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# Labor and Manpower Management Issues

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# The Dynamics of Vehicle Operator Absenteeism

CONSTANCE PERIN

## ABSTRACT

The industry-wide problem known as vehicle operator absenteeism is examined in an attempt to encourage clearer research definition and operational changes that are likely to increase productivity and improve service reliability. Absenteeism is defined as absence from work for which management has not received advance notice. The focus here is on sporadic, unanticipated absence that arises from incentives and disincentives in the structure of transit operations. Although high absence rates may be the result, they reflect other issues related to maintaining service reliability, maximizing productivity, the nature of the work, and seniority systems, all of which have tended to be insufficiently associated with the problem of absenteeism. The analysis examines management's perspectives on sizing the extraboard and assigning overtime to regular operators on their days off and employees' perspectives on trading time for money, on work perceived to be unsafe or hazardous, on stressful work schedules, and on the quality of supervision. A number of propositions are discussed that organizational theorists might use to structure comparative research and transit managers might use to conduct diagnostic analyses of transit records.

The industry-wide problem known as vehicle operator absenteeism is examined in an attempt to encourage clearer research definition and operational changes that are likely to increase productivity and improve service reliability.

Absenteeism is defined as absence from work for which management has not received advance notice. In irresponsible absence, the term "absenteeism" correctly connotes malingering and excessive absence by abusing sick leave rights and other workrules. A second form of unscheduled absence is involuntary (due to illness, injury on duty, family responsibilities ranging from bereavement to child care). This paper focuses on sporadic, unanticipated absence that arises from incentives and disincentives in the structure of transit operations. Although high absence rates may be the result, they reflect other issues related to maintaining service reliability, maximizing productivity, the nature of the work, and seniority systems--all of which have tended to be insufficiently associated with absenteeism analytically.

This perspective is also correlational and contextual; it represents a grounded point of view that may better serve the concerns of transit managers and organizational theorists hoping to introduce changes to a system of human resources and machines that is complexly layered and context-dependent. Absence rates vary widely--in a random group of 21 transit agencies, they ranged from a self-reported average annual rate of 7.6 to 68.8 days (1,p.35). At one transit agency, in another study, 45 percent of

all operators used no paid sick leave in a given year, 3.7 percent used their 12 days earned, and 11.7 percent used in excess of 12 days per year (2,p.25). Such findings should be read as a sign that organizational and operational case studies are more appropriate to these problems, but conventions in the conduct of research have led instead to a preponderance of studies (few as they are) that rely on survey methods (some with poor response rates) rather than on case studies that also include the statistical analysis of transit agency records [for an annotated literature review of absenteeism, workers' compensation, and occupational stress studies in transit up to 1983, see Perry (2,pp.7-80)].

In this contextual perspective, furthermore, priority is given to the influence of working conditions on absence patterns; individual motivations are of secondary analytic importance. The rationale for this structural emphasis is in part simply pragmatic: Managers can do more to influence working conditions than they can do to redirect the personalities of their employees or to find selection criteria that guarantee unproblematic employees. These are also subjects that management and labor can discuss and cooperate on outside of the collective bargaining context.

A small proportion of operators appears to account for a high proportion of total absence, but whether these tend to be the same operators is an unanswered question (2,pp.33-34). In any case, problem-employees are peripheral to this discussion; rather, the concern is with high rates of absence as a general, fixed feature of a transit agency's operations. Problem-operators are properly left to personnel and human resources directors who have the contractual authority to issue appropriate warnings and offer appropriate counseling before dismissal. Transit agencies are using many practicable approaches to progressive discipline along with effective programs of social support and recognition designed to maintain good morale. That transit managers are reluctant to fire employees whose work attendance and attitude are persistently problematic is one factor beyond the scope of this discussion. Past absenteeism is the strongest predictor of future absenteeism (3).

Incentive and other motivational programs are unlikely to address the underlying structural features common to transit operations that give rise to high absence rates. Such programs may, in fact, introduce formalizations that run counter to what can be productive aspects of the organization's culture--its informal system of rewards and sanctions (e.g., dispatchers' decisions about assigning overtime; management's requests to operators to take a day off without pay when the extraboard is overstaffed).

A few general facts about blue-collar absence are important background to this discussion: Higher absence rates are found among blue-collar workers than among workers in other occupations--rates are about 70 percent higher among blue-collar workers than among white-collar workers, and of the blue-collar group, the rates are about 25 percent higher among union members. Furthermore, absenteeism "is significantly higher among workers who are young, receive low wages, report unhealthy or dangerous working conditions, work the same hours each day and claim to be in poor health" (4,p.82). Safety was the most



salient issue for bus operators, rating higher than wages and work schedules, in a recent study of 1,039 California bus operators (2). This corroborates a general finding that workers in unionized jobs experience more health and safety hazards than those in nonunion jobs (5). Those structural factors deserve special attention in transit industry analyses.

Transit absence rates hide more complexity and are more systematic than most research has explored to date. These complexities are discussed first from management's perspective, and then from an operator's perspective. A number of propositions are suggested, largely drawn from the discussion, that could organize diagnoses of the specific issues on which change is needed if operational goals of reducing levels of absence, lowering operating costs, and increasing service reliability are to be served.

#### MANAGEMENT'S STAFFING PLANS AND COST-EFFECTIVENESS

Unscheduled absences appear to be clearly related to management's fundamental problem of estimating adequate staffing levels and minimizing labor costs. High rates of operator absence are a consequence of the witting and unwitting cooperation of labor and management. Each realizes certain benefits, and to managers, these benefits appear to outweigh their costs. Such benefits may be the essential ingredient of a successful, albeit ad hoc, optimizing strategy managers have adopted, lacking both the data and more sophisticated techniques for making staffing decisions. Interestingly, the costs of absenteeism, according to an economic analysis of manufacturing industries, are relatively small (6, pp.387,392).

In the ordinary course of transit operations, to maintain reliable service, all scheduled runs must be filled with available operators--every transit agency assigns some of its regular operators to an extraboard that covers runs when their assigned operators are on vacation, jury duty, recovering from an injury on duty, or when they do not, at the last minute, show up. When a run is missed because there is no operator to fill it, the operators following the run on the street take on additional service burdens, and this may increase operator stress and lower morale, perhaps resulting in illness or "sick leave".

The number of operators that should be assigned to cover for those not present is a strategic question for transit managers. In the long run, the reserve factor transit managers use (e.g., 1.32) may efficiently serve their needs at lowest cost, but perhaps not in the short run, when attendance levels remain high for a period of time and these operators, having no runs to fill, can be counted unproductive. Furthermore, it is common practice for managers to ask these surplus operators to take a day off without pay, which increases their incentive to work overtime whenever possible to make up the day without pay.

Extraboard operators are regular employees who receive fringe benefits. To avoid adding to that fixed labor cost, managers will rely instead on regular operators to work overtime, most usually on their regular day off and at premium pay that does not, however, cost as much as maintaining an additional extraboard operator. This practice follows a pattern prevalent in both manufacturing and nonmanufacturing industries (7). Circularly, extraboard size is often determined by historic absence rates, and knowing that their unscheduled absences will be covered, operators are thought thereby to have an incentive to stay away from work (2, pp.107-8;

8, p.26). To the best of this author's knowledge, however, operators have not been asked directly about their attendance decision making.

Transit managers state their problem (9, pp.61-62):

Determining the appropriate complement of drivers to operate a given service level is...a critical function of manpower management. Too few drivers will result in reduced service reliability (i.e., missed trips) and/or increased overtime wages. Conversely, an overabundance of driver labor will produce major diseconomies due to union contract provisions that stipulate straight-time guarantees and spread-time penalties for operators. Significantly, despite the appreciable impact of employment levels in our labor-intensive industry, transit has had few sophisticated tools for effective manpower planning.

A survey questionnaire returned by 19 California transit agencies reveals "a lack of uniformity...in policies for determining the size of the extraboard. It is primarily a judgmental process" (2, p.107).

These judgments are put to the test under conditions of unusual uncertainty--equipment problems and weather as well as human vagaries. But little is known now about how transit managers originally arrive at these judgments, whether and on what grounds they analyze their options or track the full range of costs and benefits of the methods they do use. One study expected to find, but did not, that absenteeism is higher at agencies where labor-management relations are strained or in conflict. Instead, it found that where the climate of labor-management relationships could be characterized as cooperative (contrasted with containment-aggression and accommodation) the rate of absenteeism was high--no explanation is offered, concluding only that "sweeping generalizations about the relationship of work rules to transit performance do not appear to be warranted....[I]ntuitive assessments of the impacts of specific work rules on performance are not always borne out by empirical analysis" (10, p.148).

Having worked overtime on their regular day off, operators are then also likely eventually to take that day off by using sick leave, once they are assured of pay equivalent, on the average, to a 40-hour week--for these "sick days" are, furthermore, likely to be unpaid. Those who work to maximize their wages and do not take such compensatory sick leave may then burn out or become ill and take legitimate sick leave (8, p.9). Despite managers' understanding that a direct relationship may exist between overtime availability and absenteeism, it appears to be rare for a transit agency to hold overtime out as incentive or reward for good attendance, evidence perhaps that this reciprocity is expected.

Scattered evidence supports this proposition that day-to-day labor-management cooperation, believed by managers to be their minimum-cost solution, means higher levels of service reliability, higher levels of overtime, and higher levels of absence:

1. Survey forms returned by 57 transit agencies out of 200 solicited (having about 50 percent of the nation's transit work force, but excluding New York City) reveal that "reducing available overtime was effective in reducing absence." One system documented an experiment with increasing the extra list, which showed a resulting drop in overtime premium, in total pay hours per platform hour, and in missed trips. The survey data do not indicate a statistically significant relationship between the respon-



dent's statement that overtime was available and high absence rates. However, the data do indicate a high correlation between unpaid sick leave and the total weekly wages of the employee. A possible explanation would be the use of overtime to compensate for unpaid sick leave (11,p.III.20). That is, operators trade one for the other. Only one of these 57 agencies assigned overtime work as a reward based on the operator's attendance record (11,p.III.4). This study also revealed that for many transit agencies "the availability of overtime pay was a major factor in making it economically tolerable for the operator to be absent on regular work days" (11,p.III.4).

2. Among the 4,400 bus drivers at the Southern California Regional Transit District (SCRTD), short-term absence is strongly associated with manpower shortages ( $r=0.74$ ), with operator work on regular days off ( $r=0.45$ ), and with unscheduled overtime ( $r=0.88$ ). More than 30 percent had more than 7 absences in the previous 12 months; the system average was more than 5 absences per year over and above holidays and paid vacation (12,p.30). Drivers having the highest absence rates (e.g., 14 or more days annually) earn an average of 40 hours of pay per week, most likely the result of management's scheduling long work runs together with overtime made available to regular drivers on their days off (12,p.32). Those are some of the findings of a self-study initiated by management in 1979.

The strong correlation between increased short-term absenteeism and operator shortages ( $r=0.74$ ) suggests (12,p.35)

that an operator shortage may induce a vicious cycle of working operators on their days off, resulting in more absenteeism, resulting in an apparent increase in the operator shortage, causing more work on weekends, resulting in an increase in absenteeism, and so on....The opportunities for (or demands upon) operators to perform work on their days off seem to induce increased absenteeism for both economic and social reasons. Economically, the employee can afford to go sick and, socially, the availability of leisure time...has been reduced [thus creating the incentive to take a day off].

SCRTD management found that (13,p.7)

the lowest labor costs per assignment were achieved when the system had a modest excess of operators...[T]he least expensive operating costs occurred when the actual operator ratio was between 1.31 and 1.32. With a system of approximately 3,350 work runs or assignments, a "surplus" of about 70 operators or 1.5% was the most cost efficient....When the operator ratio fell below 1.30 or climbed above 1.32, there was an increase in the cost per assignment....This result is consistent with the thought that lower operator levels contribute to higher overtime costs.

3. At the Twin Cities Metropolitan Transit Commission (St. Paul), the driver-to-work ratio had been increased to 1.5 (9,p.62),

yet the process was clearly not producing adequate manpower levels. This situation, in turn, played a major part in accelerating the vicious circle of increasing missed trips, overtime costs, and absenteeism. In

effect, the inadequate number of drivers not only undermined service reliability, but so increased the opportunities for overtime work as to ensure that drivers absent from their scheduled shifts could readily make up lost pay. The abundance of available overtime work is believed to have fostered an increased level of absenteeism and, inevitably, contributed to a rising incidence of missed trips.

4. The San Francisco Municipal Railway increased the size of its extraboard by about 300 operators, to 91 percent of its optimum size, and over a 1-year period saved \$0.5 million in overtime, a cost that was expected to be ultimately lower than the cost of the additional employees. In the first year, unanticipated absence declined "from almost 9 percent of the platform per day to only 7.3 percent" (8,p.26).

5. Gaps in management's absence records are further evidence that absenteeism may not be an issue in its own right. These gaps also prevent discovery of a reliable set of norms from which transit agencies can ascertain whether their absence rates are excessive, on the basis of both historical (internal) and external comparisons. A study of 28 transit agencies found that it almost appeared as if there was a tacit plan to obscure unauthorized absences by categorizing all absence as "sick leave". "In essence, the reliability of the archival absenteeism data is doubtful" (10,p.33). "The most surprising discovery was the extent to which information that would presumably be needed for ongoing management was not readily available (e.g., absenteeism rates, which would appear to be necessary for establishing employee schedules)" (10,p.11). Although "record-keeping at several of the better managed transit properties was thorough and up-to-date, there seemed to be little emphasis on the acquisition and monitoring of management information at an alarming number of others" (10,p.157). The study of 57 transit systems also found that they "do not summarize absence data for management purposes...No system was found where managers were budgetarily accountable for the absence in their departments" (11,p.V.3).

"High" rates of absence may be the norm for vehicle operators. Comparisons with other occupational groups, both in the United States and abroad, tend to show that vehicle operators experience a wide variety of physical and emotional stress symptoms [see Perry (2,pp.49-72) for a review of these studies and a summary of a current study underway at San Francisco MUNI of "Bus Operator Stress and Hypertension," funded by UMTA]. A study sponsored by the Transportation Research Board's National Cooperative Transit Research and Development Program is examining the possibility of developing a screening method for susceptibility to stress and developing training in self-reduction of stress reactions (14). There appears to be good reason for believing that operating a large vehicle in urban areas is an occupation with hazards to well-being, perhaps independently of personality attributes.

A British study comparing the absence rates of 16 different industries charts their weekly absence trends for a 1-year period--each one (including public transport) reveals a unique profile that is a function of the character of the work itself and of the employing organization (15). Moreover, in allowing for some expected level of unscheduled absence, management in effect introduces a norm or a standard by which additional absences will be judged excessive and will be judged a problem. "In general, the apparent reluctance of managements to study [absence



records], and to do anything about [the problem] supports the idea of an implicit collusion with existing rates of absenteeism...If this hypothetical argument is sound, given rates of absences become, in effect, part of existing (informal) contracts between employers and employees" (15,p.126).

The real issue becomes, then, whether transit operations relying on this kind of an optimization strategy are thereby productive, efficient, reliable, and cost-effective. Preliminary analyses of a random group of transit agencies using a formula based on a minimum cost approach suggest that extra-boards are likely to be overstaffed by about 7 percent (1). But no analyses have weighed that cost against the benefit gained from maintaining service reliability at a high standard and the peace of mind of dispatchers and transportation managers. Transit managers have a lot to worry about, but they may also take precautions that are more costly than necessary: One transit agency reviewed its operations carefully for several weeks and discovered that dispatchers were keeping extra-board operators on double reserve--instead of using them to fill in for missing operators, they called in regular operators to work on their day off, holding the extra-board for other, more worrisome, emergencies such as equipment failures on the street (16,p.7). In terms of retaining patronage and keeping revenues up, that may not be an entirely wasteful strategy.

A widespread perception of costly labor practices in transit--featherbedding, out-of-line fringe benefits, union-protected incompetence--has led to laying "absenteeism" strictly at labor's feet, perhaps because historically transit labor-management bargaining relationships tend to be highly adversarial and their day-to-day interdependence tends to be unacknowledged. For example, an improving type of relationship between labor and management had a solid influence on higher absence rates: "This relationship is possibly confounded by organizational reward and punishment policies regarding work attendance and this, in itself, may be related to management's willingness to agree to 'soft' work rules" (10,p.120). The benefits that management gains by taking a relaxed approach are not specified, but it is unlikely that there are none.

#### EMPLOYEES' TRADE-OFFS: TIME AND MONEY, SAFETY AND SUPERVISION

One analysis of the relationships in transit between the peak wage rate, relative wages, and absence rates suggests "that as wage levels improve with respect to an absolute or relative standard of living, employees are less inclined to work the full amount of their scheduled time" (10,p.134). In transit, relatively high wage levels, partly derived from overtime and the premium pay associated with long working days framed by the two peak periods, may account for the fact that although vehicle operators take sick leave, they often do not take sick pay: An analysis of 174 problem operators found that one-half claim none or almost none of their sick pay, suggesting that the other one-half value the time over the money that they are saving for authentic illness. Reimbursing operators for unused sick time might reduce this practice, the study suggests, as would paying sick pay automatically for the first day of an absence. Whenever there are "more operators available per assignment," fewer operators will be on the sick list, and conversely "when more overtime work is available, then more operators will be on the sick list" (12,p.34). Taking or not taking "sick leave" responds directly to management's choice of staffing levels, in other words.

Many labor agreements deny sick pay for both the first and second day of absence. "The effect of granting sick pay for all absenteeism could be to reduce absenteeism for those employees who go sick in order to get their 'rightful' sick pay. Also, it could reduce absenteeism by those who want to miss work, and can now do so by going sick without claiming sick pay, saving their sick pay for when they are really sick" (12,p.36). A "proof of illness" requirement was found to have had no effect on the absence rate in one study of 28 transit agencies (17).

A study of data based on a model for the substitution of leisure and income suggests that if "the average worker misses 10 days a year, it would take a 21 to 28 percent net wage increase to reduce his annual absences by one day. The gross wage would have to increase by a slightly larger proportion to obtain this same objective because such a large increase will place the worker in a higher tax bracket. These results suggest that employers interested in reducing absenteeism must resort to tactics other than wage increases to achieve their aim. It is also quite possible that the absence of indexation in the personal income tax and continuing increases in the tax rates and earnings ceilings for the payroll tax have produced higher absence rates in recent years" (4,p.82). Proposing a 4-day, 40-hour work week, managers at one transit agency suggest that because unpaid absence would cost an employee more, problem-operators might change their behavior (12,p.37).

The trade-offs operators may make between leisure and income are, then, also influenced by their working conditions--job safety, work schedule, and wage rates. As mentioned earlier, safety was of more concern to 1,039 California bus operators than were wages and work schedules. But just which aspects of safety were of concern was not explored--fear of criminal assault, accidents, or equipment failure, for example.

Workers "who feel they are exposed to dangerous or unhealthy working conditions have a daily absence rate which is about two percentage points higher than other workers, i.e., about 50% higher...Cost-benefit analyses of safety investments which do not consider the effects on absenteeism and turnover will underestimate the benefits" (4,pp.83-84). In transit, these unhealthy and dangerous conditions are, as operators perceive them, overly tight running times, inflexible schedules, unsafe working conditions, and poorly maintained equipment (2,p.25). Such quality of work life and productivity subjects--job content, redesign, enlargement, enrichment, rotation--are only now beginning to be taken seriously outside of the context of collective bargaining (18,19).

Weekend work is especially "unhealthy," of course, and most of the predictably unanticipated absences cluster around weekend work. Safety issues are not discussed in depth in one major study claiming to examine workers' compensation trends in transit (11). The single study of workers' compensation practices in transit revealed that those California transit agencies that evaluated the safety and maintenance specifications of vehicles before buying them experienced lower levels of claims and a lower percentage of their fleets out of service (2,p.166).

Patterns of sick leave abuse appear to become entrenched partly because supervision is lax. Of 57 transit agencies, 51 have either an informal or a formal performance (discipline) code but the strictness of enforcement varies. Five of 30 systems (17 percent) indicated that they had administered no suspensions for absence in 1978. Ten of 57 (18 per-



cent) did not discharge anyone for absence. Of 3,917 suspensions reported, 1,745 (45 percent) were for absence (11,p.III.5). Even so, systems that reported using a formal discipline code had greater absence than those without. This may indicate that only systems with severe problems have implemented a formal code. However, it also suggests that the performance code has not been successful in reducing the problem. In combination with progressive discipline, however, the results appeared to be better (11,p.III.21).

Supervisors appear to have a low level of legitimate authority: Management tends to recruit them from the pool of operators and their wages may remain the same (without overtime, they may earn less than drivers do; they may also remain members of the operators' union). They may not be trained for their new responsibilities; they may also be responsible for an unmanageably large number of operators. The quality of supervision is a frequent irritant--supervisors tend "to cut themselves off from informal communication with drivers (a situation frequently aggravated by physical barriers such as glass partitions)" and they may see "their role as that of a disciplinarian rather than a helper" (20,p.24). Operators appear universally to believe that their knowledge of the street goes unrecognized and that their input on operational issues is rarely requested (2).

As a general rule, studies continue to reveal that job satisfaction and absence do not correlate strongly (15,p.130). Transit vehicle operators' profile of job satisfaction appears to be unique, even as they are not especially satisfied with their jobs. Although transit workers are relatively well satisfied with wages and benefits, they are least satisfied with supervision, company policies and practices, working conditions, and promotion practices. Compared to other blue-collar occupations, transit operators were most satisfied with the independence afforded by their jobs (20,pp.24-25).

Angle and Perry (20) investigated the degree of organizational commitment and patterns of job satisfaction in a sample of 1,244 lower-level employees in 24 public mass transit organizations. The analysis compared transit workers to other occupational groups along similar dimensions. Levels of commitment among transit operators were found to be comparable to employees in other occupations, but their level of satisfaction with their jobs is lower, and operators are less satisfied than other nonsupervisory transit employees. Yet transit operators, in their assessment of job factors that provide them "strong sources" of satisfaction, included independence, variety, security, social service, ability utilization, co-workers, and achievement. This is a pattern of "specific job-facet satisfaction and dissatisfaction [that] is not duplicated in any other blue-collar occupation of which we are aware" (20,pp.24-25). In comparison to (20,p.24)

the routinized, oversupervised nature of lower-level organizational work [of other blue-collar occupations]...the transit operator performs, within general limits, as a relatively autonomous agent of the organization....To the individual passenger, the operator is the transit organization, and the operator seems aware of this. The specific job-factor satisfaction pattern...indicates that such job aspects as independence, variety, authority, and responsibility are relatively well satisfied among transit operators.

The same independence and willingness to accept responsibility characteristic of the personalities

of those choosing this occupation may play a part in the absence rate. Deciding how much they want to earn relative to the leisure they accrue is one manifestation. In short, high rates of absenteeism may be partly a function of certain of the same qualities that make drivers both reliable and satisfied with their jobs. They may be introducing flexibility (in the form of absence) into predetermined schedules and onerous routes. They may decide to be absent by calling in sick in order to reduce the job stresses beyond their control. In choosing a blue-collar job that has an uncharacteristic amount of autonomy and authority (over passengers and a large vehicle), operators' personality characteristics can be expected to be revealed in other ways as well.

The long hours and split shifts prevalent in transit appear to promote absences. Across occupations, absence rates are, as a general rule, highest among both younger workers and those unable to schedule other activities, such as medical or dental appointments, during their normal working hours. Absence rates are "about 50% higher among employees who work the same hours each day, 20% higher among those who work the standard 35 to 40 hour week, and 25% to 30% lower among those who receive some paid time off" (4,p.82). Organizational theorists suggest that taking sick leave may be one tactic in a stress-reduction strategy, and that programs to reduce absence may end up promoting it (21,p.403):

In fact, rigid efforts to ensure perfect attendance (such as through behavioral modification) may lead to unintended and detrimental consequences on the job, such as reduced product quality, increased accidents, and so forth. Hence, it would be useful if future studies could examine the extent to which changes in absence rates do or do not have adverse consequences for other aspects of organizational effectiveness. If reduced absenteeism is accomplished at the expense of product quality, accident rate, strike activity, or employee mental health, serious questions must be raised concerning the desirability of improving such attendance.

Although transit operators bid three to five times yearly for their runs according to seniority--exercising an unusual amount of control over their job schedules--the younger and newer workers inevitably find themselves with both the least desirable routes and the least desirable schedules. This, in itself, may account for some absenteeism. Low seniority may also correlate with higher job stress--as the higher absence rates of younger operators would appear to suggest. It has been documented that stress can be reduced simply by having control over the unwelcome stimulus or condition.

The seniority system affects even the quality of research: interviewing 1,244 lower-level employees in 24 transit agencies, the investigators explain that seniority has skewed the composition of their sample (20,p.21):

While blacks represent approximately 31% of the driver population, only 14% of the sample is black. Also while 54% of the population is white, 74% of the sample indicated they were white. One reason for the discrepancy may have been that whites, who tended to have greater seniority, might have been present in higher proportions than blacks during the weekday site visits. The sample also underrepresents employees in the 20-29 year age group, and overrepresents employees over 50.



Drivers with low seniority are assigned weekend work and these drivers are likely to be black and young.

#### CONCLUSION

A wholly systematic analysis of vehicle operator absenteeism has yet to be undertaken empirically. This preliminary list of propositions may provide organizational theorists and transit managers a means of organizing data and keeping the many dimensions together in analysis in order to choose strategies most likely to effect needed changes.

1. Younger operators and those with low seniority have the highest rates of unscheduled absence.
2. Undesirable runs are more likely to be operated by younger drivers.
3. Difficult runs (heavy traffic, tight schedules, high frequency of criminal assault, etc.) will be associated with higher unscheduled absence rates for operators of all ages than runs not regarded as difficult.
4. Operators having a high frequency of overtime work on their regular days off have higher rates of unscheduled absence.
5. When weekly earnings reach a certain level through a combination of overtime and regular pay, unscheduled absence increases.
6. Operators with higher seniority are likely to have a higher proportion of overtime earnings on an annual basis, and they are likely to take longer, but less frequent, unscheduled absences than operators with lower seniority.
7. The size of the extraboard bears a regular relationship to the amount of paid overtime (the smaller the extraboard, the more overtime paid).
8. Female operators have higher rates of unscheduled absence than male operators; married female operators with young children have higher rates of unscheduled absence than married male operators with young children.
9. The higher the number of dependents, the lower the amount of unscheduled absence.
10. Past absence patterns predict future absence patterns.
11. Where work rules specify that the first day of absence is unpaid, absences will tend to last 2 days.
12. Unscheduled absences will follow a pattern related to seasons and external events (e.g., sports events, major holiday weekends).
13. Unscheduled absences will be concentrated on weekends.
14. Where work rules do not allow for personal days off, unscheduled absences will be higher.
15. Where supervisors maintain face-to-face communication with drivers, absence rates are lower than when contact is infrequent and impersonal.
16. Operators with a short time until retirement will tend to maximize their earnings by picking assignments having highest pay rates, and they will take unscheduled absences more often than those farther from retirement.
17. The higher the rate at which sick leave accumulates, the higher the level of unscheduled absence.
18. Service reliability is directly related to the method used for staffing the extraboard.

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# Washington State Department of Transportation Organizational Review-How and Why

V. W. KORF and JOHN S. DAVIS

## ABSTRACT

In 1981 the Washington State Department of Transportation undertook a review of the agency to identify productivity improvements. The program yielded savings in nearly all functional areas without reducing service. The method for study relied on a three-person internal core team for management, with special sub-teams for technical subjects. One division was treated separately by a consultant. The Washington experience indicates the validity of using internal resources to bring about savings and changed attitudes toward productivity. The study, which took less than 2 years, evolved into a formal permanent productivity program in the department based on the foundation laid by the review. The program, demonstrating agency policies of cost-consciousness and visible savings, is believed to have contributed to the success of efforts to increase state gasoline taxes by increasing agency political credibility. The authors do not offer their methods as a panacea to all state departments of transportation and highways, but believe that the internal approach to productivity improvements is worth considering.

The Washington State Department of Transportation (WSDOT) made a critical self-examination of its operation and made changes that will save nearly \$2 million per year without reducing service to the public. A few of the organizational and manpower adjustments resulting from the in-depth examination are as follows:

- Elimination of 21 supervisory and management positions.
- Overhead manpower expenditures 9 percent less than the previous fiscal year.

- All annual major program expenditures completed well below budget in both dollars and manpower.
- Numerous department authorities delegated to lower levels.
- Reduced vehicle fleet by 130 units.
- Reduced telephone lines by 9 percent.
- Established program to revitalize employees' safety program.

These examples indicate the broad range of activities reviewed. A brief review of how this program was established, how it was carried out, and the projections for the future should be of interest to other state departments of transportation and highways.

## IMPROVEMENTS FROM WITHIN--WSDOT APPROACH

There are many approaches an agency can take to identify productivity improvements. The simplest approach may be to hire a consulting firm to do the job. The consultant can offer anyone from an individual project manager to a fully staffed team of management experts. You can then sit back and wait for them to present you with a solution, right? Wrong! You and your people know your organization and your jobs better than anyone else. A consultant must either draw on your knowledge (and time) or the product you get will be of little value.

This is not meant to imply that consultants should not be used. Without question, there are times when a team external to the agency is the best approach. This may provide maximum credibility to those outside the agency, minimize friction among agency managers, and provide experience and expertise unavailable internally.

Another approach, the approach taken by the Washington State DOT, is to do it yourself, if you can. In 1981 the Secretary of Transportation, Duane Berentson, decided to use an in-house team to review all divisions in the Washington DOT, with one exception; an external consultant would be used to review the Marine Division.



#### ORGANIZATION OF AN IN-HOUSE REVIEW

The first problem was how to establish an in-house team that would have the authority of the secretary of transportation, be respected by agency managers for its credentials, and have no prior biases and, therefore, would be impartial to all functional elements of the department. What appears to have worked well for the Washington State DOT was its use of a small core team reporting directly to the secretary. This core team was comprised of the following:

- Deputy Secretary of Transportation. A career employee with substantial experience both in the field and in the Headquarters office through 25 years with the department.
- Department Personnel Manager. Broad experience within and outside government; extensive experience in other state agencies as well as WSDOT; a thorough knowledge of the internal workings of the department.
- Management Analyst Supervisor. An individual with limited experience in the department, but with a high degree of analytical skills, extensive management experience outside the department, and proven organizational ability.

The secretary directed that the core team initiate studies throughout the department, which would basically ask, in a simplified manner, the following:

- Examine current functions
- What?
  - Why?
  - How?
  - Who?
  - How to improve?

The team first conducted face-to-face interviews with selected groups within the department to identify likely subject study areas. Seventy-seven subjects were listed for study and categorized in the following general groups:

- Policy
- Organizational structures
- Organizational relationships
- Procedural
- Minor remedial

This categorization of the study questions was believed necessary to assign a priority to the emphasis needed on each of the many topics raised from the review.

Many items of a major policy nature that were addressed related to fundamental issues about how the department conducts its business. At the same time, the team believed strongly that study areas of low manpower or low dollar impact must also be addressed although major organizational issues had much more visible return. Department credibility could be increased with the work force by solving many of the day-to-day annoyances, and big dollars can also be saved by making many small revisions in procedures.

#### EXPANDING THE KNOWLEDGE OF THE CORE TEAM

Shortly after the interviews were initiated among various department managers, it was realized that technical problems would require special expertise in subjects ranging from engineering to accounting and general administration.

As specialized subjects evolved, special teams of department employees were organized to address those subjects. These teams were closely administered by the core team to assure that the subjects were addressed in keeping with the secretary's direction for an open, no-holds-barred look at the department. The special team studies resulted in reports to the core team. The core team would either accept, reject, or direct additional study by the special teams and, ultimately, make a recommendation to the secretary.

A bonus benefit of the special teams was that additional department personnel could be involved in the in-house review and, therefore, have some stake in the eventual outcome. Without question, this method was highly successful in gaining acceptance of the recommendations throughout the department.

#### WHY A SPECIAL TEAM FOR PRODUCTIVITY

It may appear self-evident that managers should always work to improve the efficiency of operations. It is part of a manager's job. Why can't managers simply increase their emphasis on the subject and tell subordinates to do the same?

Washington's experience is that just as advertisers create a catchy slogan or title to influence buyers to change their behavior, so do managers need attention to influence subordinates to change their behavior, that is, to work more productively. A special title and designated effort for the study had special meaning in the Washington State DOT (and would possibly have special meaning in any department) to emphasize to the managers and employees that things are not "business as usual." It meant that innovation was welcome and encouraged, and that questions could be asked and answers given that might otherwise have been suppressed.

#### ARE THERE OTHER BENEFITS FROM A SPECIAL DESIGNATED STUDY?

There are, without question, other benefits. A special designated study will act as a catalyst. The Washington State DOT adopted more than 70 specific subjects for study. One of the most frequent comments heard was that many actions were needed for some time. Some have been tried and failed, but with the catalyst of the organization review many concerns and questions came together, bringing about coherent policy guidance with a rational plan for implementation.

Additionally, a formalized designated study will change manager and employee attitudes. It is well known that attitudes for improvements cannot be regulated, but they can surely be influenced to bring about change. This was one of the most gratifying observations as the organization review matured.

Productivity became more than a buzz word with managers; it became an element of conscious consideration in nearly all actions. Managers voluntarily left authorized positions vacant, reduced paper flow, and took many other actions that added up to increased productivity in the department. Attitudes from top to bottom were oriented toward productivity, and not just when a specific study was being conducted. The savings are substantial even though the total impact can never be quantified.

#### HOW LONG CAN A FORMAL PRODUCTIVITY TEAM BE EFFECTIVE?

The Washington DOT experience is that an in-depth study in all areas of the department, with a no-

holds-barred approach, has a limited time to be effective--not because all is well, but because managers still have day-to-day activities to accomplish. The continued probing by a study team eventually becomes an irritant, and objectivity will decrease. The study consumed less than 2 years of total effort on the 70 preliminary items selected for study.

Toward the latter part of the 2-year period, a formal productivity policy review board was established by policy order signed by the secretary. The net impact of this policy was to establish a productivity overview board as a permanent feature of the department, just as the contracting officer or the purchasing officer are a part of everyday business.

The formal productivity program continues to review the department for productivity improvements; however, it will focus on key subjects in specific department areas. The shift in emphasis will be from a broad review throughout all of the department at one time, to studies concentrated in selected phases of department operations.

Equally important in the continuing productivity review is the emphasis to all managers that improvements in productivity are as much a part of a manager's job as is designing a highway project or completing a public transportation study proposal.

#### EXTERNAL ACCEPTANCE

Any tax-supported public agency must, of course, remain supremely conscious of external opinions about the agency held by the legislature, its policy body, the governor, and last, but certainly not least, the taxpaying citizens of the state.

Washington State DOT believes that its continuing, conscious effort to achieve productivity improvements was a key factor in the department's success in obtaining additional transportation funding during the 1983 legislative session.

We are not perfect; we probably never will be. However, we believe the continuing in-house review of the organization with the direct involvement of the secretary of transportation provided credibility for the department with the lawmakers and, we hope, the citizens whom they represent.

We believe we established an atmosphere whereby we were viewed as an agency attempting to be more productive and succeeding in that effort. Thus, we could be responsibly considered for additional funding with the belief that funding would be effectively used to support the transportation system and not for alleged government inefficiencies.

Conducting a productivity study composed primarily of in-house rather than outside teams probably will make external credibility more difficult. Although the Washington State DOT was successful, frequently there are substantial reasons for government agencies to consider the use of outside people in productivity studies to reinforce external credibility. The Washington State DOT does expect to use people outside the department to accomplish future studies.

#### WHERE IS THE DEPARTMENT GOING NEXT?

Of the 70 proposals categorized for study, 51 were implemented, and the remaining ones were either rejected or are still in the process of implementation. The list at the beginning of this paper outlines only briefly some of the items studied and the results.

One important factor underlying the decision to

study the whole department at one time was to enable the core team and the secretary to address how the department as a whole was accomplishing its mission. This provided the best opportunity to determine strengths and weaknesses and overlaps and gaps within the agency. From this perspective decisions could be formulated for changes in direction in how the mission could be accomplished. The permanent productivity program will build on the foundation laid by the organization review.

A review of the established concept for accomplishing pre-contract activities was the first major study undertaken under the permanent program. The initial review addressed certain facets of pre-contract activities for improvement, but not the basic organizational concept.

During the initial team study, the department completed its review of the Computer Aided Design and Drafting (CADD) technology and has since proceeded with a contract to implement such a system. As this system is implemented, the organizational changes resulting from the pre-contract activities study will be a key to obtain maximum benefits from this new technology.

A recent decision from the productivity review is to expedite the training to introduce top managers into the computer age. It is the consensus in the department that managers must be more knowledgeable and involved in the decision-making process as we move into the automated age.

The Washington State DOT is an agency with activities in all modes of transportation. It cannot be predicted when the major studies of department operations will end. With the advancing technology occurring in the world today, the review of methods for accomplishing the agency's mission probably should never end.

#### POSTSCRIPT

There is no single unique answer to any organizational concept in the agencies of the 50 states. Departments of transportation and highways do not operate as islands separate from policymakers, elected officials, or the taxpaying citizens of the states. Maximum productivity cannot be the answer to all problems. Certainly, many services the public sector wants must be performed regardless of cost effectiveness. How cost-effective is plowing snow, for instance, when the tremendous cost of these activities to the snow states is considered and when these states cannot find sufficient dollars to fix bridges and resurface highways? Nonetheless, snowplowing is an activity that the mountain states owe their citizens for safe, convenient transportation during the winter months. It is accepted, therefore, as a service requested by citizens and one that they are willing to pay for.

Our productivity team is now spending a good deal of time reviewing the rapid advances in automation occurring across the country today. We are convinced that how transportation activities will be administered 10 years from today cannot be forecast. To survive, much less succeed, managers must address productivity and remain alert to this changing world. Transportation agencies must share individual improvements to the benefit of all.



# A Framework for Evaluating Transit Maintenance Resource Utilization

SUBHASH R. MUNDLE, DOUGLAS W. CARTER, and DONNA K. SILVERMAN

## ABSTRACT

In recent years improvement of maintenance performance has been the focus of significant concern in the transit industry. Many transit agencies have been plagued with deteriorating vehicle reliability and availability. Even more transit agencies are facing continual increases in maintenance expenditures at a time when total operating budgets are constrained or even diminishing. These trends have moved transit maintenance from the backroom to the executive suite where maintenance performance and expenditures are coming under increased management scrutiny. Maintenance managers need effective, yet straightforward methods for assessing and evaluating the extent to which scarce resources are expended in a productive manner. Resource utilization should be directed toward completion of specific tasks that result in achievement of established performance objectives. Although maintenance is recognized as a complex function, there are some relatively uncomplicated methods for determining the extent to which resources are expended productively. One such methodology is presented and its application at two transit properties is discussed.

Every day, the maintenance departments of the nation's public transit systems are expected to have more than 37,000 buses and 14,000 rail cars on the road and moving. Often these expectations are not met. This failure to achieve vehicle availability and reliability objectives in recent years has resulted in maintenance being moved from a backroom support function to the executive suite. The high public visibility of vehicle shortages and in-service breakdowns is only too obvious to transit managers and board members. A frequent response to deteriorating performance has been to increase the influx of dollars allocated to the maintenance function. Unfortunately, this strategy does not always work—many properties still experience declining maintenance performance, albeit at a higher cost.

It is important to note that not all transit agencies are experiencing a decline in maintenance performance; a few are enjoying steady improvements in revenue vehicle availability and reliability. However, most have done so at substantial cost. The transit industry, as a whole, has experienced unprecedented cost growth for maintenance activities in the past several years. In dollar terms, maintenance expenditures increased by 129 percent between 1975 and 1980, as shown in Figure 1 (1). This compares to an increase of 80 percent in transportation costs and 32 percent in general administration costs for the same period. Maintenance costs are now running at a rate of about 30 percent of total operating expenses and,

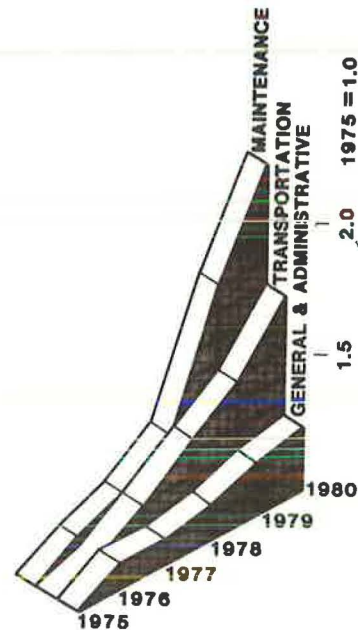


FIGURE 1 Transit operating cost increases.

unchecked, this escalating trend will cause these expenditures to claim an even greater percentage of diminishing operating budgets.

The financial needs of mass transit were recognized in the recent gasoline tax increase that was expected to raise \$1 billion per year for repairing and upgrading (an amount approximately equal to the increase in maintenance costs over the last 5 years). Better equipment and more money, however, are not the sole mitigating strategies for today's maintenance problems. Better management of available resources, despite the emphasis to "keep them running at any cost," can provide substantial payoffs for transit managers. By improving the quality and performance of existing systems, transit managers can justify their higher cost. One framework for evaluating maintenance resource allocation and associated performance, which has been used to identify opportunities for realizing operational benefits, is discussed in this paper.

## PROBLEM STATEMENT

In diagnosing the problems of numerous transit properties, several common themes have emerged:

1. Revenue equipment has become more sophisticated and technologically complex, but personnel training is often nonexistent or informal (i.e., on-the-job training).
2. Inadequate training is compounded by high labor turnover rates caused by increased competition for skilled labor, and excessive absenteeism.

3. Work scheduling and manpower planning are usually performed manually and are geared toward emergencies, not toward a production line type of operation.

4. Routine activities are frequently performed without adequate consideration of job content. Standards for activities that can be easily scheduled and monitored, notably preventive maintenance, are not adhered to rigorously.

5. The infrastructure of garages and terminals is by and large of turn-of-the-century vintage and has received little attention.

6. Maintenance shops also tend to overstock parts and supplies to avoid being caught short. Inventory systems generally do not monitor holding costs, material burn rates, or availability of supplies in a manner readily understood by management.

7. Management information systems, if they exist, often track the wrong performance measures and do not support resource allocation decision making.

The historical approach to transit maintenance (i.e., keep the vehicles running at any cost) has contributed to today's problems. More often than not, maintenance managers are rewarded for and are pressured to get equipment on the road to meet peak demand. This immediate charge overshadows the need to develop what in the long run are more effective quality control activities.

The magnitude of current maintenance cost and performance problems warrants a shift in maintenance philosophy toward effective resource management. Costs and performance can be improved through better management planning, monitoring, and control. Although the only solution to serious deterioration of facilities is capital expenditure for rehabilitation and repair, better management systems and productivity improvements require relatively small investments with respect to the possible payoffs. Thus, it is in these categories that immediate maintenance improvement opportunities are most abundant.

Although maintenance is recognized as a complex function, managers need a relatively straightforward means for identification and assessment of potential maintenance problems. The authors offer one approach to maintenance problem resolution, which has proven successful on several recent assignments, that involves four steps:

1. Complete a quick diagnostic review to identify substantive issues;
2. Evaluate the issues to identify resources influencing performance;
3. Define the organizational-procedural-systems changes to correct existing deficiencies; and
4. Put in place the organization and systems to prevent a recurrence. This approach is further addressed in the following paragraphs.

#### ISSUE IDENTIFICATION

A given condition in almost any maintenance analysis is that every division of the organization is a candidate for improvement. The universe of issues that could be investigated almost always exceeds the resources available for the task. Therefore, a screening mechanism is needed to separate substantive issues from those of lesser consequence. Substantive issues are those that currently or potentially could have a significant effect on performance and cost, or both. In order to define and isolate substantive issues, it is necessary to assess how effectively maintenance resources are being managed. Only after the issues have been

defined is it possible to develop effective strategies for resolving problems.

Issues can be identified by applying quantitative tools to measure performance and qualitative tools to measure organizational effectiveness. In this approach, performance is interpreted as how efficiently the maintenance department uses resources to meet vehicle availability and reliability requirements. Organizational effectiveness is interpreted as how supportive the management structure is in directing and controlling the activities comprising the maintenance function. It is important to recognize that diagnostic tools aid in assessing what is happening with regard to performance, and not why a particular trend occurs. The four major diagnostic tools that the authors have applied in issue identification are described in the following paragraphs.

#### External Peer Group Analysis

This technique is used to compare a transit agency's maintenance performance indicators with those from a set of peer transit systems (i.e., those of similar size and characteristics). The purpose of the external peer group comparison is to flag those aspects of an authority's performance that appear substantially different from what could be expected. This is done in two ways. The first step is to compare the subject transit agency's performance for specific measures (e.g., mean miles between mechanical failures) to mean, maximum, and minimum values from the peer group (excluding the subject agency). When the property's performance falls into the upper range, one can conclude that performance is satisfactory to good. Conversely, a lower range of performance identifies a potential issue and suggests the need for improvement.

The second step in the external peer group analysis is to consider all the measures in a collective sense. This can be done by examining the subject property's rank in the peer group for each maintenance performance indicator and then determining the overall rank for the entire functional area. It must be stressed that although a peer group comparison is generally not conclusive enough to develop recommendations, it does assist in separating substantive issues from perceived issues.

#### Internal Peer Group Analysis

This technique compares performance among cost centers within the subject agency's maintenance function. Cost centers are organizational units that conduct similar operations but in different locations. Thus, this type of analysis is most applicable to larger transit systems with multiple maintenance facilities. As with the external peer group, these comparisons are based on performance indicators that are descriptive of maintenance resource utilization and are used to flag inadequate performance. Because internal data bases are generally consistent, the analyst may have greater flexibility in comparing indicators than was the case with the external peer group. Because cost centers operate under theoretically consistent cost and labor structures, each center's performance could be compared against the best rather than the average performance of the group. If there is only a 10 percent difference between best and worst, substantial improvement would probably be inconsequential in a cost sense. Greater differences, however, may indicate the potential for a good return on time and resources invested in correcting the disparity.



### Trend Analysis

This technique is used to compare maintenance performance over time. A 4- to 5-year time period is desirable, although this time frame may vary in accordance with local occurrences (e.g., change in work rules, large service change). Trend analysis is very helpful in isolating positive and negative performance in both financial and nonfinancial measures. Financial measures, such as maintenance cost per mile, can be expressed both graphically and in terms of annual rate of growth. Annual rate of growth is a derivation of the standard compound interest formula, which describes percentage growth from year to year. The merit of this approach is that once established, the rate can be compared with the average annual inflation growth rate to discern how closely costs correlate with inflation.

### Structured Interviews

This qualitative technique assists in identifying past decisions or events that have affected performance. The structured interviews provide a medium for further investigation of specific performance questions arising from the previous analyses. In addition, this technique is used to identify potential problems relative to span of control, clarity of role, duplication of effort, and communication of objectives.

The application of one or more of the preceding tools serves as a first screen in defining what activities should be pursued to improve overall resource management. The issues identified as offering potential savings and performance improvements are then evaluated using a resource utilization approach.

### EVALUATION FRAMEWORK

The authors have found, on numerous assignments in the past 3 years, that a great number of transit properties are experiencing a decline in maintenance performance despite an increase in actual expenditure. The trend of deteriorating performance requires an analytical approach that seeks to isolate those primary factors that influence maintenance performance. Accordingly, the authors have used a resource evaluation framework for analyzing the maintenance function. The approach recognizes that maintenance is a complicated function that embraces several interrelated tasks including: (a) service and cleaning, (b) inspections and preventive maintenance, (c) unit overhauls, and (d) repair.

The evaluation framework, which is shown in Figure 2, acknowledges that performance, as reflected by equipment availability, road calls, and vehicle appearance, is influenced by three key resources: (a) labor availability and skills; (b) equipment and facilities; and (c) information availability.

The manner and extent to which these resources are managed and productively used to fulfill the primary maintenance functions have a significant impact on performance and cost.

Under this framework, evaluation of an issue (i.e., a deteriorating performance trend) begins with examination of the functions and corresponding resources that contribute to performance and cost in the issue area. The function is examined in terms of the specific tasks to be performed and the anticipated level of resource expenditure (or range of resource expenditure) deemed necessary to complete the tasks. The expected level, or standard, for resource expenditure is then compared with actual resource availability and expenditure. Issue areas exhibiting substantial variation between anticipated

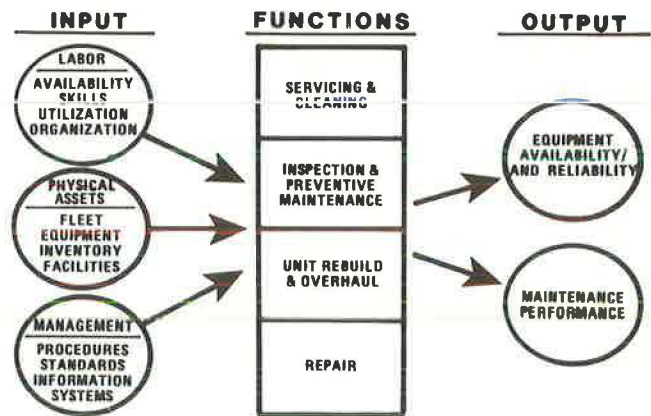


FIGURE 2 Maintenance evaluation framework.

and actual resource utilization warrant more rigorous analysis to determine the cause of the deviation.

The deviation may be the result of one or more of three problems: (a) the standard for resource requirements may be inappropriate, (b) the utilization of resources may be inefficient, and (c) extenuating circumstances may account for the deviation. The resource allocation analyst must review each possibility to isolate the source of the problem before corrective actions can be developed and applied. Application of this evaluation framework to actual issue areas is discussed in the following section.

### EMPIRICAL APPLICATIONS

This evaluation framework has been applied by the authors at several U.S. transit agencies in the past year. Empirical results from two of these assignments are discussed in the following paragraphs.

In an assignment for a southern transit agency, significant cost efficiency and productivity problems were identified in the issue identification phase. The subject property was experiencing a serious decline in maintenance performance, although expenditures were increasing at a rate that exceeded inflation. The subject system was identified as having significantly higher labor costs per vehicle mile, a greater number of maintenance personnel per active vehicle, and fewer vehicle miles per mechanical failure than a group of its peers. Labor productivity, identified as a primary issue, was subsequently examined using the evaluation framework presented earlier.

The productivity analysis was conducted for three major maintenance functions: cleaning and service, inspections, and unit overhauls. Each of these functions is characterized by routine or repetitive activities that are relatively easy to standardize and schedule. The objective of the analysis was to determine how efficiently labor resources were being used to perform these functions. The analysis was conducted by comparing total available labor hours with the time needed to perform the specified tasks. The results of the analysis are presented in the following sections.

### Cleaning and Service

The first step in the resource utilization analysis was to identify available labor hours. Total available hours were calculated as follows:

**Total available**

Labor hours = Number of line employees  
 x [(Base hours - deductions)  
 x (Scheduled breaktime factor)  
 + (Overtime)]

The cleaning and service section at one garage had 15 line employees dedicated to revenue vehicle service and cleaning (supervisors and vaultpullers were excluded). The standard number of employee base hours is 2,080, predicated on a 40-hour work week. Deductions including vacations, holidays, illness, injury, absence without leave, and requested leave reduced base hours by 13 percent at the subject property. Scheduled break time, consisting of two 15-min breaks per day per employee, further reduced total hours by 6.25 percent. Overtime averaged about 17 percent of scheduled man-hours (i.e., base hours less holidays and vacations) and increased available man-hours accordingly. In the aggregate, the cleaning and service section at the bus garage had 30,269 labor hours available to perform this maintenance function.

The next step in the analysis was to calculate the total time required to clean and service revenue vehicles at the garage on an annual basis. Using monthly bus assignment sheets, it was estimated that 70,563 vehicles are deployed annually and therefore cleaned and serviced at the garage. The agency had an established standard of 12 min per bus for cleaning and servicing. Thus, 14,113 labor hours are needed if the standard is adhered to at the division.

A comparison of total labor hours available (30,269) to hours required (14,113) suggests that excess manpower was available for this function. According to these calculations, there are 16,156 excess hours, or 53 percent of total available labor hours, that are not expended productively. One mitigating factor in this productivity assessment is that the influx of vehicles to be cleaned and serviced is not constant. Although some of the potentially unproductive time is attributable to lulls between peak surges, overall vehicles were not being cleaned and serviced in accordance with the 12-min standard. Instead, the vehicles were being cleaned and serviced at a rate of more than twice the standard.

In an effort to assess the validity of the established standards, work activities and facilities were examined. The time standard appeared sufficient to cover work activities under reasonable conditions. However, the job was not conducted under reasonable conditions. The facility where this function was performed required that buses move through three different buildings, exiting onto a public street several times--the 12-min standard was unrealistic. It was subsequently recommended that management reevaluate the standard it was using to schedule work and manpower.

Inspections

A similar analysis was conducted for the section dedicated to preventive maintenance. The agency's formal policy was to inspect each revenue vehicle at 6,000-mile intervals; actual practice resulted in inspections at 13,500-mile intervals. Available labor hours were estimated at 30,269 hr annually, as compared to labor requirements of 11,760 (based on the established standard of 8 hr per inspection with inspections occurring at 6,000-mile intervals). These estimates indicate that the unit was more than adequately staffed to perform the desired number of inspections at the 6,000-mile interval. In fact, 18,509 hr, or 61 percent of the total available

hours, exceed the amount needed to conduct inspections in accordance with the standard. Because inspections were actually performed at more than 13,000-mile intervals, the staff appeared to be productively deployed only a small percentage (i.e., 20 percent) of the total labor hours available.

Investigation of the standard of 8 hr per inspection revealed that it includes time for inspection and some on-the-spot repair. Examination of actual practices indicated that the majority of the time intended for inspection was actually spent on running repair, and thus was impeding the ability of mechanics to conduct scheduled inspections. The dearth of timely inspections was, in turn, resulting in poor vehicle reliability and excessive in-service breakdowns. Therefore, it was recommended that greater supervision be imposed on this section to enforce compliance with formal inspection objectives. It was also recommended that management develop guidelines suggesting the maximum amount of time to be spent on running repair during inspection to promote greater productivity in this unit. The guidelines should be supplemented with a mechanic training program to ensure that procedures are understood and followed responsibly. Major running repair needs uncovered during inspection were to be scheduled for completion by inspectors after primary duties are completed, or by the repair section.

Unit Overhaul

In general, components are rebuilt on a failure basis. The subject property did not maintain component life records that would indicate the expected longevity of the rebuilt unit. The dearth of information pertaining to useful component life impedes management's ability to project work requirements and schedule production. No formal job standards were in-place for unit overhaul--foremen responsible for ensuring productive deployment of mechanics kept informal records on anticipated and actual job completion times. These anticipated job times correspond closely with actual job completion times at an aggregate level and were used to determine resource requirements.

The resource needs were estimated at 25,455 labor hours for major rebuild projects, with total available labor hours projected at 38,341. Approximately 34 percent of available time cannot be accounted for by major unit rebuilds. The foremen estimated that 20 percent of total time was spent on small unpredictable jobs such as rebuilding valves and relays, and degreasing components, although no verifying records were maintained. The remaining 14 percent of available hours was assumed to be devoted to unreported rebuilds and unproductive time.

The lack of pertinent production and performance information in this section was determined to undermine managerial efforts in unit rebuild planning and control. It was recommended that procedures be formalized for recording production data and that an information system be developed to provide management with accurate longevity, resource requirement, cost, and productivity information. Management could then establish standards for routine rebuilds based on sound production information. Such information would also aid in work and manpower scheduling and control.

The authors used this evaluation framework in a slightly different manner at a large eastern transit property. In the issue identification phase, maintenance cost efficiency, labor productivity, and vehicle availability were identified as substantial problem areas. The property was experiencing a severe decline in vehicle availability although the vehicle repair staff was increasing in size.



In an effort to determine the reason for these seemingly conflicting trends, a review of revenue vehicle availability and maintenance worker availability was performed at each garage. The results, shown in Figure 3, indicated that most mechanics were generally scheduled to work when the majority of vehicles were in revenue service. During the morning peak, the number of mechanics available actually exceeded the total number of vehicles at the garage. Conversely, relatively few mechanics were scheduled for work during the periods when the greatest number of vehicles were available to be worked on.

In this case, it was recommended that some maintenance staff be rescheduled to offer more productive use of labor resources. The problem was resolved by rescheduling some day shift staff to the evening and night shifts. The change was carefully planned to ensure that adequate staff was available to respond to vehicle breakdowns and other availability problems during the day.

In addition to scheduling of mechanics, labor productivity in the repair function exhibited some significant shortcomings. Although engineering standards (i.e., time and motion standards) had been formally established for a wide variety of routine repairs, the automated work order system showed significant discrepancies between the standard and reported times for specific repairs.

Further investigation revealed that the primary reason for the disparity was that mechanics were not reporting their time accurately. On the automated work order system, a mechanic might log on for a single repair job (e.g., replacement of a lower radius rod) and in the course of that repair, the mechanic may discover other required work (e.g., air bag replacement).

After notifying the foreman, the mechanic would complete all repair work while recording his time on the original assignment. Some foremen were not instructing mechanics to record time accurately be-

cause they knew the time was spent productively. However, in doing so those foremen were detracting from the usefulness of the automated work order system as a management tool.

It was recommended that training programs be altered to emphasize the importance of accurate time reporting and that supervisors promote mechanic responsibility for accurate information reporting. Foremen and mechanics should be held accountable for proper use of the system to promote compliance. Management's ability to plan and control maintenance activities is significantly affected by the quality of information available.

CONCLUSIONS

Although the resource evaluation framework described in this paper is theoretically sound, some problems must be anticipated in its application. First, many transit agencies do not really know what the optimal level of resource expenditure (e.g., labor hours, materials) is for the conduct of specific maintenance functions. Although several properties have conducted extensive industrial engineering studies to determine resource requirements and time standards for specific tasks (e.g., preventive maintenance, inspection, service and cleaning, routine repair, and unit overhaul), more work is needed in the industry as a whole to allow maintenance managers to anticipate, plan, schedule, and deploy resources in an effective and efficient manner. Second, some transit properties with established standards for activities that can be easily scheduled and monitored, notably preventive maintenance, do not adhere to the established resource requirements. A third problem in the field is that most information systems do not track resource utilization in a manner supporting efficiency and productivity analyses. In this respect, the cost of existing performance levels is not always visible to

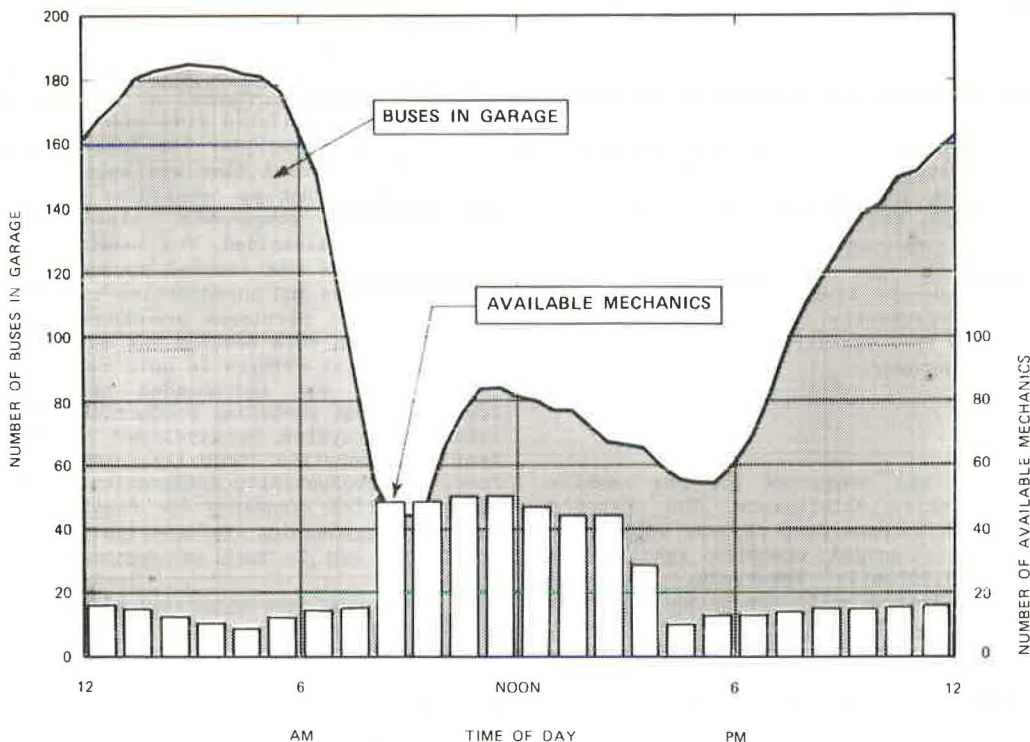


FIGURE 3 Relationship between manpower and equipment availability.



managers responsible for resource planning, allocation, and control.

Each of these problems can be resolved with relatively small investments with respect to the potential benefits in management monitoring, planning, and control systems. Appropriate information support systems are elements essential to effective resource management and performance quality control in transit maintenance. Utilization of basic industrial engineering tools will help maintenance managers change work scheduling from an ad hoc process to a more efficient production line procedure.

The resource evaluation framework presented here is one straightforward means for analyzing productive utilization of resources in transit maintenance. It can be applied in a variety of operating environments, and it offers some flexibility in data requirements for use. The technique has proven successful in identification of substantive issues, as well as the extent and cause of specific resource utilization problems. Armed with this information, maintenance managers are in a better position to implement improvement strategies and realize poten-

tial benefits (i.e., cost savings and better equipment performance) from improved resource utilization.

Again, it must be stressed that one relatively uncomplicated approach to evaluating maintenance resource utilization is presented in this paper. Additional research in maintenance resource management is necessary to help identify break-even or optimization points for the conduct of specific maintenance tasks. The magnitude of the problems in transit maintenance, and therefore of the opportunities for improvement, implies that the additional research will not be long in coming.

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## Restructuring the DOT Research Organization: Washington State Case Study

ROBERT S. NIELSEN and G. SCOTT RUTHERFORD

#### ABSTRACT

The Washington State Department of Transportation has operated a successful research program for many years, producing findings that have supported the operating divisions of the department. Because of personnel changes, an increased research budget, and a desire for closer ties to state universities, the secretary of transportation requested that a major review of the research organization be carried out. This review included interviews with key department employees, universities, other departments of transportation, and transportation center contacts. Also included was a national survey of 51 departments of transportation on their practices (100 percent response). On the basis of this information and careful study, a new research organization was recommended that included a new committee structure and stronger ties to operating divisions and state universities. The study also recommends a joint director for the department of transportation research office and state transportation center, which includes the department of transportation and two universities. The secretary accepted the recommendations now under implementation.

For some years, the Washington State Department of Transportation (WSDOT) has operated a successful research and development program. A large number of projects have been undertaken, often through contract research with different universities, and the results have been satisfactory.

The research completed has produced significant cost-effectiveness advances in several areas. Most of these have been quantified and made available to the top management of the department, and many of the recommendations emerging from the research efforts have been put into practice. Associated with the overall research program has been a developing technology transfer activity, which has translated research findings into effective use and also brought to key department personnel a large amount of information from sources outside the state. In general, the research effort has been satisfactory and has produced good results for the department.

This was accomplished through consistent attention to research needs, supported by a stable organization in which staff turnover was kept to a minimum. Because of the stable relationship that had been developed over the years, it was possible to look forward to a regular output of effective research results, most of which were implemented by the department. Commencing in early 1981, however, this pattern was broken and several staff changes at WSDOT, plus new persons at the University of Washington, saw changes to the stable, basic research

pattern that previously existed. This, combined with an increase in the level of research funds available, convinced the secretary to call for a study of the entire program.

The results of the study to determine the effectiveness of WSDOT's research and development program are summarized in this paper. It has recently been proposed that some changes are necessary in order to make the program more responsive. It was believed that the basic objectives of the program and the organizational structure were two items that needed examination.

#### THE RESEARCH MISSION

Successful research organization and operation must be geared to a clear understanding of the mission of research. This requires the development of goals and objectives, as well as specification of the types of research to be undertaken.

The major research goal for WSDOT is to develop dynamic research support that will assist the department to provide safe, effective, and economical transportation for the state of Washington. This should be accomplished through the design and conduct of research programs that enable the department to meet its comprehensive goals and objectives.

The research effort should be focused on but not limited to the following activities:

1. Highway materials and product evaluation
  - Materials
  - Geotechnical
  - Product evaluation
2. Highway operations and development
  - Structures
  - Construction
  - Design
  - Environmental
  - Maintenance
  - Operations
  - Traffic
  - Safety
3. Planning and multimodal
  - Public transportation
  - Energy
  - Administration
  - Planning
  - International trade
  - Marine
  - Aeronautical
  - Computing
  - Local cooperation
  - Private carriers
4. Objectives common to all areas
  - Technical assistance
  - Technical training
  - Technology transfer
  - Research implementation
  - Intergovernmental
  - Program funding

To understand these activities, the research effort must make use of two major research techniques:

- Applied Research. Analytical and experimental study to increase the understanding of causative relationships necessary for meeting the specific needs of Washington's transportation system. One measure of success is the ability to identify needs not yet perceived at the operational level but that can reasonably be expected to require operational or administrative attention in the future.
- Conceptual Research. Analytical and experi-

mental study to identify major trends, variables, or conditions that are likely to affect Washington's transportation system in the longer term. Conceptual research deals with more general and longer range concerns than do applied research studies.

#### ALTERNATIVE ORGANIZATIONAL STRUCTURES

As the study progressed, it became clear that if the organizational structure could be improved and the right people appointed to key positions, then the research effort of the department would meet the objectives of the study. In other words, the research mission would be accomplished, and the effort to develop an ongoing, effective program would be successful.

Various alternatives considered are summarized below and are shown in Figure 1:

- Deputy Secretary. If the research effort was concentrated under the deputy secretary, it would enjoy high level visibility and be a direct indication of top management support for the research function. Disadvantages include the possibility of diversion of research staff to operational projects, lack of familiarity with current research methodologies and techniques, and an additional work load for the deputy secretary.
- Assistant Secretary for Highways. Under this organizational alternative, the research office would be where most of the problems are and where the money would be spent. Staff resources would be significant and career opportunities would be enhanced. Conversely, it could lead to endorsement of a heavy highway research program and other modes would not receive appropriate research consideration.
- Materials Engineer. In some ways, this arrangement would be advantageous because the Materials Laboratory is involved with day-to-day problems and could generate practical research ideas. But the visibility for the research office would be reduced and the emphasis may shift to construction-oriented research.
- Assistant Secretary for Public Transportation and Planning. This is the current arrangement and it has certain advantages. The staff members are already familiar with research and the basic institutional and individual contacts are in place. There is a natural tie to planning through the Highway Planning and Research (HPR)

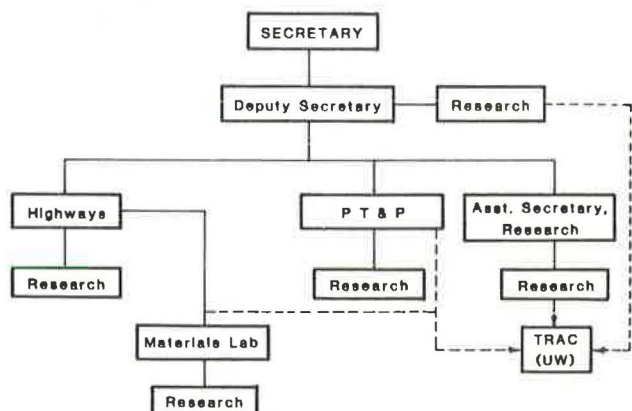


FIGURE 1 WSDOT research organizational alternatives.

funds, and this organization has a multimodal perspective. Disadvantages include the lack of a direct tie to the Highways Division and its work program and some possible lack of credibility with the operating divisions.

- (New) Assistant Secretary for Research. This alternative would require the appointment of a new assistant secretary for research. Such an arrangement would ensure high visibility and management support. However, the research area is not really large enough to justify such an appointment, and it is likely to be a high-cost activity.
- Research by each division (autonomous). Under this alternative, the activity would be close to the problems that needed research and would attract the interest of senior management in the various divisions. Disadvantages include: duplication of research units and staff, lack of coordination and programming and research results, and an increase in administration costs.

It should be noted that the Washington State Transportation Center could operate effectively with any of the foregoing organizational structures, providing the right persons were selected for the key research positions at WSDOT and also at the universities involved.

#### INTERVIEWS

During the study of the research program, a large number of interviews were conducted with senior personnel at WSDOT, the two Washington universities, private sector organizations and universities, and other groups outside the state. The purpose of the interviews was to obtain comments on the perceived effectiveness of WSDOT's research program and suggestions for improvements that might be made.

The following subjects were raised most often during the interviews:

- Research Director. The success of any research and development effort depends primarily on the research director. It is thus essential that the right person be selected for this job.
- Problem Identification. What types of problems are relevant? Mostly those that lend themselves to applied and developmental research.
- Priority Determination. There is a need to set up a better system of research project priority determination than the one that currently exists.
- Program Selection. Before project priorities can be determined, it is necessary to set up a research program. This should be directed to those functional areas in which WSDOT has a marked need for research.
- Funding Sources and Budget. There is a need to set a "floor" to the funds allocated for research and development purposes in order to allow for stability in the research activities of the department.
- Research Office and Location. The location of the research office is less important than the people operating it. Some attempts should be made to combine an effective research office at headquarters with an equally effective operation at the universities.
- Research Staff. There was general agreement that WSDOT's research staff, supporting the research director, must be capable technical persons, who also know how to manage and coordinate research activities.

- Research Fellowships. Consideration should be given to setting up a WSDOT research fellowship (possibly in collaboration with FHWA) that would allow WSDOT employees to work in the research area for one year.
- Research Project Monitoring. There is need for a better system of research project monitoring. In the past, WSDOT does not appear to have given this aspect the attention it deserves.
- Research Findings and Implementation. There is need to do a better job of implementing research findings.
- Technology Transfer. This is an area that needs considerable emphasis and attention from the research and development section of WSDOT. Technology transfer should be a crucial part of the technical advancement of any organization.
- Short-Term Versus Long-Term Research. The primary emphasis of WSDOT should be on short-term, problem-solving research geared directly to the needs of WSDOT. However, the department should also be participating in long-term research that examines problems that extend over several years.
- Research Out-of-State Travel Budget. WSDOT suffers from its inability to send key technical persons to certain out-of-state meetings. To overcome this problem, it is proposed that a budget be developed, within the research and development funds, that will allow key persons to attend technical meetings that are being held out of state.
- Transportation Commission Involvement. The matter of involvement by the Transportation Commission in the research and development effort of WSDOT is of interest. It is expected that the Commission Subcommittee on Research will provide policy direction for commission activity, and the department will develop appropriate procedures for integrating this effort.
- WSDOT Management Commitment. The research and development program of WSDOT is not likely to be successful unless it is strongly supported by senior management within WSDOT.

Comments were also made about the Washington State Transportation Center (TRAC). The question asked was: Where is it going, and should an attempt be made to develop something else?

The answer appeared to be that TRAC could (and should) work, and if it did, it would provide an important research promotional activity, which would also be deeply involved in research coordination. It also was believed that the two major universities in Washington State should continue to play a key role in the research effort of WSDOT.

#### RESULTS OF NATIONAL TRANSPORTATION RESEARCH SURVEY

##### Overview

In April 1983 a questionnaire containing 23 questions was sent to the departments of transportation (DOTs) in all states and the District of Columbia. It is noteworthy that a response was received from every DOT.

This was a significant event, because it is unusual to obtain a 100 percent response to a mail questionnaire. It suggests that there is considerable interest in this topic and the recipients of the questionnaire were willing to participate. Many of them enclosed additional summaries and reports with the completed questionnaire, and a large amount of valuable information was received.



### State DOT Research Organizations and Functions

In terms of location of the research function, the responses indicated that the Planning Division is the most favored. (Note that some states have more than one research office.) Details are as follows:

<u>Location</u>	<u>Number</u>
Planning Division	16
Highway Division	8
Materials Division	6
Research Division	4
Construction Division	4
Others (10)	14

In comments and interviews, respondents indicated that the Planning Division is often used as the location for research because of the link to HPR funds and existence of research-oriented personnel. The survey indicated that 74 percent of the research organizations are actively engaged in conducting research projects. This indicates the importance of qualified research staff (as well as management structure) for most DOT research organizations.

A large number of activities are performed as part of research management. The leading activities are as follows:

<u>Function</u>	<u>Positive Response (%)</u>
Problem identification	88
Project management	88
Document reruns	86
Technology transfer	84
Contract administration	82
Project surveillance	76
Proposal development	74
Participation in projects	74
Implementation of findings	67
RFP development	59

This list is probably what might be expected. Of some interest, however, is the relatively low positive response for implementation of findings. This function is discussed further at a later stage in this section of the paper.

It is interesting to note also that almost three-quarters of the DOT research offices manage the research program and also are actively engaged in conducting research projects. There appears to be some correlation between the number of research personnel in the department and the ability of the research group to handle both functions.

### Research Program Development

Ideas for research projects come from a variety of sources. About one-half of the DOTs solicit their departments for research ideas, some get ideas from technology transfer seminars, some solicit outside, while others have committees that generate the program. Forty-three DOTs have Research Advisory Committees, most of which assign a priority to projects in the program development phase.

The departments appear to enjoy considerable success with their research programs, irrespective of where the project ideas are generated. But the most successful organizations are those that have a formal system for identifying research needs and then proceed to develop priorities through a carefully structured technical process. Also, success appears to accrue to those organizations that develop their research programs considerably in advance of the budget cycle.

After projects have been proposed and evaluated,

the final selection of those that will be funded is made as follows:

<u>Project Selector</u>	<u>Percentage of States</u>
Department committee	37
Management	21
Other	8
Department/university	7
Combination of above	27

The survey responses indicated that research projects currently under way are heavily highway-oriented. Every respondent (51) reported conducting highway-oriented research, while only 11 indicated they were doing transit research. For rail and intercity bus, the numbers were 7 and 5, respectively. It is clear that HPR funding has a substantial impact on the type of research being conducted.

The survey showed all 51 respondents conducting applied and development research, or both, while 21 reported an additional effort in conceptual or theoretical efforts. The basic effort is directed to pragmatic problem-solving, but the longer-range needs have also been identified.

### Conducting Research

The performance of research for DOT programs is generally split between the departments and universities. The survey reported the following breakdown:

<u>Research Performance</u>	<u>Number of DOTs</u>	<u>Percent of Funds</u>
Within DOT	46	57
University	45	33
Private consultant	21	4
Other state and local agencies	8	2
Other	14	4

Thirty-three DOTs reported having a materials laboratory available for various research efforts.

To monitor research projects, the DOTs reported 45 techniques or reporting systems. Because the vast majority of funds is HPR-based, it is assumed that all states produce quarterly reports for FHWA even though only 22 reported this activity. The other techniques included various written and oral reports, meetings and visits by research managers, on-site monitoring by research managers, telephone contacts, and seminars. Reporting ranged from weekly to annually with quarterly being most common.

### Relationship with Universities

The involvement of universities in DOT research efforts is demonstrated in the previous paragraphs where it was noted that 33 percent of the total DOT research effort is performed by universities. When asked if they had a formal cooperative research program with one or more universities on a continuing basis, 14 answered yes and 37 answered no.

Most of the more successful research efforts in the nation appear to be closely linked to the universities. Texas is obviously the leading example, but Arizona, Illinois, Pennsylvania, Tennessee, and Virginia are other states where the relationship is effective. If a relationship does not already exist, it appears unlikely that it will develop. This is borne out by the response to the question that asked where the DOTs would prefer to have most of their research conducted. (Some dual preferences were stated.) The results were as follows:

Research Conducted	No. of Responses
Within departments	37
By universities	22
Private consultants	6
Other	6

As suggested, the preferences appear to be based on established working relationships.

Funding

FHWA and the state DOTs provide virtually all of the money spent on research, and it is divided almost equally between them. The approximate breakdown is the following:

Source	Percent
FHWA	48
State DOTs	48
Other	4

The state DOT percentage tends to be weighted by a few states that make use of large amounts of state funds for research purposes. But that is not the normal experience--most of the states continue to use HPR funds for research (and planning) in order to minimize the need to use state funds.

Research Implementation and Technology Transfer

One of the surprises of the survey was the finding that only 10 states reported a formal procedure for implementing research findings. However, 41 reported that their programs did include technology transfer activities. The survey showed that technical libraries are available at 44 DOTs, and one-half of these include formal and effective technology transfer activities.

PROPOSED WSDOT RESEARCH ORGANIZATION

Analysis of the information collected allowed recommendations to be formed. The recommendations contained in this section are designed to achieve the following research objectives:

1. Establish a coordinated program of results-oriented research.

2. Build a qualified research team at WSDOT.
3. Establish the Washington State Transportation Center (TRAC) as a viable and responsive member of WSDOT's research effort.
4. Provide technology transfer, training, and technical assistance for WSDOT.
5. Achieve these objectives before December 31, 1985.

It is proposed to meet these objectives through a revised organizational structure and an effective research program. The recommendations for these items are summarized in the following sections.

Organization Overview

The proposed research organization is presented in Figure 2. It shows that the research director will oversee the efforts of three research specialists and have strong and direct ties with the two universities. The director will also be directly involved with TRAC and, as mentioned later, will be responsible for the development of the research program for TRAC and WSDOT. The research director will be responsible for research policy to the research executive committee and to an assistant secretary for administrative matters. The proposed transportation research council will provide a high level support and advisory role to the department's research effort.

Research Specialists

It is proposed that the research efforts of the department be broken into three functional areas, and that a research specialist be assigned to each. The functional areas are (a) highway materials and product evaluation, (b) highway operations and development, and (c) planning and multimodal.

The research specialists would be located in the appropriate WSDOT divisions. Their responsibilities would include

- Undertaking and coordination of ongoing research projects,
- Development of new research opportunities,
- Coordination of technology transfer,
- Involvement in technical training, and
- Involvement in research implementation.

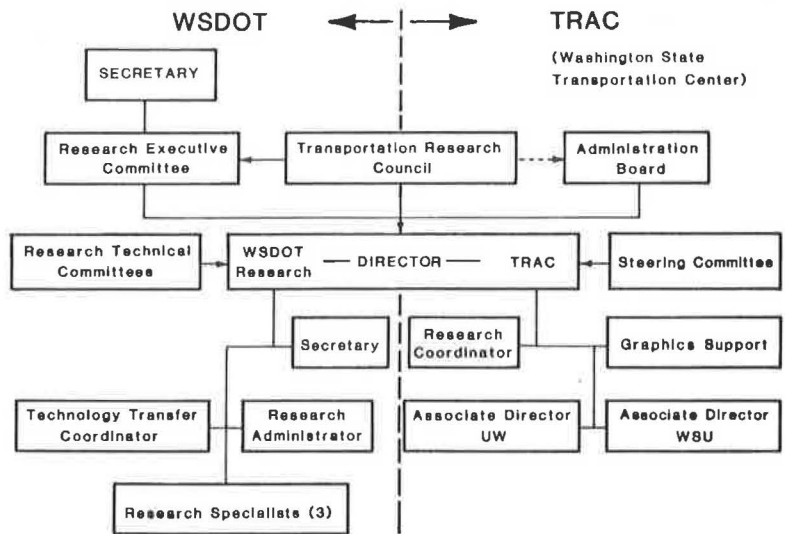


FIGURE 2 WSDOT and TRAC research organizations.

### Faculty Counterparts

To complement the research specialists at WSDOT, it is proposed that faculty counterparts be set up at the universities. These faculty members would be the lead persons for the functional areas already listed. Thus, it will be important to develop communications between WSDOT and the universities and to establish relationships that will provide long-lasting benefits.

### Research Director

This is the key position in this whole endeavor--if the wrong person is selected for this particular activity, then the proposed organization has little chance of success. Because of the diverse objectives facing the research director and the degree of mobility that must be shown, as well as the fact that two organizations will be built, it is important that time be split between the University of Washington and Olympia. It is anticipated that 2 days would be spent each week in Olympia and another 2 days at the university, and the fifth day would be spent in the field.

### The Role of TRAC

It is recommended that the Transportation Center be retained and that its role be expanded. But, before this takes place, it will be necessary for representatives from WSDOT, the two universities, and the Legislative Transportation Committee to meet and revise the agreement that currently exists. In addition to being in charge of WSDOT's research program, the research director will also be the director of TRAC with concurrence of the universities.

### Transportation Research Council

In order to provide top-level support and involvement for the research effort, it is proposed that a senior research council be created, known as the transportation research council. The organization would include senior persons from the private sector and government and academic organizations.

The purpose of the council would be to bring together top-level individuals who have an ongoing interest in WSDOT's research program. It is anticipated that the chairman of the council would be the chairman of the State Transportation Commission Research Committee.

### Research Executive Committee

One of the important groups within this proposed research organization is the research executive committee. It is envisioned that this committee would be chaired by the Deputy Secretary and would include three members--the Assistant Secretary for Highways, the Assistant Secretary for Planning, Research and Public Transportation, and a District Administrator who would be selected on a rotating basis. This committee would establish research policies and provide overall direction to the research effort.

### Research Technical Committees

It is proposed that three technical committees be created--one for each of the functional areas already discussed. The responsibilities of the technical committees would be to deal with all technical aspects of the research program, including development of priorities for research projects. In addition, these committees would ensure that research results were implemented as quickly and as effectively as possible.

### Location of Research Activities

It was pointed out, in an earlier section, that the research effort of WSDOT could be located in a number of different areas. After consideration, it is recommended that the Assistant Secretary for Planning and Public Transportation continue to be responsible for the research effort of the department, but that his title be changed to Assistant Secretary for Planning, Research and Public Transportation.

### SUMMARY

The foregoing research organizational structure will bring WSDOT into harmony with several of the more successful departmental research efforts in the United States, particularly California, Tennessee, Texas, and Virginia. The proposed organization for WSDOT will ensure continuous, energetic, innovative attention to the vitally important research needs of the department.

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# Extraboard Scheduling, Workers' Compensation, and Operator Stress in Public Transit: Research Results and Managerial Implications

JAMES L. PERRY and LYN LONG

## ABSTRACT

The results of a year-long study of practices associated with employee absence in the transit industry are reported. The research focused on three subjects: extraboard scheduling, workers' compensation, and occupational stress. An extensive review of prior research was conducted, and new data about both organizational policies and employee attitudes within California transit agencies were collected by mail surveys and analyzed statistically. Twenty-one organizations and 1,039 operating employees from within California responded to the surveys. The research indicated that most organizations use judgmental methods for determining the size of the extraboard and that these methods are likely to result in extraboards that are either too large or too small. Strong relationships were identified between workers' compensation experience and equipment design and maintenance practices. Occupational stressors were strongly correlated with self-reported health outcomes and job attitudes. Suggestions are offered for managerial actions that would mitigate some of the problems identified by the research.

Each day transit managers and administrators are faced with complex issues that affect the productivity of their organizations. Between 1970 and 1980, transit operating expenses rose more than five times faster than operating revenues (1). This difference can, in part, be explained by fares that have been held down to attract ridership, by increases in employee compensation, and by expansion of unprofitable routes into low-density suburban areas. However, because transit agencies were less productive in 1980 than in 1970 there is a need to examine their policies and practices to determine whether improvements can be made.

Previous research (2-6) has uncovered substantial inefficiencies in transit labor utilization. Because labor represents between 75 and 80 percent of transit operating costs, any improvement in labor utilization holds promise for curtailment of overall operating expense. The results and implications of a study supported by the state of California's Business, Transportation, and Housing Agency in 1981-1982 (7) are summarized in this paper. The research explored three facets of human resource productivity in public transit: extraboard scheduling (i.e., scheduling practices involving runs left open because of the absence of regular operators, work not selected by regular operators, or charter runs and special assignments); workers' compensation; and operator job stress.

These topics share a common characteristic: they all have been associated with employee absence in the transit industry. Managers have isolated workers' compensation as a program that may serve as an incentive for employee absence because of the attractiveness of payments and potential claims fraud. Extraboards, too, have been viewed as an incentive for employee absence because they help assure a ready pool of labor to replace absent employees. Operator stress has often been linked to these other issues both as a cause of workers' compensation claims and illness-related absence and as a result of inefficient scheduling practices that place undue strain on employees.

This research examines

- Inefficiencies in current practices regarding extraboard sizing and scheduling, and the impact of these practices on transit operating costs and employee behaviors;
- The impact of transit agency size, policies, and employee demographics on workers' compensation claims and costs, and the potential for reducing these outcomes;
- The role of operator stress in overall agency costs and productivity, and the relationship between work schedules and employee attitudes, job performance, and health; and
- The causes and possible countermeasures for the increasing rate of employee absence in the transit industry.

In conducting this study a number of information sources were relied on, including consultation with subject experts and the administration of three separate surveys to managerial and operating personnel within a sample of California transit agencies. As a preliminary step, a large number of international studies of operator stress and occupational illness, workers' compensation, and operator absence behavior was reviewed (8,9). The results of these reviews are summarized in the following paragraphs.

## PREVIOUS RESEARCH

Although research on transit employee absence has only recently received attention within the U.S. transit industry (10,11), a substantial body of foreign literature points to significant occupational risks that influence employee attendance. Results of this research indicate that transit operators appear to be more susceptible to health disorders such as heart disease and back problems than a variety of control groups. Occupational stress also appears to be directly related to absence from work. Transit operators are prone to illnesses that result in the use of sick leave, turnover, and early retirement. Some absences are probably induced by operator efforts to avoid stress on the job. Although injury-on-duty rates have not been clearly linked to stress, it also appears rea-



sonable to expect an association between this work attendance outcome and stress.

An alternative model for explaining operator absence behavior is the income-leisure theory of workforce participation. This explanation posits that employers contract with employees, either explicitly or implicitly, for jobs with specified work schedules and wage rates. Some employees will accept jobs for which the hours of work exceed their preferences, given the specified wage. They will thus retain an incentive to consume leisure and thereby be absent from work. Even employees who accept a work schedule at a given wage may choose not to report on days when relatively more attractive alternatives are available. The attractiveness of alternatives is, of course, a function of both the work and nonwork situation.

Although the income-leisure and occupational stress explanations for absence behavior are quite different, they are not mutually exclusive. Four recent case studies of U.S. transit organizations (12-16) provide a rich source of information on the antecedents of employee absence from work. Multiple antecedents supportive of both the income-leisure and occupational stress explanations were isolated in each case study. The antecedents identified in these case studies are summarized in Table 1. Three general factors emerged as being of particular significance: (a) widespread availability of overtime pay, which has made the economic benefits of attendance at regularly scheduled work less clear; (b) scheduling inflexibility, which reduces the operators' opportunity to take time off when needed; and (c) occupational stressors, among them tight schedules, long hours, split shifts, poorly maintained equipment, difficult interaction with passengers, and threat of physical violence.

The research reported in the following paragraphs gives results of further investigations of these relationships within a sample of 21 California public transit agencies. Special emphasis was placed on the impact of scheduling provisions on employee health, attitudes, and behaviors.

## METHODS

Three survey instruments were developed and mailed to California transit agencies to obtain information about the basic issues addressed earlier. Two of the survey instruments, the extraboard and workers' compensation questionnaires, were directed to management and were completed by staff specialists in these areas. The third instrument, the transit operator questionnaire, was mailed in bulk to a designated agency representative for distribution to a stratified sample of transit operators.

### Extraboard Survey

The extraboard questionnaire was mailed to 21 agencies with approximately 50 or more operators; responses were received from 19 agencies. The questionnaire included 29 items in 3 general categories: procedures for managing the extraboard, extent of use of the extraboard, and general background information about the transit agency. The questions on procedures for managing the extraboard permitted open-ended responses that provided a great deal of insight into the nature and diversity of management practices in using the extraboard.

Additional information on extraboard practices was provided by a review of the labor agreements of participating agencies. Data from this source and from the survey were supplemented by results from a limited number of earlier studies on the operation of the extraboard (16-19).

### Workers' Compensation Survey

The workers' compensation questionnaire was mailed to the same 21 transit agencies that received the extraboard questionnaire. Usable responses were received from 14 agencies. The workers' compensation questionnaire was designed to provide information on agency policies and practices in the administration

TABLE 1 Summary of Concerns Expressed in Case Study Agencies

	Southern California Rapid Transit District	Washington Metropolitan Area Transit Authority	Orange County Transit District	Utah Transit Authority
Characteristics of absenteeism				
Polarized (i.e., some drivers having exemplary attendance, others extreme offenders)	X	X	X	
Clustered around weekends and holidays	X	X	X	
Major concerns				
Environmental				
Poorly maintained equipment	X	X	X	X
Threat of physical violence	X	X		
Too fast a pace/unrealistic schedules		X	X	
Unsafe working conditions		X		
Long hours or irregular shifts	X	X	X	X
Problems with passengers	X	X	X	X
Organizational				
Lack of peer pressure for good attendance		X		
Lack of pre-employment screening		X	X	
Negative interaction with supervisors	X	X	X	X
Easy availability of overtime	X	X	X	
Lack of discipline for high absenteeism	X	X	X	
Lack of incentives for good performance		X	X	
Feelings that management is unresponsive to driver concerns	X	X	X	
Individual				
Changing work ethic/workforce composition	X	X	X	X
Need for more leisure time	X	X	X	X
Lack of flexibility in schedule assignments	X	X	X	X
Family problems caused by schedule	X	X	X	X

of workers' compensation, and data on the extent, cause, and cost of on-the-job injuries. The questionnaire included 32 items in 6 categories: injury and loss experience, general workers' compensation policies, specific policies for cost control, specific programs developed to limit workers' compensation claims, information on equipment condition and policies, and general characteristics of the work force. Most questions were structured, requiring specific responses to a limited choice of options describing agency policies or practices. A few questions were open-ended, requesting a more detailed description of policies and practices. This information, supplemented by the results of other research studies, provided the basis for the analysis.

### Transit Operator Survey

Thirteen agencies participated in the transit operator survey. Each transit agency provided a seniority list of its operators. From this list, a random sample of 1,783 operators was selected. The sample was designed to provide a cross section of new operators, medium-term operators (e.g., with 1 to 5 years of experience), and longer-term operators. A total of 1,039 operators responded and returned completed questionnaires by mail.

The operator questionnaire included 118 items soliciting information on operator job characteristics and demographics; how well the operators' needs were satisfied by the job factors that were most important to them in bidding for assignments; extent of job exposure to unpleasant or hazardous conditions; frequency of certain desirable and undesirable job incidents; number of absences and general health conditions; degree of job satisfaction; feelings toward the organization; and job loyalty. Responses to these questions were tabulated and cross-tabulated to reveal relationships. These data were also compared with data from other research studies investigating operator attitudes and sources of job stress (20-29).

## RESULTS

### Extraboard Analysis

#### Methods for Determining Extraboard Size

Most California transit agencies use subjective or judgmental methods as the primary means for determining extraboard size, relying on past experience or historical absence rates. In several instances, however, agencies have used formal optimization models to determine extraboard size. The most commonly used formula was developed by Peat, Marwick, Mitchell and Company (10,17,18). This formula defines the optimum size of the extraboard as the point at which the costs of nonscheduled operator overtime are balanced against the costs of guarantee pay for extraboard operators who are not used.

#### Allocation Inefficiencies

Subjective methods for determining extraboard size may result in extraboards that are either too large or too small. The industry-wide costs of these allocation inefficiencies have been estimated to be as high as \$50 million per year (17). Although transit managers acknowledge that as overtime becomes more available, employee absence rates will increase,

they tend to understaff the extraboard and rely on regular operators to work overtime. Management believes that this strategy costs less in fringe benefits and wages than would the addition of employees to the operator list. However, what actually occurs is that operators who are forced to work overtime are more likely to take unscheduled days off because their normal schedules have been disrupted and they are assured of a pay equivalent of 40 hr per week.

### Operational Problems

Several operational problems associated with extraboard scheduling were identified from the literature review and survey. Among these problems were the following:

1. Absence incentive. Caused by fixed levels of employee absence based on historical patterns being built into schedules and employees' awareness that replacements are available;
2. Dispatcher error. Caused by situations in which dispatchers rely upon or favor regular-day-off operators to fill open runs rather than extraboard operators;
3. Operator strain. Caused by employees working long and irregular hours;
4. Poor operator-passenger relations. Caused by lack of predictable operator assignments and service reliability problems; and
5. Low employee morale. Caused by extraboard understaffing and regular-day-off operators having to fill missed runs.

### Workers' Compensation

The analysis of workers' compensation was guided by a number of hypotheses developed from a detailed review of the literature. These hypotheses assessed the effects of a variety of factors, among them public policies, organizational and management policies, and equipment design and maintenance, on variations in workers' compensation claims and associated costs.

#### Claims Experience

Workers' compensation claims in California transit agencies appeared to be extensive, but well within levels reported elsewhere in the transit industry (10,14). For 1981, among 14 organizations responding to the survey, 3,559 workers' compensation claims were filed for job-related injuries, averaging 37 claims per 100 operators. The average cost per claim, based on the aggregate actual payments, was \$1,519 or \$589 per transit operator in 1981. The operators in the study experienced 3.07 days lost per employee, with an average labor cost per claim of \$314.

#### Organizational Policies for the Control and Prevention of Workers' Compensation Claims

Many of the organizational policies recommended in the literature for preventing claims and minimizing cost had already been implemented by the transit agencies participating in the study. Among these policies and preventive programs were preemployment medical screening, analysis of data on accidents and losses, and programs for controlling accidents and



litigation. For the most part, these and other agency policies were not significantly related to higher or lower frequency, cost, and severity of workers' compensation claims. The absence of significant associations, however, could not be interpreted as a lack of efficacy of prescribed policies because there was relatively little variation in these policies among organizations in the sample.

#### Public Policies

The analysis contained no direct assessment of the strengths and weaknesses of existing workers' compensation law or policy. The survey of management opinion did, however, reveal that public policies were perceived to be the dominant reason for current workers' compensation problems in transit agencies. The most significant problems identified were liberal interpretation of the law, fraudulent claims, and the medical diagnosis process. These findings mirror those of other recent research on workers' compensation, and suggest that policies external to the organization may offset internal attempts to effectively control the rising incidence and cost of workers' compensation.

#### Equipment Design and Maintenance

The survey indicated that while one-third of all workers' compensation claims originate from equipment, most transit organizations had no means for evaluation of potential liabilities that stem from different equipment designs. Lower workers' compensation experience was found in those transit agencies that evaluated vehicle specifications before purchase and in those agencies that reported a smaller percentage of the fleet out of service. These results from the workers' compensation survey corroborated results from open-ended comments on the operator survey. The most frequent complaint from operators about the working environment involved equipment conditions. The following comments from operators illustrate this complaint:

I got hurt driving a bus with very hard steering. I kept writing it up on defect code, but the buses are never fixed. As a result, I hurt my back.

We need better designed buses with orthopedic seats for the driver. That will help cut down on injury to the back and tailbone.

We have to drive old buses. Some are over 20 years old, drafty, noisy...leak water on the driver when in motion.

#### Operator Job Stress

One thousand and thirty-nine operators from 13 transit agencies responded to the survey. Information was obtained on operator demographics, work schedules, job-related attitudes, job behaviors, and health. A majority of the respondents were male, high school graduates at minimum, married, between 30 and 50 years of age, and earning between \$1,000 and \$2,000 per month. Forty-seven percent of the operators surveyed were white, 29 percent were black, and 16 percent were Hispanic. Most respondents were regular operators who had been working for their current organization for more than 5 years. Single and multifactorial analyses revealed

no systematic differences between regular and extra-board operators, or between operators employed by different transit agencies. The data were, therefore, collapsed across these factors.

#### Job Attitudes

Operators indicated the degree of satisfaction they felt toward various aspects of their jobs by choosing one of seven points on a scale ranging from very dissatisfied at the low end to very satisfied at the high end. Tabulated responses indicated that, in general, operators were slightly satisfied with their jobs and were at the midpoint of the scale (neither satisfied nor dissatisfied) on organizational commitment and on job involvement. Attitudes regarding the transit agency (e.g., organizational satisfaction, organizational commitment, and membership commitment) were lower, on the average, than attitudes regarding the operator's role. This finding suggests that organizational components (e.g., bidding and sick day policies, route lengths) may function as sources of job stress for transit operators.

Most of the demographic and job characteristics were not associated with job attitudes. The exceptions to this were age (with older operators reporting more positive attitudes) and education (with more educated operators reporting poorer job attitudes). In addition, married operators and operators on the job less than one year exhibited more positive job attitudes. Job attitudes appeared to be more strongly determined by external factors (e.g., environmental stress factors) than by internal factors. Environmental stressors, job risks, and employee abuse all had negative impacts on operator attitudes.

#### Health

The most commonly reported health problems were fatigue, insomnia, and back pain or stiffness. Generally these symptoms occurred about one to four times per month. Surprisingly, younger operators reported more frequent problems than older operators. Married operators reported fewer problems than either single or divorced operators. The only other demographic variable to distinguish health problems was sex: female operators reported more problems than males.

#### Job Behaviors

Absence due to illness was measured by two questions--one measuring the number of days absent during the previous year, the other measuring the number of occasions absent during the previous year. The mean value of days absent was 10.7 (standard deviation = 27.02) and the mean value of occasions absent was 3.34 (standard deviation = 6.67). The standard deviation for these measures suggested a substantial variation of absence rates across operators. Operators reported few miss-outs in the 3 months before completing the survey (mean = 0.55). Similarly, few operators that responded reported filing workers' compensation claims in the last year (mean = 1.24, with 1 = no claims and 2 = 1 claim). Performance errors in the last month (e.g., traffic accidents, customer complaints, rule violations) occurred infrequently (mean = 1.32, where 1 = never and 2 = once or twice a month).

#### Factors Affecting Stress

In terms of exposure to environmental stressors (e.g., pollution, noise, dangerous equipment), the

responses indicated that some exposure occurred, but not to a great extent. For job risks (e.g., risks of disease, personal attack, and traffic accidents), exposure was more common than for environmental stressors. Rewards for performance (e.g., compliments, recognition of good service) were reported to occur a little over once or twice per month (mean of performance errors = 2.21 with 2 = once or twice and 3 = about once a week). Employee abuse from passengers (e.g., verbal abuse, passenger refusing to pay a fare) occurred with about equal frequency (mean of job abuse = 2.20 with 2 = once or twice and 3 = about once per week).

#### Schedule Needs and Satisfaction

Operators were asked how important certain schedule characteristics were in their choice of work assignments. A parallel set of questions asked how much the operators' current schedule satisfied their needs for each characteristic. From these two sets of questions, discrepancy scores were calculated that indicated whether operator needs were either exceeded or unmet by current work assignments. A relatively large percentage of operators indicated that their needs were exceeded in the following areas: pay (26 percent), overtime (31 percent), and variety in assignment (35 percent). However, operator responses reflected significant unmet needs for safety (49 percent), better fit between work and home schedule (45 percent), ability to schedule non-work interests (40 percent), and convenience of eating and restroom facilities along their line (38 percent).

#### Predictors of Job Attitudes

Environmental stressors, job risks, employee abuse, and most of the positive discrepancy scores were negatively related to attitudinal outcomes. Job rewards, however, had a slight positive relationship with attitudes. Multiple regression analysis revealed that, of these, environmental stressors and employee abuse were the strongest predictors of job attitudes.

#### Health Predictors

As expected, the frequency of health problems increased as negative job attitudes and job behaviors increased. Regression analysis showed that environmental stressors and employee abuse were the strongest predictors of health problems. These findings shed some light on why younger operators report more health problems; if younger operators have less chance of obtaining desirable routes, then it follows that their increased exposure to environmental stress on the undesirable routes would lead to more health problems.

#### Overtime Work

Operators who received less overtime than preferred expressed a greater likelihood of leaving the organization. Operators who indicated an oversupply of overtime work also reported a significantly greater likelihood of leaving. These operators also filed workers' compensation claims more frequently.

#### Scheduling and Nonwork Interests

Conflicts between nonwork interests and assigned work schedules were significantly related to a range of attitudinal, health, and behavioral outcomes.

Unmet needs in combining work and family schedules, getting the right days off, and scheduling nonwork interests were, in general, associated with lower job attitudes, higher intent to leave, more health problems, and higher levels of employee absence.

#### Managerial Implications

The large number of factors influencing absenteeism in transit precludes simple solutions. Furthermore, because some of the causes appear to be occupational in nature, radical changes may be necessary in order to make significant strides in reducing absenteeism. Research on the subject leads to the conclusion that a strategy composed of at least six elements is necessary to deal successfully with absenteeism in transit.

#### Evaluation of Operator Staff Levels

Because of the improvements in operator staffing that a few organizations have achieved by evaluating the size of their extraboard, it is expected that similar assessments might contribute to successful changes elsewhere. The logical approach to such an evaluation would be for transit agencies to apply one of the optimization formulas currently available.

#### Development of an Extraboard Monitoring Program

Although an evaluation of the optimal size of the extraboard may help to eliminate allocation inefficiencies, it will not resolve many of the operational problems associated with extraboards. Some of these problems, such as disruption of regular operator-passenger relations, are inevitable. There is some value, however, in developing a monitoring program that would provide the organization with information about these operational problems. As part of the monitoring program, performance data related to extraboard operations, such as employee absence, service reliability, and dispatcher performance, should be collected and reported regularly. These data, which might be reported separately for regular and extraboard operators, could be gathered in conjunction with current organization-wide or route-specific data collection activities.

This type of monitoring and reporting system could have several uses. It could serve as a warning system to indicate when allocation inefficiencies occur in staffing. Because the equilibrium between the costs of nonscheduled operator overtime and the costs of guarantee pay for extraboard operators who are not used may be disturbed by unexpected events, the system would need to be reviewed regularly. The monitoring program would facilitate accomplishment of this objective and would also help assess whether inevitable problems associated with extraboard operations would stay within accepted boundaries. A monitoring program could be used to develop operating standards and to evaluate their attainment. As an outgrowth of the development of standards, the monitoring system could also be used for goal-setting and for managerial performance reviews.

A performance monitoring system already being used by the San Francisco Municipal Railway (18) is a good example of such a program for assessing extraboard operations. The performance measures monitored under this program include

- Unscheduled overtime,
- Missed service hours due to no operator,
- Guarantee pay hours (extraboard operators who



- are surplus, and report operators who do not catch out on a run),
- Absenteeism (sick leave, miss-outs, and industrial leave), and
- Percent of optimum extraboard achieved.

Using this program, and the standard management-by-objectives method, targets for MUNI are established for each quarter, and results are reported and evaluated.

#### Development of Methods for Decreasing Workers' Compensation Liabilities Stemming from Equipment

Initial and continuing review of workers' compensation liability associated with equipment designs appears to be the single most important area for management action. A number of steps could be taken to improve performance in this area. One step would be to involve workers' compensation and safety specialists in the preparation of vehicle specifications and evaluation of bids. Although the involvement of these specialists would appear to be an important risk management activity, it is apparently not widely practiced by California transit agencies. Their involvement in equipment purchase decisions would help to prevent procurements that perpetuate current liabilities and would broaden the perspectives and criteria against which equipment purchases are judged.

Another step would be to communicate the needs for risk management of equipment designs to industry and government organizations, such as the American Public Transit Association (APTA) and the Urban Mass Transportation Administration (UMTA). These particular organizations have, in the past, had significant influence on bus designs. The advanced design buses are a product of cooperation between these and other organizations. Although some risk management aspects of vehicle design can be controlled by an agency that procures vehicles, this issue also needs to be recognized by UMTA and APTA guidelines conveyed to potential suppliers.

Involvement of employees in the assessment of equipment-related liabilities may be another means of reducing workers' compensation costs. Obtaining feedback from employees about current or proposed equipment is often an efficient method for isolating problems.

Given the large proportion of compensation claims that are equipment-related, there would appear to be advantages for analysis of the etiology of such claims. This type of analysis would be useful for isolating the precise causes underlying particular types of claims. In turn, the results could be used to develop remedial action (e.g., operator training, equipment redesign). These analyses could be conducted either by in-house professionals trained for such special studies or by consultants for those cases in which existing personnel cannot perform an analysis and the claim costs are expected to be reduced sufficiently to cover the additional fees.

#### Monitoring and Controlling Dysfunctional Overtime

Although optimal extraboard staffing may reduce dysfunctional overtime (e.g., amounts of overtime that result in employee turnover or physical strain), it is unlikely that this procedure will eliminate it. Thus, it might be useful for transit agencies to develop means for monitoring and controlling excessive overtime. Payroll reporting systems could easily be modified to call the appropriate manager's attention to large amounts of

overtime. If after study by management or joint labor-management committees these amounts of overtime are found to have dysfunctional consequences, then changes in the labor contract would probably be needed. Among changes labor-management committees could consider is allocation of overtime as a reward for good attendance so that it becomes an incentive for reducing absence.

#### Increasing the Variety of Work Schedules Available for Bid

As they are presently designed, the work schedules available for bid appear to be quite satisfactory in meeting employees' needs for pay, overtime, and stability and variety of assignments. However, large numbers of employees find their work schedules inadequate for satisfying other types of needs, such as the fit between their schedule and their family's schedule. These results and open-ended responses suggest the prospect for increasing schedule suitability by increasing the different types of work schedules available for employee selection when work is bid. For example, types of schedules could be designed that provide more leisure time each week, more break time each day, and more integration between work and nonwork pursuits. Among the scheduling options that might increase suitability for a large number of employees are the following:

1. Four shifts per week or 9-hour shifts with an extra day off every second week. This option would give employees more leisure time. In order to become feasible, this plan would require the redefinition of premium pay in most labor agreements.

2. Building more break time into schedules. The research clearly revealed operator concerns about the lack of lunch breaks or rest stops. Such breaks could be built into schedules and both employee health and job attitudes would improve in the long run. Whether these breaks were paid or unpaid could be negotiated, but because they meet expressed needs of employees, the assumption is that, within limits, they would be unpaid.

3. Integrate split shifts with nonwork activities. A 1982 study of Swedish bus drivers (23) suggested that employees who could not get home during the break in a split shift usually had no meaningful use of that time. Although one solution to this problem is to limit the proportion of split shifts, another is to expand opportunities for conversion of the break time between split shifts into meaningful pursuits. This might be achieved by locating garages near recreational and adult education resources, creating multipurpose ready rooms that would house recreational and educational activities, and permitting operators to return home during breaks.

4. Permit employees more flexibility to schedule absences upon sufficient advance notice. Scheduling research suggests that anticipated absences are considerably less costly than unanticipated absences. Few transit organizations have taken advantage of this fact by developing scheduling practices that accommodate employee needs for greater flexibility.

#### Reduction of Sources of Strain in the Job Environment

This is perhaps the area that permits the broadest scope of labor-management action, but also the area for which the recommendations are most tentative. The tentativeness of these suggestions rests on two observations: First, the employees' perceived en-

vironmental stress may actually be produced by the job and not by the environment. For example, tight schedules rather than the environment may be the cause of passenger abuse; therefore, any action taken to lessen passenger abuse would probably be ineffective if the ultimate reasons underlying this source of environmental stress were misunderstood. Second, the costs and benefits of certain potential solutions are uncertain, and the costs associated with some solutions are quite high. For example, operators would be safer if security personnel were assigned to each bus, but the cost of this recommendation may be prohibitive.

Having expressed these reservations, there is nevertheless a general strategy that transit agencies might consider implementing while other solutions are being generated: initiate actions that will increase employee perception of the supportiveness of supervisors, the reasonableness of organizational policies, and the central role of employee needs and desires in union-management interaction. Although certain aspects of the urban environment may be immutable (e.g., crime and violence), how operators perceive the job environment and cope with environmental stressors is, to some extent, a function of social support for the operator. The survey findings consistently indicate that many operators find sources of social support in their job environment to be deficient. Operators frequently expressed feelings such as these: supervisors only see them to criticize, rarely to give praise or ask about their concerns; organizational policies are stacked against them (e.g., the customer is always right, the operator always wrong); any suggestions for improvements from operators are unheeded; management and union leaders have lost sight of the workers' needs and desires.

This research, supported by other studies of operator attitudes and job behavior (21,23,26), points to the need for substantial improvement of the quality of first-line supervision as a way of reducing operator stress and strain. Attention should also be directed toward programs that will increase the operators' ability to deal with passenger demands (29). Actions that alter the elements of the job environment and thereby reduce the operators' feelings of alienation and increase feelings of supportiveness can positively affect the whole range of employee responses thereby reducing the impact of job strain and associated health problems and improving job commitment and performance.

#### CONCLUSION

The results of this broad assessment of employee absence in transit indicated that extraboard scheduling, workers' compensation policies and practices, and operator job stress are important influences on absenteeism. Although employee absence is the product of a complex set of variables related to the areas investigated in this study, it is only partially understood by researchers and practitioners. Although transit organizations pursue multifaceted programs to reduce absenteeism, further basic and evaluative research is needed on this critical productivity issue.

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