
OR PARKING
EA
AYS)
Sup REM Sup
PASSAGEWAY
CLERICAL
Lockers
Lockers
LUNCHROOM
BOILER R'M
TIRE SHO
Comp'nt & Minor Items
MACHINE
ALTERNATIVE BAY LAYOUTS
OUTER WALL
3' BENCH TYPICAL
34' - TYPICAL
40' RADIUS
14' TYPICAL
42' - 0"
44' - 0"
OUTER WALL
OUTER WALL
13'-6"
39' - 0"
15' - 9"
SHOP DESIGN & FACILITIES

Figure 10.



WORK TYPE		YEAR–TO–DATE							
CODE	NAME	NUMBER OF JOBS	ACTUAL HOURS	DEVIATION FROM STANDARD	% DEVIATION	AVG. ACTUAL HOURS	PARTS COST	AVG. PARTS COST	AVG TOTAL COST
01	ENGINES	233	971	258-	21	4.2	3,392	15	33
02	CLUTCH & TC	28	98	8-	7	3.5	598	21	37
03	DRIVE LINE	54	225	27-	10	4.2	428	8	26
04	CHASSIS	17	79	3-	4	4.6	249	15	35
05	ELECTRICS	92	253	48-	16	2.8	328	4	15
06	BRAKES	48	217	37	17	4.5	555	12	31
07	STEERING	39	130	1-	1	3.4	519	13	28
08	BODY & CAB	73	175	24-	12	2.4	417	6	16
09	HYDRAULICS	27	91			3.4	159	6	21
10	TIRES	66	3		7	.1	2,004	30	30
11	ATTACHMENT	96	558	133-	19	5.8	1,573	16	42
12	FUTURE USE								
13	UNIDENT.		26	9-	26		71		
14	PM A								
15	PM B	11	52	13-	20	4.8	41	4	25
16	PM C	97	364	29-	7	3.8	229	2	19
17	PM D	286	565	6	1	2.0	104		9
18	PM E								
19	STATE INSP.	8	8	2-	21	1.0	1		4
	REPORT TOTAL	1,175	3,822	523-	12	3.3	10,675	9	23

than 93 percent. Although this was slightly short of target, the program exceeded its goal of 85 percent for mechanic "uptime" well ahead of schedule.

The general body of the work force not only took sincere interest in the project but also revealed itself to be responsive to constructive leadership and challenge. Most importantly, the program personnel have regained their confidence and pride. This was restored by the unequivocal evidence of their own achievement.