

Reducing Railroad Dispatcher Fatigue with Alternative Work Schedules

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ABSTRACT

Railroad dispatchers perform a safety critical job in a time-sensitive environment. Their attention and concentration on routing trains and other track occupants is key to the efficiency of the railroad's operations and the safety of its employees, the environment and the public. Both dispatcher staffing levels and work schedules can affect performance and safety. A recent research study of dispatcher fatigue found that dispatchers display characteristics typical for shiftworkers. The present study explored alternative dispatcher work schedules that offer the potential to reduce dispatcher fatigue. Visits to six dispatching centers documented current scheduling practices. All of the railroads follow the same schedule format: a 3-shift system with a relief crew filling in on scheduled days off for the permanently assigned dispatchers and an extra board to cover unplanned vacancies. Review of these schedules identified several major problems in terms of potential fatigue and quality of work life. Four alternative scheduling strategies are suggested as ways to relieve at least some of these problems.

INTRODUCTION

Railroad dispatchers perform a safety critical job in a time-sensitive environment. They are responsible for planning, coordinating and monitoring the safe and efficient movement of trains and other vehicles/equipment that travel on or along the rail system. Dispatchers are also responsible for protecting those individuals who work on or around the track. Their attention and concentration on routing of trains is key to the efficiency of railroad operations and the safety of its employees. Dispatcher errors resulting in conflicting train movements may lead to accidents.

As most dispatching centers provide monitoring and train control services around-the-clock, seven days a week, dispatchers are considered shiftworkers. Shiftwork is defined as any pattern of work in which most of the work hours are outside the period 8 a.m. to 4 p.m. Shiftwork and night work can pose exceptional challenges to human performance, due to sleep loss and circadian disruption. Research has also shown that individuals who are shiftworkers have higher rates of health problems and accumulate a higher sleep debt than individuals who work during daylight hours (1).

A recent FRA-sponsored study examined workload, stress and fatigue of railroad dispatchers through a field study. Dispatchers reported increasing levels of fatigue throughout all shifts, but the ratings for the night shift were significantly higher than those for the day and evening shifts. This research also found that dispatchers who worked nights reported "waking up tired" more frequently than those working days or evenings. Not surprisingly, the night workers were the most likely group to use split sleep and naps to obtain adequate rest. Overall, the results of this study indicated that dispatchers display characteristics typical for shiftworkers, regardless of type of work (2).

Work schedules have been shown to greatly affect workers' performance, health and well-being. The impact of work schedules holds even greater importance in safety-critical jobs, such as railroad dispatching, that require highly developed cognitive skills and vigilance. Yet to date, there has been no attempt to assess the types of work schedules currently employed in the railroad industry for dispatchers.

The purpose of the research described in this paper was to explore alternatives to current railroad industry practices with regard to the staffing level and the scheduling of railroad dispatchers. As each dispatching center is unique in terms of workload, size and dispatching technology, the methods and findings of this analysis are intended as a guide to optimization of dispatching center staffing levels and work schedules.

CURRENT INDUSTRY PROCEDURES

A prerequisite to exploring alternatives to current dispatcher schedules is an understanding of current industry procedures. Site visits to six railroads provided the means determine current practices. Table 1 presents the characteristics of the six sites that were visited. These railroads represent Class I, commuter and switching/terminal railroads.

The nature of railroad operations requires that dispatchers work around the clock. To meet the demands of 24-hour operation, for the most part, railroads staff their dispatching centers with three 8-hour shifts. There are three categories of jobs in all dispatching centers: regular jobs, relief jobs and extra board jobs. Regular jobs work five consecutive days on the same shift followed by two days off. Relief jobs fill in for regular dispatchers on their assigned days off and may rotate through different shifts. As is the case with the regular jobs, relief jobs usually work five consecutive days followed by two days off. The extra board dispatchers fill in for regular and relief dispatchers during vacations, training and road days and when there is an unplanned absence. Every extra board dispatcher is guaranteed five paid workdays every week, but the days and shifts that each individual works are not fixed. In addition, most agreements do not guarantee two consecutive days off for extra board dispatchers.

This standard dispatcher scheduling model exposes both the relief and the extra board dispatchers to rapid and constant shift changes that are physiologically fatiguing. In addition, extra board dispatchers have no regular work or rest patterns because they fill mostly unscheduled short-term vacancies sometimes on very short notice. Consequently, these dispatchers are the weak link in the chain, performing safety critical jobs as primary backups, while likely working shift patterns that are known to contribute to sleep loss resulting from disruption of the individual's wake-sleep cycle. This can, in turn, adversely impact performance and overall well-being. Work-related fatigue can impair concentration and vigilance and threaten safety. The standard dispatcher scheduling model, which relies on relief and extra board dispatchers to protect staffing levels, exposes dispatching centers to extra cost, sub-optimal dispatcher performance and increased safety risks.

The current schedules are a product of a number of factors. Most important are the Hours of Service regulations and the labor agreement between the railroad and its dispatchers. The Hours of Service Act requires that a dispatcher may not remain on duty for more than 9 hours, whether consecutive or in the aggregate, in any 24-hour period in operations that employ two or more shifts. Where only one shift is employed, the dispatcher may remain on duty up to 12 hours in any 24-hour period. During an emergency situation, the regulations allow dispatchers to remain on duty for an additional 4 hours in any 24-hour period for a maximum of three days over the course of seven consecutive days. (49 CFR Part 228) These regulations limit the length of the dispatcher's shift and provide for a minimum rest period between shifts.

The labor agreement typically stipulates provisions for hourly wages, vacation days, sick time and other benefit days off. It will also provide for a seniority-based method for assigning work. Since all dispatchers earn the same hourly wage after five years on the job, allowing the most senior dispatchers to choose the job that they work rewards longevity on the job. ("Job" refers to the specific shift and days on duty.) The labor agreement will provide the rules as to how the seniority system works. The seniority rules may also govern the assignment of overtime, which is typically paid at 1½ times the regular hourly rate. Some dispatchers are anxious to work overtime while others, typically the more senior dispatchers, prefer to work only their regular 40-hour week.

Depending upon the size of the operation, responsibility for the weekly schedule lies with the chief dispatcher, the scheduling clerk or, in the case of the large Class I railroads, a separately staffed department that manages the dispatcher schedules. Each of the railroads visited as part of this study provided one month of actual dispatcher schedules for examination. Based on this small sample, the percentage of shifts that were staffed by someone other than the regularly scheduled dispatcher ranged from 10 percent to 25 percent. For example, for a center that has 300 shift positions over a four-week period, the individual(s) responsible for the schedule are likely to have to find replacement dispatchers, from either the extra board pool or the regular or relief dispatchers between 30 and 75 times over a month. The limitations of the Hours of Service requirements and the desk qualifications of each individual dispatcher complicate this replacement process. Since many replacement assignments are due to vacations and other planned absences, these assignments do not create the level of last minute uncertainty that these figures might imply.

Staffing levels tend to remain constant over time unless changes in traffic or a merger necessitate the addition of new desks. The staffing level is usually determined based on the experience and judgment of management rather than a rigorous analysis.

METHODOLOGY FOR ESTABLISHING OPTIMAL STAFFING

Determining the optimal staffing level is a prerequisite to designing alternatives to current schedules. The optimal staffing level for any dispatching operation is a function of both the number of dispatcher positions that must be staffed and the extent to which someone other than the regularly assigned person works each position. The term “shift position” is used in the following subsections to refer to a specific desk and shift. This section presents a methodology for computing optimal staffing level. It is important to keep in mind that this method is based on the *average* number of positions required over the course of a week and the *average* level of absenteeism for the center. It is still possible that, due to unusual circumstances on a given day, there may be a need for individuals to work on a regularly scheduled day off.

Average Number of Positions to Meet Workload

Assuming center management has established the number of desks that must operate and the days and shifts that each will be staffed, the staffing analysis can proceed. The first step in estimating the optimal staffing level is to determine the average number of shift positions that must be staffed over the course of the week. The number of positions may be the same each day and shift or it may vary.

The average number of daily shift positions can be computed as a total for the entire dispatching center or by shift. For example, assume the number of dispatchers on duty varies by day as shown in Table 2. The average number of daily positions for each shift (far right column of Table 3) is calculated as

$$\frac{\text{Total dispatcher days}}{\text{Total service days}}$$

The shift relief factor formula uses the average number of daily positions to compute the optimal staffing level.

Shift Relief Factor (SRF)

Shift relief factors are used to identify the number of employees required to staff a given number of shift positions. Specifically, a shift relief factor is a single number that suggests the number of employees needed to staff one desk on one shift over the course of the week. Shift relief factors have values greater than one and can be interpreted as the number of employees or dispatchers per desk per shift. SRFs are directly related to the number of days that the position or desk operates; the more days that the desk operates, the higher its relief factor. Operations that are staffed seven days per week have SRFs in the range of 1.5 to 1.8.

The shift relief factor is calculated as

$$\frac{\text{Number of days that the center operates}}{\text{Average annual employee on duty days}}$$

Since railroading is a 24 hour per day operation year round, for most dispatching operations, the number of days that the center operates will be 365. Average employee on duty days is calculated as 365 less the days that the employee is not at work.

Dispatcher absences fall into one of two categories: 1) regular days off or 2) benefit and other days off. Labor agreements typically provide for two regular days off per week or 104 regular days off per annum. Benefit and other days off include the following:

- Holidays
- Vacation
- Sick leave
- Compensatory time off
- Funeral leave
- Personal leave
- Family emergency
- Military leave
- Education leave
- Road trips
- Training
- Special assignments

Calculation of the shift relief factor is as follows:

$$365 / (365 - 104 - \text{benefit and other days off})$$

If experience at a dispatching center for one year indicates the following average absences for the dispatching staff:

Vacation days	21.0
Sick days	6.0
Training days	3.0
Other absences	2.6
Total annual days not at work	<u>32.6</u>

then the shift relief factor for this center will be

$$365/(365 - 104 - 32.6) = 365/228.4 = 1.6$$

The optimal staffing is defined as

$$\text{Shift relief factor} \times \text{average number of daily positions}$$

Assuming the average number of daily positions for this center is 11. Then the center requires

$$1.6 \times 11 = 17.6$$

or 18 dispatchers. The SRF can be computed for either an entire center or a single shift.

Effect of Additional “not at work” Days on Staffing Level

The Shift Relief Factor can be used to determine the point at which additional “not at work” hours will necessitate additional dispatchers. Assume benefit and other days off total 32.6 days, the center has 11 daily shift positions to staff and a current staffing level of 18. Assume management wants to know how many additional days off will require increasing the center’s staff to 19.

Let x = the number of additional “not at work” days (NAWD) that will result in the need for another dispatcher. Since

$$\begin{aligned} \text{Staffing level} &= \text{SRF} \times \text{Daily Shift positions, and} \\ \text{SRF} &= 365/(365 - 104 - \text{benefit and other days off}), \end{aligned}$$

the data for this center can be substituted in the staffing level formula as

$$19 = [365/(365 - 104 - 32.6 - n)] \times 11$$

Solving this equation for n the result is 17. In other words, another dispatcher would be needed to staff this center if average “not at work” days increased by 17 days to a total of 153.6 days.

Individual dispatching centers can perform a similar analysis with their specific data to determine how sensitive their staffing level would be to increases in “not at work” days. This type of analysis might be helpful if increases in training or road days are under consideration.

The total staffing requirement is a function of both the “not at work days” and average number of daily shift positions that must be staffed. Figure 1 illustrates this relationship for average daily shift position levels of 8, 11 and 15. The relatively flat slope of the lines on this chart illustrates that significant increases in NAWD must occur before hiring an additional dispatcher can be justified. Similar curves can be developed for any number of shift positions. The minimum value of average NAWD on the chart is 114 because all dispatchers have 104 scheduled weekend days off and 10 days of vacation. The minimum total staff requirement for each of the daily shift position levels will be greater than the number of daily positions to account for these NAWD.

Limits of the Shift Relief Factor Formula

By anticipating and projecting staffing absences based on historical absenteeism data, it is more likely a dispatching center will be able calculate average employee numbers needed to staff a given number of positions, knowing that vacancies will occur. The SRF can be used to determine the number of dispatchers that should be scheduled in order to insure a specified average number report to work to protect operational needs based on projected vacancies.

For example, in a center with four desks, five dispatchers may be scheduled to report for work. Due to absences such as vacation, sickness and road trips, only four may report. Since each dispatcher works 5 days a week, seven dispatchers will provide a total of 35 staff-days per week. If distributed uniformly over all seven days of the week, these staff-days will provide five on-duty dispatchers each day of the week – one more dispatcher per

day than is required. The additional dispatcher scheduled on each day of the week will not, *on average*, result in overstaffing. S/he will, on average, be working a desk.

CHARACTERISTICS OF CURRENT DISPATCHER SCHEDULES

Schedule Classification

All six of the railroads reviewed follow the same schedule format: a 3-shift system with a relief crew filling in on the scheduled days off for the permanently assigned dispatchers and an extra board to cover unplanned vacancies. These schedules are categorized as *non self-relieving 3-crew systems with a relief crew*. Non self-relieving refers to the fact that there are not dedicated extra board dispatchers who fill in on only one shift.

A typical schedule for one division within a large dispatching center is shown in Figure 2. In this example there are 23 regular jobs, 9 relief jobs and 10 extra board jobs for a total staffing level of 42 dispatchers. Nearly half of the dispatchers, the relief and extra board people, by the nature of this type of schedule, must work rapidly rotating shifts. Rapidly rotating shifts are known to be fatiguing due to human maladaptation to changes in sleep schedule. Because the Hours of Service regulations require at least 15 hours off before returning to work, the rotations cannot be backward rotating, which is known to be even more fatiguing.

Schedule Characteristics

Research has shown that there are a number of characteristics of a work schedule that determine whether or not the schedule can be potentially fatiguing (3, 4). This section discusses current dispatcher schedules in terms of these characteristics. These characteristics are summarized in Table 4.

Fixed or Rotating Schedules

Fixed schedules assign a dispatcher to a specific shift and s/he remains on that shift for each duty cycle. (The duty cycle for dispatchers is 1 week.) Rotating schedules require dispatchers to work more than one shift in a given duty cycle. The dispatching centers utilize a combination of both fixed and rotational schedule formats. The majority of the dispatchers are assigned to one of three shifts; day, evening, or night shift. The relief dispatchers are usually assigned to rotate through at least two of the three shifts. The larger Class I centers are frequently able to arrange their relief jobs so that a given job involves work on only one shift but covers desks in two divisions. The extra board dispatchers are not assigned to any particular shift, but fill in for absences based on qualifications for specific desks within Hours of Service limitations.

There are benefits to both fixed and rotating schedules. Fixed shift schedules are preferred because they allow dispatchers to stabilize their lifestyle around a particular shift. Novice dispatchers look forward to the opportunity to bid into a preferred shift. Many fixed shift schedules based on 8-hour shifts have two major drawbacks. First, they require some dispatchers to rotate through all three shifts within one week, and, in addition, weekend time off is limited to a select few of the most senior dispatchers. Rotating schedules are preferable when a balance of skills is required throughout each shift and when the labor force prefers to share in an equitable distribution of days off, including weekends off.

Number of Consecutive Work Hours and Days

The current Hours of Service regulation limits the dispatcher to working no more than 9 hours in any 24-hour period. This rule requires the use of 8-hour shifts. (Eight hours are a multiple within the 24-hour day.) The dispatch centers examined utilize a five-day consecutive shift duty period with two consecutive days off. Each job consists of a fixed consecutive five days on in accordance with the center's need by desk, time of day, and day of week. Within a seven-day period, the five days on and two days off need not follow what is considered a standard Monday to Friday daytime workweek. An example could be working Thursday through Monday on night shift, having Tuesday and Wednesday off.

Fixed or Staggered Days Off

Fixed days off can be in two formats, one format is a multiple of seven days. Other fixed days off formats use a multiple of seven, i.e. 14 or 28 days. Current dispatcher schedules employ the first format. All dispatchers have a fixed two days off consecutively. The other fixed days off formats, being a multiple of 14 or 28, are schedules

where all or a set of dispatchers in a shift rotate their days off equally in a fixed pattern. Employees rotate through the schedule in groups and all those rotating in the fixed pattern receive the same days off as each other.

Staggered days off are schedule formats where the on/off duty cycle is not a multiple of seven days. A common fixed schedule with staggered days off has six consecutive days on with two consecutive days off. All dispatchers share the same days off in a staggered pattern based on the eight-day cycle.

Equitable Distribution of Off-Duty Days

Equitable distribution of off-duty days means that all dispatchers rotate their on duty/off duty days. As mentioned above, this is not the case with the dispatch centers reviewed. These centers function on a seniority system, common throughout the railroad industry, that allows the most senior dispatchers to choose which shift and days they will work. This process is repeated down to the dispatcher with the least seniority. The primary concern of this characteristic of scheduling is that it causes sociological disruption for the majority of dispatchers. This disruption can result from never having any regularly scheduled weekend time off, or working fixed night shifts with no weekend time off. Compounding the issue is that there are relief dispatchers who rotate through all the shifts while never receiving weekend time off.

The same principle applies here as with the concept of fixed or staggered days off. If there is the desire for all to receive some equitable days off, then the schedule needs to have some staggered pattern to allow all or some of the dispatchers to stay on fixed shifts, but rotate the days on and days off pattern.

Shift Start and Stop Times

Shift start and stop times, in general occur at 7 a.m., 3 p.m. and 11 p.m. Centers may have shift change times up to 1 hour earlier or may stagger them. A primary concern with respect to shift change times is that they not require employees to commute during times of reduced alertness.

Humans have two peaks in alertness and two troughs. Alertness is at its lowest between 3 a.m. and 5 a.m. Based on individual circadian profiles, the actual nadir period can range between midnight and 6 a.m. This is the time that most individuals who work around the clock identify as the most difficult to maintain their vigor and alertness on the job

As hard as it is to maintain alertness while at work during the nadir period when stimulated by and responding to the rigors of a job, it is even more difficult to maintain vigor when driving. To help ensure the safety of dispatchers during their commutes to and from work it is recommended that shift start and stop times not occur during this most difficult time of day. This does not appear to be an issue for dispatchers.

Quality and Quantity of Weekend Time Off

A key social characteristic in schedule design for most dispatchers is having as many weekend days off as possible. However, in a continuous 24/7 operation, someone must work the weekends. In practical application, rotating 8-hour schedules allow between one quarter and one half of the staff to have both weekend days off. Fixed shift and day off schedules provide some 40 to 50 percent of the staff with at least one weekend day off. This appears to be the case for railroad dispatchers. For example, at one of the Class I dispatch centers reviewed, the dispatcher schedules provided for at least one weekend day off for 47 percent of the dispatchers while the remaining 53 percent do not receive any weekend time off. Of the 47 percent who receive weekend time off only, less than half receive a full weekend off each week. For this Class I railroad, only 21 percent of the regularly scheduled jobs provide for two weekend days off each week.

Off Duty Time Between Consecutive Workdays

Ergonomic work schedules provide two consecutive days off to allow the worker adequate time for relaxation and restorative sleep. With the fixed 3-shift schedule, the off-duty time between consecutive workdays is 16 hours. The off-duty time between consecutive workweeks is two full days, but a total of 64 hours between on-duty cycles. This is the case unless a dispatcher is called in to work on his/her day off. For the relief crew, the time off between consecutive same shifts is 16 hours, but the time between forward rotating shifts (e.g., day to evening shift) can be 24 hours or more. Off duty time for relief dispatchers between consecutive workweeks can vary based on what shift ends the workweek and what shift begins the next workweek. The shortest period is when a relief dispatcher ends the workweek on a night shift and starts back to work the following week on the day shift. This leaves the

dispatcher with a disruptive schedule only 48 hours off. Since extra board dispatchers at most centers are not guaranteed two consecutive days off, their off duty time between consecutive days must be at least 15 hours and will vary from week to week. This group of dispatchers is not assured of the opportunity for two consecutive days off and thus may never be adequately rested.

Variable On-Duty Staffing by Day of Week

A strategic characteristic of any schedule design is the staffing by time of day and day of week. If the staffing is equal through each shift, then the scheduling format can be kept simple and equitable. When staffing varies by time of day, day of week, or through seasonal fluctuation, the scheduling format can become more complex with the use of proportional staffing.

All of the freight dispatching centers reviewed have relatively even staffing by time of day and day of week. In contrast, the commuter railroads have a variation in staffing at nights and during the weekend period. On the weekends, they have fewer staff assigned by day and shift.

Length of Shift

The Hours of Service regulation limits the length of a dispatcher's shift to a maximum of 9 hours and requires an off duty period of at least 15 hours between work periods. As consecutive hours within a given shift and/or the number of consecutive workdays in a work block increase so does cumulative fatigue.

Fatigue research has shown that the number of consecutive workdays should be limited to a maximum of seven 8-hour shifts within a block of consecutive workdays. The Hours of Service regulation does not address the number of consecutive workdays.

Relief Crew and Placement of Extra Board Dispatchers

While the relief dispatchers work a regular schedule of five consecutive days, their schedule frequently requires rapid forward rotation, an arrangement that is potentially fatiguing. The extra board dispatchers are guaranteed five days but not on any set schedule. The extra board is solely used to cover for any absenteeism by the regularly assigned dispatchers. As a result extra board dispatchers work varying shifts, within the Hours of Service limitations, usually do not have two consecutive days off and in general have an unpredictable schedule unless they are filling in for someone on scheduled vacation leave or other planned absence.

ALTERNATIVES TO CURRENT DISPATCHER SCHEDULING SYSTEM

The current dispatching schedule format does have many desirable characteristics. However, there are some significant modifications that have the potential to lessen the negative features described above. Innovations in schedule design that have developed in other environments, such as fire and police operations and manufacturing and process industries, offer some options for consideration in railroad dispatching centers. The range of options is limited by the Hours of Service regulations, current labor agreements, a weekly payroll system, assignments based on seniority and the expectation, in some locations, of overtime. Possible options are described below.

Option A: Create three crew self-relieving system

Once the proper staffing analysis has been established for each shift, whether day, evening, or night shift, place the optimum number of dispatchers on each shift and make the shifts self-relieving.

For example, assume the day shift has eight desks, operates 7 days per week, and the Shift Relief Factor (SRF) is 1.60. The optimal number of dispatchers for the day shift is $8 \times 1.60 = 12.8$ or 13 dispatchers. In other words, a total of 13 dispatchers are assigned to work days. The same process is applied to the evening and night shift. Depending upon the current staffing level, this approach need not lead to an increase in total staff. On average, there should be enough staff to cover an unplanned absence.

Making the crews self-relieving by assigning the optimal staff to cover for "Not at Work Days" on any given shift, the solution increases the number of people working fixed work shifts. That is, it can potentially free the relief crew and most of the extra board from working rotating shifts. Maximizing the workforce on fixed shifts will allow the maximum number of dispatchers to stabilize their physical and social lifestyle around a fixed pattern. From a performance measurement and team building perspective, the more dispatchers assigned to a fixed shift, the greater the accountability and cohesiveness within each shift. With this arrangement, the additional dispatchers

assigned to the fixed shifts would have to qualify on all desks. Some railroads have already chosen to have their extra board dispatchers qualify on all desks so this arrangement may be feasible in these locations.

Option B: Allow fixed shifts to maximize weekend time off

Option A is a pre-requisite to implementation of Option B. Once the 3-crew system is optimized to the appropriate staffing level, keep the senior dispatchers on the fixed days off with weekend time. Keep the remainder of the dispatchers on each of the fixed shifts but rotate the days off schedule to 6 on/2 off, 7 on/2 off, 7 on/4 off.

This arrangement would allow the non-senior dispatchers, including the extra board dispatchers, to receive a long weekend off—Saturday, Sunday, Monday, and Tuesday—every 25 days. Overall this option equally distributes weekend time off. If desirable, this schedule can be implemented seasonally, as with the summer time, and it need not be implemented for all three shifts. This option includes a limited extra board to fill the “relief” positions at the center.

Option C: Utilization of relief dispatchers and extra board dispatchers

Option A is a pre-requisite to implementation of Option C. If there is a necessity to distinguish between relief and extra board dispatchers, assign the relief dispatchers to cover for unexpected absenteeism within their designated fixed shift and allow the extra board to fill-in for vacations, long-term training or disability.

The relief dispatchers being assigned to their appropriate fixed shift will be more alert to take on unexpected absences when they are on the fixed shift. The extra board, covering all other long term fill-in days off, will have the opportunity to slow down the randomness of the traditional extra board schedule by staying on the same shift longer with less rotation between work assignments.

Option D: Mon – Fri 8-hour shifts, Sat – Sun 12-hour shifts

Convert Saturdays and Sundays to two 12-hour shifts.

If an exemption or waiver from the Hours of Service regulations could be obtained, the extension of hours only on the weekends is possible. This option would guarantee three-quarters of the dispatchers some weekend time off. The change on Saturdays and Sundays may be accomplished while maintaining all of the positive aspects of a fixed shift system. A key feature of this option is that it does not include an extra board. The other options have an extra board that is smaller than under the current system.

CONCLUSIONS

The work schedules for US railroad dispatching operations are non self-relieving three fixed shifts with a relief crew. The current system is easy to manage because of the fixed assignments inherent in it. One of the disadvantages is that this system requires an extra board to fill in for occasions when the regularly assigned dispatcher is unavailable to work.

The extra board creates problems for both railroad management and the dispatchers who work those jobs. Based on data provided by six dispatching centers, during any given week as many as 25 percent of the assigned shifts may require the use of extra board dispatchers. Schedulers have the responsibility for securing a replacement dispatcher. Many times this must be done on short notice and, due to Hours of Service limitations and qualifications of available dispatchers, several dispatchers must be re-assigned to accommodate the vacancy. From the dispatchers' perspective, as many as one quarter of a center's dispatching staff may be subject to the random and potentially fatiguing work schedule inherent in an extra board position. Also, under the present system, relief dispatchers may have rapid forward rotation in their schedules. While relief dispatchers have a regular schedule, rapid rotation is not a preferred arrangement with regard to potential fatigue. In centers where relief dispatchers work a rotating schedule, as many as half of the center's dispatchers may be working a potentially fatiguing schedule.

Another major shortcoming of dispatcher schedules involves off-duty time. The present scheduling system for dispatchers results in an inequitable distribution of off-duty time with some having nights and/or weekends off and other always working at those times. The current arrangement limits weekend off-duty time to less than half of

the staff. Less than a quarter of the staff has two weekend days off. The inability to spend social time with family and friends may be further compromised if the dispatcher works nights.

Both labor and management are likely to benefit from any change in the present system, but implementation of any of the options suggested above will require teamwork from both groups. One approach to exploration of alternative scheduling options would be to establish a committee to identify the scheduling concerns at the dispatching center. This committee should include representatives of all stakeholder groups, including desk dispatchers, chief dispatchers, schedulers and management of the dispatching center. If there is consensus that a change is desirable, then a specific scheduling strategy can be selected and impediments to the change can be addressed. Factors that are important to consider include the terms of the current labor agreement, a weekly payroll system, and any dispatcher expectations regarding the opportunity to earn overtime pay. The Hours of Service will be a concern if 12-hour weekend shifts are desirable.

The focus of this study was on determining staffing levels that accommodate the “not at work days” pattern of a center. Human physiology and quality of work life considerations were the basis for the evaluation of dispatcher schedules. Cost was not considered directly in this analysis. Before implementing any of the suggestions offered in this report, railroads will likely also want to examine the economic consequences of any change in either staffing level or schedule.

A staffing analysis based on the shift relief factor may suggest a change in the total number of dispatchers at a center. Only a detailed analysis of the salaries and payroll costs for a specific dispatcher center will reveal if the change will bring about an overall increase or decrease in the cost of operating the center. With regard to changes in work schedules, the motivation for considering an alternative work schedule is because it offers benefits to the work force and is cost neutral. Alternative schedules, such as the four suggested above, have benefits in terms of reduced fatigue and an improved quality of life for the dispatcher work force. These benefits are qualitative and not easily translated into a monetary equivalent.

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Table 1. Characteristics of case study sites

	Type of Railroad	Number of Desks/ Chiefs	Total Staff	Location of Dispatching Center
Conrail Shared Assets	Switching/ Terminal	3/1	24	Mt. Laurel, NJ
Metra Railroad	Commuter	4/1	24	Chicago
Metro-North Railroad	Commuter	10/2	52	New York City
Long Island Rail Road	Commuter	5/1	33	Jamaica, NY
Burlington Northern and Santa Fe Railway	Class I	95	518	Ft. Worth, TX
Union Pacific	Class I	N/A	375	Omaha, NE

Table 2. Staffing requirements by shift and day of week

Shift	Number of Dispatchers on Duty							Total Dispatcher Days
	Day of Week							
	M	T	W	T	F	S	S	
1	7	7	7	7	7	7	7	49
2	8	8	8	9	12	12	0	57
3	5	5	5	5	5	0	0	25

Table 3. Average number of daily positions by shift

Shift	Total Dispatcher Days	Total Service Days	Average Number of Daily Positions
1	49	7	7
2	57	6	9.5
3	25	5	5

Table 4. Characteristics of current schedules at dispatching centers

Characteristic	Dispatcher Schedule
Fixed vs. Rotating	3 crews on fixed shifts. Relief crew rotates through shifts.
Consecutive Work Hours and Days	8 hour shift length per day with 2 consecutive days off in a row for regular and relief jobs. Extra board not usually guaranteed 2 consecutive days off.

Fixed vs. Staggered Days off	Days off are fixed for regular and relief jobs and staggered for extra board jobs.
Equitable Distribution of Days Off	Days off are determined by seniority.
Shift Start and Stop Times	Shift starting and stopping times are fixed based on an eight hour shift.
Quality and Quantity of Weekend Time Off	Weekend time off is limited to seniority and availability.
Off Duty Time Between Consecutive Workdays	All dispatchers must have at least 15 hours off duty between shifts. Days off for extra board not necessarily consecutive.
Variable On-duty Staffing By Day of Week	Staffing by day of week is dependent on each center's needs. Commuter railroads have lighter staffing at nights and on weekends.
Length of Shift	All centers limited to 9 hours on duty per 24-hours period.
Relief and Extra Board Placement	Relief dispatchers are 4 th crew rotating through the shifts. Extra board fills in randomly.

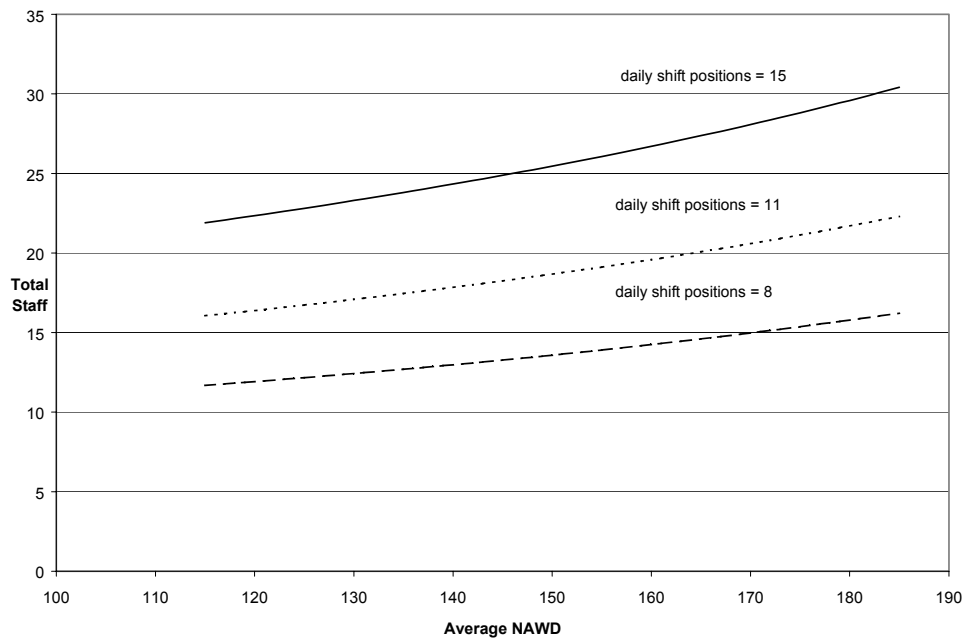


Figure 1. Total staff as function of not at work days and average daily shift positions

SHIFT/ID		Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Regular Scheduled Jobs (1 Week Cycle)	D 1	D	D	D	D	D	-	-
	D 2	D	D	D	D	D	-	-
	D 3	D	D	D	D	D	-	-
	D 4	D	D	D	D	-	-	D
	D 5	D	D	D	D	-	-	D
	D 6	-	D	D	D	D	D	-
	D 7	-	D	D	D	D	D	-
	D 8	D	-	-	D	D	D	D
	E 9	E	E	E	E	E	-	-
	E 10	E	E	E	E	E	-	-
	E 11	E	-	-	E	E	E	E
	E 12	-	E	E	E	E	E	-
	E 13	-	E	E	E	E	E	-
	E 14	-	-	E	E	E	E	E
	E 15	-	-	E	E	-	E	E
	E 16	E	E	E	-	-	E	E
	N 17	N	N	N	N	N	-	-
	N 18	N	N	N	N	-	-	N
	N 19	N	-	-	N	N	N	N
	N 20	N	N	-	-	N	N	N
	N 21	N	N	-	-	N	N	N
	N 22	-	-	N	N	N	N	N
	N 23	N	N	N	-	-	N	N
Relief Jobs (1 WK)	R 24	D-7	D-1	-	-	D-6	D-6	D-7
	R 25	-	-	D-5	E-7	E-7	E-6	E-6
	R 26	E-4	N-4	-	-	D-4	D-4	E-4
	R 27	E-1	E-1	N-1	-	-	D-1	D-1
	R 28	D-5	E-5	E-5	N-5	-	-	D-5
	R 29	N-4	N	N-5	N-6	N	-	-
	R 30	-	-	N-1	N-6	N-3	N-3	N
	R 31	E-8	E-8	N-7	-	-	D-8	D-8
	R 32	E-2	N-7	-	-	-	E-3	E-3
	Extra Board Jobs (4 week cycle)	X 1	N	N	-	N	N	-
		N	-	-	N	N	N	-
		-	-	-	-	-	-	-
		D	-	-	N	N	N	N
X 2		-	E	-	-	-	-	-
		-	-	-	-	-	-	E
		-	-	-	-	-	-	-
		-	-	-	-	-	D	-
X 3		-	E	N	-	-	D	D
		E	E	N	-	-	D	D
		E	-	-	-	-	-	-
		N	-	-	-	N	N	-
X 4		D	-	-	N	-	-	N
		-	-	-	D	-	-	N
		D	-	-	N	N	N	N
		-	-	-	-	-	D	D
X 5		-	D	-	-	D	-	-
		-	-	D	-	D	D	D
		-	-	-	-	-	-	-
X 6		-	-	-	-	D	N	-
	-	-	-	-	-	-	-	
	E	-	-	E	E	-	-	
	-	-	-	-	-	-	E	
X 7	N	-	-	D	D	E	E	
	-	-	-	-	-	-	-	
	-	-	-	-	-	-	N	
X 8	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	
	-	N	-	-	-	-	-	
X 9	-	-	-	-	-	-	-	
	-	-	-	-	-	E	E	
	-	-	-	-	-	-	-	
X 10	N	-	-	D	D	D	-	
	-	-	-	-	-	-	-	
	-	N	-	-	-	-	-	
	-	-	-	-	-	-	-	

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Figure 2. Typical Dispatching Center Schedule