time of reconstruction the quality of the pavement structure is still relatively good (trend II).

The agency costs will vary within the zone of the cross-hatched lines in Figure 13, according to the condition of the pavement at the point of time of renewal, as a function of the maintenance interval, Δt. Additional costs for the road users, $\Delta\bar{N}$, relative to the initial pavement condition (zero stage for planning, 0) arise from deterioration of the pavement with time ($\Delta\bar{N}_P$), and at maintenance sites where traffic delays occur ($\Delta\bar{N}_B$). The following elements comprise $\Delta\bar{N}$:

- Additional time costs, $\Delta\bar{Z}$;
- Additional operating costs, $\Delta\bar{T}$; and
- Additional accident costs, $\Delta\bar{A}$.

The diagram in the center of Figure 13 shows the additional user costs, $\Delta\bar{N}$, for trends I and II as a function of Δt. Furthermore, the diagram shows $\Delta\bar{N}_P$ (discounted additional user costs as a result of changes in quality) and $\Delta\bar{N}_B$ (discounted additional user costs resulting from delay of traffic at repair sites).

The diagram on the right shows the sum of agency and user costs for both serviceability trends I and II. A definite optimal point in time exists (Δt_{opt}) for performing road maintenance, depending on the trend for which the discounted total cost reaches a minimum. If the time chosen for rehabilitation is greater or less than the optimum (Δt_{opt}) then additional costs will be included in the total economic costs. Figure 14 shows an example of the extent of the additional discounted cost, $\Delta\bar{G}$, (in millions of DM per km of highway), subject to certain assumptions that are not discussed here. If the time of rehabilitation on the road network of the Federal Republic of Germany (which comprises approximately 160 000 km) should be changed by more than approximately $\Delta\Delta t = 5$ years against the optimum (Δt_{opt}), the loss in real terms of public expenditure would be on the order of 6 billion DM.

CONCLUDING REMARKS

An attempt has been made to show in this contribution that a useful, practical instrument for both the establishment of financial needs and for the optimization of decisions for road rehabilitation has been developed in the Federal Republic of Germany. Because of the limited time, only a brief sketch of the subject could be presented. However, it is hoped that this discussion has provided at least an overall impression of available decision-making techniques and encouraged further interest in them.

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Calculating a Zero-Based Maintenance Budget and Allocating Budgeted Resources by Using Objective Levels of Service and Performance Measures

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ABSTRACT

A new approach to the estimation of labor resource needs being developed by the California Department of Transportation to be used in budgeting is described. Seven calculation methods are employed to estimate labor resource needs for the entire maintenance program: historic projection, frequency calculation, condition evaluation, organization plan, training plan, proration, and capital project scheduling plan. Extensive research and engineering and statistical analyses are employed to develop the formulas and factors that correlate workload and labor resources by considering geographic variations due to station locations and staffing patterns and labor intensity variations by work type. The research and analysis rely heavily on information from the department's maintenance management system, which has been in operation more than 10 years. Another primary feature of this process is the definition of quantified levels of service for all field maintenance activities. These will be used in conjunction with the new calculation methods to relate staffing needs to variable levels of service. Top management decision makers will be able to make budget recommendations with a clear understanding of what they can buy and what they must forego if staffing is increased or decreased incremen-

tally in each maintenance subprogram. These same features can be used to allocate resources geographically in an equitable manner to provide a sound basis for developing annual work plans for field managers and to provide a basis for field compliance reviews.

California is located between latitude 32 and 42 degrees north of the equator. It stretches 825 miles from its northwest to its southeast corner. This is equivalent to the distance from Boston, Massachusetts, to Charleston, South Carolina, on the Eastern Seaboard. It covers some 158,693 miles^2 and has a maximum width of some 345 miles. California, unlike most regions of the United States, has only two distinct seasons, mild wet winters and dry summers, except at its higher elevations and in the northeast corner of the state. The climate is classified as Mediterranean; it occurs in only 1 percent of the world and in no other part of the United States. Rainfall varies from 110 in. in the northwest to less than 2 in. in Death Valley. Elevation ranges from 282 ft below sea level to 14,495 ft on Mt. Whitney. Topography varies from mountainous areas to vast valleys to the desert and coastal plains of Southern California.

Through this vast, diversified state, the California Department of Transportation (Caltrans) maintains almost 16,000 centerline miles of roadway. If all the lanes of pavement were laid end to end, they would be equal to the distance of nine round trips from Los Angeles to New York City. Associated with this network are more than 17,000 landscaped acres and 60,000 acres of maintained roadside, making Caltrans the largest farmer in California. The system includes 87 roadside rests for user convenience and some 2,469 miles of safety guardrail. Although California's climate is classified as Mediterranean, winter weather conditions require some 10,000 of its 52,000 lane miles to be classified as roads routinely requiring winter snow removal.

To maintain a system of this magnitude, Caltrans expends more than 6,000 person years and more than $350 million annually. This work is limited to those activities associated with the operation of the highway facility and the preservation of the system's components. Maintenance responds to emergency repairs necessitated by accidents, storms, or other unexpected emergencies. Major reconstruction, restoration, or rehabilitation work is not included as normal maintenance activities.

Caltrans developed and implemented its maintenance management system (MMS) around 1970, with the assistance of a consultant. The original concept of the MMS was to implement a zero-based budgeting and management system based on quantity standards. That system, or that approach, lost credibility as a documentation and justification approach for budgeting, principally because needs, as identified by field forces, were overstated. Over time, the maintenance budgeting process evolved into an approach that involved a base line and incremental increases. That approach subsequently was subjected to external challenges because it was believed that the basic work-load documentation and justification lacked credibility and were not supportable.

In 1981 the budget bill approved by the legislature directed Caltrans to pursue the development of a performance-based budget. In 1982 the legislature directed Caltrans to retain a consultant to perform a diagnostic study of Caltrans' maintenance management practices. That study was concluded in the summer of 1983. The consultant identified deficiencies and problems in the current Caltrans MMS as determined by a composite evaluation of all states reporting maintenance management features. After the consultant's diagnostic study of former practices, the department decided to engage the same consultant to evaluate current efforts to enhance the Caltrans maintenance management practices, which will be described conceptually in this paper.

The Caltrans maintenance organization is under the direction of a headquarters division of highway maintenance. The state is subdivided into 11 highway districts, 46 regions, 144 areas, and 611 crews, which are the basic cost centers for accumulating maintenance field costs. Those 611 crews consist of general crews that handle highway maintenance and landscape maintenance and special crews that handle unique maintenance problems such as those related to electrical systems, striping, and bridges.

Over the 13 years that Caltrans has operated an MMS, maintenance activity costs for labor, equipment, and materials consumed have been captured and preserved at the crew or cost-center level. All of those 13 years of records are still available for developing modifications to maintenance management practices. The highway maintenance program at Caltrans is subdivided into five primary components for administrative purposes: HM-1 (roadbed), HM-2 (roadside), HM-3 (structures), HM-4 (traffic safety devices), and HM-5 (maintenance auxiliary services). The five basic maintenance program components are further subdivided into 19 subcomponents, HM-11 through HM-54, shown in Table 1. Those 19 program subcomponents are further subdivided into work methods that describe how the work was accomplished.

TABLE 1 Highway Maintenance Program

•HM-1			Roadbed "Component"
"SUBCOMPONENT"	HM-11		Flexible Roadbed
	HM-12		Rigid Roadbed
•HM-2			Roadside "Component"
"SUBCOMPONENT"	HM-21		Drainage and Slopes
	HM-22		Roadway Litter and Debris
	HM-23		Vegetation Control
	HM-24		Public Service Facilities
	HM-25		Planted Areas
	HM-26		Major Damage
•HM-3			Structures "Component"
"SUBCOMPONENT"	HM-31		Bridge and Pump
	HM-32		Tunnel, Tubes and Ferries
•HM-4			"Traffic Control and Service Facilities "Component"
"SUBCOMPONENT"	HM-41		Pavement Delineation
	HM-42		Signs
	HM-43		Electrical
	HM-44		Traffic Safety Devices
	HM-45		Snow Removal and Ice Control
•HM-5			Maintenance Auxiliary Services "Component"
"SUBCOMPONENT"	HM-51		Headquarters Management and Support
	HM-52		District Management and Support
	HM-53		Maintenance Stations
	HM-54		Training and Employee Development

The primary emphasis of work-activity descriptions in the original MMS was to describe how work was done. The new Caltrans concept endeavors to describe maintenance expenditures in terms of what work was done, why the work was done, and how the work was done. Each of the maintenance program subcomponents, like roadside maintenance, is being subdivided into subprograms or families that define what kind of work is being done (i.e., fence repair, drainage correction, unpaved shoulders, and slopes). The families then are subdivided into problem statements that are descriptions of why maintenance activities are performed. For each problem statement, the correction method defines how the work was done, that is, what method was used:

manual, mechanical, chemical, biological, or special. This identification has been accomplished through a maintenance expenditure-numbering system, as follows:

Expenditure Number 521311:

5 = maintenance program
21 = drainage and slopes (subcomponent)
3 = drainage management (family)
1 = obstructed drainage opening (problem)
1 = manual (corrective method)

521311 = work expenditure code

This expenditure-numbering system is used universally throughout the Caltrans MMS.

Historic maintenance expenditure information is available for headquarters staff (since 1982-1983) and each of the 11 Caltrans districts. The district expenditures are subdivided into nonmaintenance branch charges (new in 1982-1983) and charges of the maintenance branch in each district. Each maintenance branch is further subdivided into regions, areas, and individual crews. Field charges by crews are separately reported as direct production time when field activities are under way; crew supervision by the maintenance supervisor of each crew; and mobilization charges, which consist of delay time, travel and haul time, and time for preparation of extra equipment. Figure 1 shows the level of detail of historic expenditure information that is available within the Caltrans maintenance information system.

LEVELS OF SERVICE

Levels of service have been employed in the Caltrans maintenance program over the years and have apparently evolved full circle. Initially levels of service were described in objective and quantifiable terms to communicate policy and promote understanding and consistency throughout the field maintenance organization. The objective, quantifiable levels of service were deemed inappropriate by the Caltrans legal staff because they were believed to increase tort liability (negligent maintenance). Currently at Caltrans there is an attempt to revert to quantifiable objective measures. Several parameters are used to define levels of service for each maintenance problem.

The new maintenance levels of service define maintenance activities according to three categories or objective functions:

1. Response activities are those that cannot be specifically predicted and are associated with public safety or, if not handled immediately, will re-

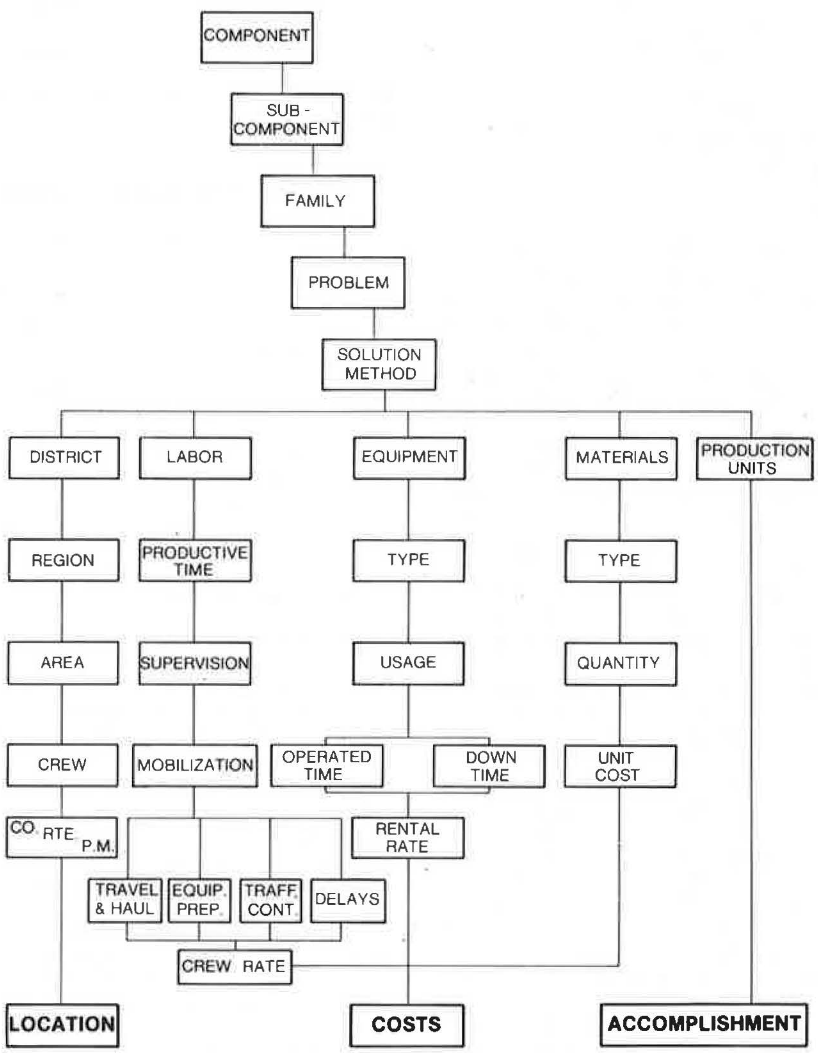

FIGURE 1 Expenditure information.

sult in major loss of a capital investment or curtailment of user service. Depending on their severity or consequence, these are handled on an emergency, quick (next-day), or ordinary (planned into weekly work schedule) basis.

2. Scheduled activities are those conditions that are scheduled to be corrected on a regular or frequent basis. Many landscape activities fall into this category, such as vegetation control, pruning, and roadside litter control.

3. Condition deterioration (planned) activities are primarily those identified through inspection as potential problems and scheduled for repair 1 to 3 years in advance. These types of repairs can be included in the budget process as specific projects. Such activities primarily fall in the pavement and bridge maintenance subprograms and are related to preservation of investment but, if left unattended, could become safety-related items.

Figure 2 shows the percentage of work represented by each of the previous three categories. Seventy-nine percent of these activities are scheduled or responsive in nature and are recurring each year. Less than 21 percent are of a condition-related nature.

FIGURE 2 Percentage of expenditures by category.

The new level-of-service concept also recognizes maintenance program priorities: safety, preservation of investment, user service, and appearance. Maintenance levels of service so defined become an expression of policy direction for the implementation of the maintenance program consistently through Caltrans. Figure 3 shows the level-of-service parameters applied to the HM-21 subcomponent of the roadside management program.

The levels of service relate to the basic highway system planning concepts in subdividing the state highway system into three components. The three components or subsystems have the following potential policy implications for maintenance and rehabilitation. Subsystem 1 would be eligible for upgrading to current geometric standards when rehabilitation is warranted. Subsystem 2 would be eligible for major rehabilitation but would not be eligible for upgrading to geometric standards. Subsystem 3 would not be eligible for upgrading to geometric standards nor would major rehabilitation be performed. This subsystem would be totally dependent on maintenance corrections to retain its operational integrity. Extraordinary situations would, however, be recognized.

In Table 2 the extent of the highway system subdivision in terms of centerline miles and lane miles included in each of the three subsystems is shown. The new level-of-service concept under development at Caltrans would recognize that the maintenance

FAMILY	MAINTENANCE PROBLEM	SYSTEM CLASSIFICATION 1	2	3
UNPAVED SHOULDER MGMT.	VERTICAL DROP—OFF OR DEPRESSIONS ADJACENT TO PAVEMENT EDGE	RS	RS	RO
	RUTS IN AREAS USED BY TRAFFIC IN EMERGENCIES	RO	RS	RS
FENCE MGMT.	FENCE DOES NOT PROVIDE ACCESS CONTROL / SECURITY / SAFETY	RQ	RO	RO
DRAINAGE MANAGEMENT	OBSTRUCTED DRAINAGE OPENINGS PIPES OR OVERSIDE DRAINS	RS	RS	RS
	OBSTRUCTED SUBSURFACE WATER DRAINAGE SYSTEMS	RS	RS	RS
	MATERIAL OBSTRUCTING ROADSIDE SURFACE DRAINAGE	RS	RS	RS
	WORNOUT OR DAMAGED DRAINAGE FACILITIES	PC	PC	PC
	DRAINAGE FACILITIES HAVE SUSTAINED MINOR DRAINAGE	RS	RS	RS
SLOPE AND EMBANKMENT MAINTENANCE	SLIDE MATERIAL OR SLIPOUTS ON SHOULDER	RQ	RQ	RQ
	SLIDE MATERIAL OR SLIPOUT ON TRAVELED WAY	RE	RE	RE
	DAMAGE TO ROADSIDE OTHER THAN SLIDES OR SLIPOUTS	RS	RS	RS

LEGEND:

RESPONSE	SCHEDULED	CONDITION
RE Emergency	F^1 Annual	PC Plan Repair
RQ Quick	F^2 Biannual	FC Fix Problem
RO Ordinary	F^4 Quarterly	
RS Seasonal	F^{12} Monthly	
	F^{52} Weekly	

FIGURE 3 HM-21 subcomponent of roadside management program.

TABLE 2 Highway System Subdivision for Maintenance Service Levels

Extent	Subsystem 1	2	3	System Totals
Centerline miles				
No.	6,000	4,600	4,400	15,000
Percent	40	31	29	
Lane miles				
No.	26,200	12,500	9,200	47,900
Percent	55	26	19	

service level can vary based on the system subdivision just described.

MAINTENANCE STAFF NEEDS CALCULATIONS

The maintenance program consists of a heterogeneous combination of work activities that requires several calculation methods to determine total staffing needs. Efforts to date have concentrated on determining procedures for calculating such needs. The final calculation will include labor, equipment, material, and other operating-expense needs related to work load or performance. In this paper only the staffing portion of the maintenance work-load determination will be addressed.

The Caltrans maintenance program staff work load requires seven unique calculation methods to determine total program person-year needs. Staffing needs related to calculation methods are shown in Figure 4.

The calculation methods for each of the seven categories are described in the following.

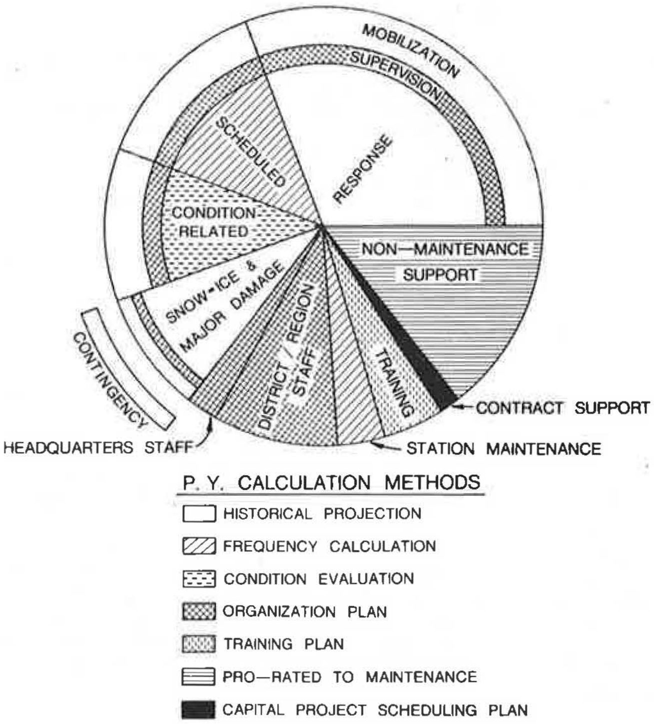

FIGURE 4 Total program person-year needs (3-year average; 6,229 person years).

Historical Projection

Historical projection is used for work in response to uncontrollable situations, typified by storm damage, snow and ice control, and other problems that must be corrected when they occur (e.g., signal and lighting outages and warning and regulatory sign disruptions). This method is also used to calculate the daily mobilization effort associated with on-site production work (i.e., travel, haul, traffic control, and extra equipment preparation).

In the case of production work, the historic production-expenditure files are first researched for each problem or activity to identify those that represent a significant amount of work. The intent is to deal with a manageable number of work-load indicators. The remainder of the response-type production work will also reflect historic levels of effort, but in a composite miscellaneous category. The historic base data will cover approximately 5 years, depending on the annual stability of each problem or activity.

In each case the data will be subjected to standardized trend analysis and statistical evaluation to determine the most appropriate basis for future needs projections. The projection will yield work-load estimates in terms of number of occurrences or number of specific problems anticipated or number of times specific activities are expected to be performed to satisfy the prescribed levels of service. The work-load estimate is then multiplied by productivity factors derived from recent past performance history to quantify labor person-year needs. Equipment and material types and quantities will also be related to work load based on correlation of historic work accomplishment and material and equipment use.

In the case of daily mobilization activities, the historic projection-expenditure files are again researched and analyzed to develop acceptable productivity factor correlations between type of work performed and geographic work-environment variables like rural or urban, freeway or two-lane, conventional or city street, and organization or territorial or geographic. These labor resource needs are ultimately added to production work resource needs (plus associated crew supervision) to yield total labor resource needs for each maintenance program.

Frequency Calculation

Frequency calculation is the method used for scheduled maintenance activities like litter pickup, signal relamping, and roadside rest and maintenance station maintenance. The levels of service typically prescribe the frequency with which these activities are to be performed (i.e., daily, weekly, or monthly).

The historic production-expenditure files are researched for each specific activity to determine activities with significant work loads. Standard statistical methods are used to determine staff hours per unit of service for each scheduled activity. The activity work load is determined by multiplying the units of service by the level-of-service frequency. The labor resource needs are the product of the activity work load and the hours per unit of work load. Total labor needs for each activity are the sum of this direct work load, associated mobilization, and crew supervision.

Condition Evaluation

The condition-evaluation method is used for work on facilities that deteriorate gradually through aging. It is restricted to those facilities that can be inspected 1 to 2 years before the budget implementation year to identify a condition that will trigger planning for work during the budget year. A second trigger condition is specified by the level of service that defines when work should be performed in the field. Pavement, bridge structures, and culverts represent the major portion of the condition-related maintenance work load.

The Caltrans highway program differentiates among maintenance, rehabilitation, and improvements in a budgetary and program management sense. The condition surveys are used to identify work load for each of these three program elements.

Caltrans routinely conducts condition surveys on pavements and bridges. Additional surveys may be required when analysis indicates items with significant work loads in the condition-deterioration category. Determination of the condition-related maintenance work load requires data-systems interaction among the maintenance information system, the pavement management system, and the structures maintenance system.

Research and analysis of the pavement management system, structures maintenance system, and the maintenance information system provide information on the rate of condition deterioration to establish the dual trigger conditions for budget planning and for field corrective actions. The condition trigger values are determined by correlating and comparing condition changes from survey to survey and maintenance activities related to condition states.

A comparative analysis is made for groups of common condition states to determine the type and quantities of maintenance resources expended for homogeneous condition ranges. Activity work load is then determined by applying planning condition trigger values against the condition survey files.

The historic maintenance production-expenditure files are analyzed for each significant problem type. Standard statistical methods are used to develop productivity factors (staff hours per unit of work load). Production labor resource needs are calculated by multiplying work-load units by the productivity factors. Total labor needs for each problem type are the sum of production hours, mobilization, and crew supervision.

Organization Plan

California state government programs are legislatively controlled by dollars, person years of effort, and positions. Position control is accomplished through centralized approval of organization and program staffing plans (reporting relationships, numbers of positions, and personnel classification levels).

Portions of the Caltrans maintenance program staffing resources are readily predictable from approved organization plans. The most obvious examples are HM-51, Headquarters Management and Support, and HM-52, District Management and Support, in which numbers of positions and personnel classification levels are rigidly controlled. In essence, the approved organization plan provides a body count that can be translated into person years (e.g., 1,800 hr equals 1 person-year).

By the same token the number of field crews (cost centers) is rigidly controlled by headquarters. By definition each crew is headed by a crew supervisor. According to the instructions for reporting work accomplishment, only the crew supervisor (or his acting replacement in his absence) can report work in field supervision. Therefore, the number of authorized crews determines the number of hours or person years of field supervision each year.

The supervision effort is not a specific budget item; it is reported or included in each maintenance program. The relative degree of supervision varies by program or type of work. Some are typically accomplished by one supervisor and one or two workers (e.g., signal or lighting relamping and snow and ice patrol), whereas some, like litter pickup, involve large crews with one supervisor. Historical production-expenditure files will be analyzed to determine the relative supervision intensity for each problem type.

Approved organization plans dictate the total amount of crew supervision. Relative supervision-worker intensity will determine the distribution of supervision among the budgetary production programs.

Training Plan

The Caltrans maintenance budget recognizes maintenance staff training as a unique subprogram within the maintenance auxiliary services component. Throughout Caltrans, training is divided into six categories according to priority:

1. Mandated,
2. Job required,
3. Job related,
4. Upward mobility,
5. Special program, and
6. Career related.

Training records are maintained for individual employees. Training needs are determined for all employees annually by subject matter and category from a training catalog. The catalog describes the training objectives, content, and employee hours for each course. A statewide maintenance staff training-needs plan is developed that summarizes proposed training by priority category and person hours or person years. The training-needs plan is evaluated by top-level management to determine staff resources to be requested in the budget process.

Prorated to Maintenance

Several nonmaintenance support activities chargeable to the maintenance program are aggregated into administrative technical services. These charges are then prorated to all of the Caltrans modal programs based on each program's relationship to the department's total program. These activities are considered direct costs or services and include the following:

1. Legal services,
2. Material procurement,
3. Building operations,
4. Telecommunications,
5. Computer services, and
6. Equipment services.

The proration formulas are determined and administered by the Division of Budget Development and Administration based on historic levels of activity by each budgeted program. The various activities included in this category have not been identified separately at this writing. It is understood that the department is converting them to a project or program cost-reporting basis so actual charges can be determined for each activity by budget program for future budget-estimating and cost-accounting purposes.

Capital Project Scheduling Plan

The Division of Highways and Programming and the Division of Budget Development and Administration developed an automated electronic data-processing capital-project scheduling plan to plan, schedule, and monitor progress of plans, specifications, and estimates for capital-outlay projects. This system also generates project development, construction, and other support staffing needs.

Staff resource estimates generated by this system have been accepted within Caltrans and by external budget reviewers. This system produces the budget estimate for the staff support of major maintenance work accomplished by formal contracts (e.g., some seal coats, minor asphalt-concrete pavement blankets, and bridge painting).

MANAGEMENT DECISION OPPORTUNITIES

After the foregoing seven calculation methods have been employed to determine the staffing resource needs estimate for each of the 19 maintenance program subcomponents shown in Table 1, the results are summarized by program, subprogram, and problem as shown in Figure 5 for the HM-21 drainage and slopes program.

Figure 5 gives the staff work-load needs estimate for management decision making. The work-load matrix summary prepared for each program quantifies the following:

1. What is to be done (subprogram), for example, unpaved shoulders, fence, drainage, and slopes and embankments;
2. Why work is to be done (problems), for example, dropoff at the edge of the pavement and ruts in the emergency use area;
3. Work type, for example, response, scheduled, or condition deterioration;
4. Priority, for example, safe (safety), save (preservation of investment), serve (user service), or seen (appearance); and
5. System classification, for example, high-level routes, medium-level routes, or low-level routes.

DRAINAGE & SLOPES PROGRAM •SUBPROGRAM (FAMILY) — PROBLEMS	WORK TYPE	PRIORITY	UNITS	WORK LOAD		SYSTEM CLASSIFICATION (PERSON YEARS—PY's)		
				QUANT.	PYs	1	2	3
• UNPAVED SHOULDERS					210	50	70	90
— Dropoff at E. P	Response	Safe	Shldr. Mi.	28,000	160			
— Ruts in emerg. use area	Response	Safe	Ea. Loc.	9,700	50			
• FENCE — Not secure	Response	Safe	Fence Mi.	175	76	40	16	20
• DRAINAGE					78	38	15	25
— Openings, pipes, drains	Response	Save	Ea. Loc.	28,000	17			
— Subsurface drains	Response	Save	Ea. Loc.	700	16			
— Roadside drainage	Response	Save	Lin. Mi.	530	12			
— Wornout facilities	Condition	Save	Ea. Str.	15,200	28			
— Minor damage	Response	Save	Ea. Str.	2,700	5			
• SLOPES & EMBANKMENTS					136	50	40	46
— On shoulder	Response	Save	Ea. Loc.	1,500	70			
— On travelled way	Response	Safe	Ea. Loc.	700	51			
— Other	Response	Save	N/A	N/A	15			
TOTALS	R = 472 S = 0 PC = 28	Safe = 337 Save = 163 Serve = 0 Seen = 0			500	178	141	181

FIGURE 5 Work-load matrix summary.

The function of this matrix is twofold: to describe what type of work is needed and why and to point out the impacts or consequences of not attending to some of the identified needs. The overall objective is to foster informed decision making.

The decision alternatives are numerous when resources are limited and all needs cannot be corrected:

1. What types of work can be delayed:
   a. Can some response-type problems be ignored?
   b. Should scheduled frequencies be extended?
   c. Should condition-related work be allowed to worsen before being corrected?
2. What lower-priority work can be eliminated:
   a. Should the user service work load (e.g., roadside rest maintenance) be reduced?
   b. Should appearance work (e.g., litter pickup) be eliminated?
3. What service or problem corrections can be reduced on lower-level class routes on the state highway system:
   a. Should maintenance frequencies be extended for all (or specific) problem types?
   b. Should conditions of some problem types be maintained at a worse level on class 2 or class 3 routes or both?

The work-load summary format shown in Figure 5 permits or forces the decision maker to delete or reduce a specific problem work load to an acceptable level with full knowledge of the specific impacts and cost of these decisions. These same methodologies can be used in essentially reverse order to allocate resources based on local needs per approved level-of-service policies after the final budget has been adopted. Caltrans will employ the foregoing methodologies in late 1984 to approximately one-half of the maintenance program in the budget development process.

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