

THE TWELVE-HOUR SHIFT IN THE PETROLEUM AND CHEMICAL INDUSTRIES

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The literature on continuous operation shift work is replete with analyses of the sociological and psychological impact and effects of regularly changing hours of work, sleep, and recreation.¹ The aspect of continuous operation that is most aggravating to shift workers, however, is the manner in which the second shift (3:00 or 4:00 P.M. to 11:00 P.M. or midnight) and weekend work

remove an employee from family and social life. The second shift precludes the possibility of attending family, school, and social functions before late night work, and weekend work takes one from family and friends at a time when such interactions can be most enjoyable.

In recent years, as worker income and alternate job opportunities have increased, companies have found it difficult to maintain experienced personnel in shift operations. Discussions with management of firms in such industries as chemicals and petroleum, in which both technology and economics require continuous operation, report a strong demand of workers to transfer to maintenance, even at lower wage rates, in order to avoid shift work. The traditional response both of management and unions is to raise wages or shift premiums—a response that companies surveyed in these industries found wide of the mark.

Remarkably, a different approach seems to have won support from the affected employees themselves—an increase in hours worked on each turn in exchange for fewer afternoons, evenings, and weekends worked. This article, based on interviews with management representatives in fifty plants in the chemical and petroleum industries in the United States and Canada in 1977, describes how the twelve-hour shift developed, compares it with the standard eight-hour shift, and analyzes the impact of and reactions to this innovation.

This article reports the results of a 1977 field survey of managers in fifty plants in the United States and Canada that have recently instituted twelve-hour shifts in continuous operation situations in the chemical and petroleum industries. The authors report that in all the plants studied the shift change has significantly improved morale without impairing efficiency, job safety, or workers' health. The drawbacks of this work schedule include the difficulty that some older workers have in adjusting to it; the possibility that it might not be feasible in industries in which the work is more arduous; and the general opposition of unions—which were present in only three of the fifty plants—to any lengthening of the workday.

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¹See, for example, Paul E. Mott, Floyd C. Mann, Quin McLoughlin, and Donald P. Warwick, *Shift Work: The Social, Psychological, and Physical Consequences* (Ann Arbor: University of Michigan Press, 1965), and Marc Maurice, *Shift Work* (Geneva: International Labour Office, 1975).



Typical Eight-Hour Shifts

A common eight-hour schedule in a continuous operation is illustrated in Figure 1, which designates sets of employees as A, B, C, and D.

Another sample schedule (though infrequently encountered among locations surveyed) is a four-crew system with a twenty-week cycle of rotation.² As illus-

Figure 1
Eight-Hour Schedule

	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
12 P.M.-8 A.M.	A	A	A	B	B	B	B	B	B	B	C	C	C	C	C	C	C	D	D	D	D	D	D	D	A	A	A	A
8 A.M.-4 P.M.	D	D	D	D	A	A	A	A	A	A	A	B	B	B	B	B	B	B	C	C	C	C	C	C	C	C	D	D
4 P.M.-12 P.M.	B	C	C	C	C	C	C	C	D	D	D	D	D	D	D	A	A	A	A	A	A	A	B	B	B	B	B	B
Off	C	B	B	A	A	D	D	D	C	C	B	B	A	A	A	D	D	C	C	B	B	B	A	A	D	D	C	C

Note: When the sixth and seventh consecutive workdays fall in a different week, the Fair Labor Standards Act does not require payment of overtime rates.

As can be seen, the schedule provides for seven days off out of every twenty-eight, with three of these days falling on a Friday, Saturday, and Sunday. In addition, the long weekend occurs after seven days worked from 8:00 A.M. until 4:00 P.M. The remaining four days are evenly divided, two following the afternoon shift (4:00 P.M.-12:00 P.M.) and two following the night shift. Some plants modify this schedule to reduce average weekly hours from forty-two to forty through the use of shift breakers (employees who work usually on the day shift for additional manning purposes or for replacing absent workers).

trated in Figure 2, this schedule provides for three weeks of five workdays and a fourth week of six. Average weekly hours are forty-two (without shift breakers). Rest periods following shift changes last for either seventy-two or forty-eight hours, but no three-day weekends are scheduled. In addition, there are periods of five weeks' duration in which two crews receive neither weekend day off, but this schedule does avoid the undesirable seven consecutive days on afternoon or night shifts.

²Maurice, *Shift Work*, p. 33.

Figure 2
Four-Crew System

	Week 1							Week 2							Week 3							Week 4							
	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	
8 A.M.-4 P.M.	A	A	A	A	A	B	B	B	B	B	C	C	C	C	C	D	D	D	D	D	A	A	A	A	A	A	B	B	B
4 P.M.-12 P.M.	C	C	D	D	D	D	D	A	A	A	A	A	B	B	B	B	B	C	C	C	C	C	D	D	D	D	D	A	
12 P.M.-8 A.M.	B	B	B	C	C	C	C	C	D	D	D	D	D	A	A	A	A	A	A	B	B	B	B	B	C	C	C	C	C
Off	D	D	C	B	B	A	A	D	C	C	B	B	A	D	D	C	C	B	A	A	D	D	C	B	B	A	A	D	

Development of the Twelve-Hour Shift

It is not remarkable that the twelve-hour shift spread rapidly in the chemical and petroleum industries but not in other continuous operation industries, such as steel, other metals, refining, glass, or paper manufacturing. Shift work in chemical, petrochemical, and petroleum facilities is not extremely arduous, at least on a continuous basis, because the work permits employees to relax at irregular intervals. In time of breakdowns or emergencies, of course, stress can be harsh and extend for a long period, but this is atypical. As noted, however, the twelve-hour shift has not been extended to steel or aluminum mills or glass plants—industries in which working conditions are likely to be more difficult—although it has begun to appear on a trial basis in paper manufacturing, an industry in which working conditions are somewhat similar to, but probably more strenuous than, those in chemicals or petroleum. In addition to the difference in their working conditions, these other continuous operation industries are much more completely unionized than chemical facilities and in general unions have opposed accepting wage adjustments management usually considers essential to make the twelve-hour shift economically feasible.

Although in 1955 Eli Lilly of Indianapolis introduced the twelve-hour shift in a continuous operation pharmaceutical plant and then used it in other facilities, the current movement apparently began around 1970 at an Imperial Oil (Exxon controlled) facility in Winnipeg, Canada. At the suggestion of employees, a joint employee-management committee was set up to deal with shift-work problems. It recommended a twelve-hour shift to which the company agreed on three conditions:

- the cost of administering the twelve-hour schedule be roughly equivalent to the costs involved in the eight-hour schedule then in effect;
- safety standards be maintained; and
- the new schedule have the support of a majority of the employees.

The joint committee felt that a test period was necessary and recommended a nine-

month trial to provide a thorough assessment for both management and workers. Approximately 75 percent of the plant employees voted in favor of the experiment, and the trial began in January 1971. At the termination of the trial, the new system was unanimously approved by both workers and management. The schedule spread rapidly to five other plants within Imperial, each adopting a schedule modified to meet its own particular needs and workers' wishes.

The schedule moved into the Gulf Coast area, first at a Ciba-Geigy plant, as a result of an article describing the Imperial experience, which was left purposely in a recreation room by the plant personnel manager to test employee interest.³ Their interest proved very great. Within three years of Ciba-Geigy's adoption of the twelve-hour shift, about twenty other locations within a fifty-mile radius had begun using it. Since then, it has spread throughout the country, particularly to other locations of companies that had already adopted it and to locations near those where it was already in use. Adoption has generally followed the Imperial procedure—employee request after discussion with management, study, trial period, and continuation with employees' enthusiastic support.⁴

Employers have generally supported the twelve-hour shift subject to four basic requirements:

- continued employee support (all plants underwent at least one trial period after which employee votes were tallied to determine acceptance, a majority in support being necessary for continuation of the schedule);
- no increased difficulty in administration (such as in covering overtime, etc.);
- no decrease in productivity and efficiency; and
- no increase in accident frequency and no violation of OSHA regulations.

³Charles H. Vervalin, "The Short Work Week Has Arrived," *Hydrocarbon Processing*, Vol. 51 (August 1972), p. 112.

⁴The proximity of plants in the Gulf Coast petrochemical industry and the mutual concern of managers and employees to deal with the "shift work problem" undoubtedly contributed to the rapid spread of the twelve-hour shift.

Twelve-Hour Schedules

Most plants on a twelve-hour shift follow one of three schedules: one allowing for every other weekend off (EOWEO); a three-on, three-off rotating schedule; or a four-on, four-off rotating schedule. The most popular schedule is the EOWEO. Although averaging forty-two hours weekly, as do most others, the EOWEO schedule assures each worker of having every other Friday, Saturday, and Sunday off (see Figure 3).

As can be seen, the schedule has a cycle of four, forty-two hour weeks. No employee works more than three consecutive days (or nights), and each has three consecutive days off (Friday, Saturday, and Sunday) every two weeks, in addition to four weekdays off. Most managements using EOWEO schedules reported that employees consider them

to be more beneficial than other schedules, mainly because of the regularity and frequency of weekends free for leisure. The schedule yields more desirable time off than other shift schedules and may aid in communication because workers are away from work no more than two consecutive days between Monday and Friday.

The second most popular shift is a three-on, three-off rotating schedule (Figure 4). Seven of the plants visited used such a schedule, which also averages forty-two hours weekly. This schedule is somewhat easier to implement than the EOWEO. It has a twelve-week cycle and affords the worker two three-day weekends and two two-day weekends every twelve weeks. Each two-day weekend is followed by a three-day weekend, which is then followed by four consecutive

Figure 3

Twelve-Hour Schedule Providing Every Other Weekend Off

	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
Nights	A	B	B	D	D	C	C	C	A	A	B	B	D	D	D	C	C	A	A	B	B	B	D	D	C	C	A	A
Days	D	C	C	A	A	B	B	B	D	D	C	C	A	A	A	B	B	D	D	C	C	C	A	A	B	B	D	D
Off	B	A	A	B	B	A	A	A	B	B	A	A	B	B	B	A	A	B	B	A	A	A	B	B	A	A	B	B
Off	C	D	D	C	C	D	D	D	C	C	D	D	C	C	C	D	D	C	C	D	D	D	C	C	D	D	C	C

Figure 4

“Three-On, Three-Off” Twelve-Hour Schedule

	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S
Day	A	A	A	C	C	C	B	B	B	D	D	D	A	A	A	C	C	C	B	B	B	D	D	D	A	A	A	C
Night	B	B	B	D	D	D	A	A	A	C	C	C	B	B	B	D	D	D	A	A	A	C	C	C	B	B	B	D
Day	C	C	B	B	B	D	D	D	A	A	A	C	C	C	B	B	B	D	D	D	A	A	A	C	C	C	B	B
Night	D	D	A	A	A	C	C	C	B	B	B	D	D	D	A	A	A	C	C	C	B	B	B	D	D	D	A	A
Day	B	D	D	D	A	A	A	C	C	C	B	B	B	D	D	D	A	A	A	C	C	C	B	B	B	D	D	D
Night	A	C	C	C	B	B	B	D	D	D	A	A	A	C	C	C	C	B	B	B	D	D	D	A	A	A	C	C

weekends during which one or both days (or nights) are worked.

A third schedule, which was adopted at only two plants, is the four-on, four-off schedule (see Figure 5). This schedule lacks some of the benefits claimed both for EOWEO and for three-on, three-off schedules, but it was chosen by employees in preference to the other two.

Wage and Manning Factors

Because the twelve-hour schedule implies built-in overtime, base wage rate revisions are often necessary in order for companies to comply with the Fair Labor Standards Act (FLSA) and the Public Contracts Act (Walsh-Healey) and still maintain costs within prescribed limits. Methods used to

Figure 5

“Four-On, Four-Off” Twelve-Hour Schedule

	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	
Day	D	D	A	A	A	A	B	B	B	B	C	C	C	C	D	D	D	D	A	A	A	A	B	B	B	C	C		
Night	B	B	C	C	C	C	D	D	D	D	A	A	A	A	B	B	B	B	C	C	C	C	C	D	D	D	A	A	
	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	
Day	C	C	D	D	D	D	A	A	A	A	B	B	B	B	C	C	C	C	D	D	D	D	A	A	A	A	B	B	
Night	A	A	B	B	B	B	C	C	C	C	D	D	D	D	A	A	A	A	B	B	B	B	C	C	C	C	D	D	
	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	
Day	B	B	C	C	C	C	D	D	D	D	A	A	A	A	B	B	B	B	C	C	C	C	C	D	D	D	A	A	
Night	D	D	A	A	A	A	B	B	B	B	C	C	C	C	D	D	D	D	A	A	A	A	A	B	B	B	B	C	C
	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	
Day	A	A	B	B	B	B	C	C	C	C	D	D	D	D	A	A	A	A	B	B	B	B	C	C	C	C	D	D	
Night	C	C	D	D	D	D	A	A	A	A	B	B	B	B	C	C	C	C	D	D	D	D	A	A	A	A	B	B	

It has a sixteen-week cycle, which provides for four three-day weekends and for two two-day weekends. The other ten weekends in the cycle allow at least one day off. Average weekly hours remain at forty-two if shift breakers are not used.

Which schedule was actually implemented at a plant depended not only on its feasibility but also on the employees' perceptions of the relative desirability of the various schedules, which in turn was often influenced by which plan was currently popular in the company or area. What management generally required for adoption was that the motivation for the change, and as much of the actual procedure as possible, should come from the employees. The result is many variations of these three schedules operating with basic twelve-hour arrangements.

deal with increased overtime payments differ, but most companies have been able to contain cost increases within 2 percent of original costs. One firm, however, allowed a 9.4 percent increase initially, hoping to recover it through improved operating and maintenance efficiency.

The typical eight-hour shift averages weeks of forty-two hours in length, if shift breakers are not used, and yields an average of forty-three hours of pay. The majority of twelve-hour shift schedules studied alternate thirty-six and forty-eight hour weeks and yield an average of forty-two hours worked and forty-four hours paid.

The FLSA requires a company to pay overtime for any hours worked above forty in any one workweek (but not for work on sixth and seventh consecutive workdays if those days fall in a different week). Be-

cause all twelve-hour schedules involve such overtime, a revision of the wage schedule is required to maintain costs within allowable limits. In firms affected by the FLSA alone, simply restructuring holiday pay seems to have been the most successful method of revision. Figure 6 illustrates two ways of doing that: compensating holidays worked at straight time instead of overtime rates, and paying nothing for holidays not worked. The objective, of course, is to maintain total compensation at about the same level as before the twelve-hour shift was adopted.

As noted previously, in a continuous-process operation employees on eight-hour shifts usually work twenty-one of every twenty-eight days (Figure 1) and those on twelve-hour shifts usually work only fourteen of every twenty-eight days (Figure 3). Thus, the twelve-hour shift reduces the probability that an employee must work on a holiday from 75 to 50 percent, and that factor might ameliorate the effects on worker expectations of a decrease in holiday pay. Yet, the tendency of employees is to

attempt to regain any initial losses in specific types of pay, even when overall yearly wages remain much the same under the new schedule as under the old. The revised schedule in Figure 6 largely meets that problem; the only pay “missed” by employees on a twelve-hour shift is that for holidays not worked.

Pay leveling, or the “all salaries” concept, also mitigates the effects of a decrease in any portion of the total pay package when the twelve-hour shift is adopted. Each employee is then paid the same wage each week, based on his average rather than actual weekly hours worked or paid for. Pay for unscheduled overtime is added to the average weekly wage as it occurs.

Further pay problems are presented by the Walsh-Healey Act, which requires that a firm contracting with the federal government for amounts in excess of \$10,000 must also pay overtime for any hours worked over eight in one workday. For plants affected by Walsh-Healey, the most feasible method for maintaining constant costs is through a reduction in base wage rates. For example,

Figure 6

An Example of Pay Schedule Revisions for Firms Affected by the Fair Labor Standards Act

Base Pay—\$6.00 per Hour	Eight-hour Shift	Twelve-hour Shift
1. Base pay without unscheduled overtime		
a. 52 weeks at 40 hours/week	\$12,480.00	
Overtime: 8 hours x 13 days x 1.5	936.00	
	\$13,416.00	
b. 26 weeks at 36 hours/week		\$5,616.00
26 weeks at 40 hours/week		6,240.00
Overtime: 26 weeks at 8 hours/week x 1.5		1,872.00
		\$13,728.00
2. Holiday pay—10 holidays		
Average 7.5 days worked x 8 hours x 1.5	540.00	
Average 5.0 days worked x 12 hours x 1.0		360.00
Average 2.5 days not worked x 8 hours x 1.0	120.00	
Average 5.0 days not worked		000
	\$14,076.00	\$14,088.00

△ = \$12.00 yearly.

assume a plant in which an operator working on the eight-hour shift receives a base rate of \$7.50, works two hours overtime in an average week, and averages \$322.50 weekly. If the base rate remains the same, payment of time and one-half after eight hours in a day for the fourteen days worked monthly on a twelve-hour shift would average \$367.50 weekly, a difference of \$45.00. In order to equate weekly pay under the two schedules, the hourly base rate must be decreased to \$6.58 on the twelve-hour shift.⁵ Additionally, hours worked outside the normal schedule must be compensated at 1.7093 (instead of 1.5) times the newly adjusted base rate in order to equate unscheduled overtime pay on twelve-hour schedules with the previous pay for such hours on an eight-hour schedule. Finally, holiday pay must also be adjusted, and an example of that adjustment is presented in Figure 7.

In firms averaging forty-hour weeks on three-shift, eight-hour schedules, it may be possible for management to offset any cost increase of twelve-hour shifts by decreasing the number of workers necessary to cover

continuous processes. The use of shift breakers allows employees to work twenty out of twenty-eight days, thus bringing weekly hours worked to forty when eight-hour shifts are used. One shift breaker is needed for approximately every twenty shift workers. When the twelve-hour shift is adopted and the workweek is increased to an average of forty-two hours, only four employees are required—instead of the four and two-tenths required on a forty-hour schedule—to man a post on continuous operations.

At one such location employing approximately 1,100 shift workers, the estimated increase in costs was nearly \$550,000. A reduction in head-count of 55 workers amounted to a savings of \$535,000. Another location encountered a similar situation, but could not decrease the work force because of union contract restrictions. As an alternative, the unscheduled overtime hours were reduced while the size of the work force was maintained.

An interesting solution to the cost increase was implemented at one plant affected by Walsh-Healey that had used eight-hour shifts with forty-two hour weeks. The workers are given two thirty-minute unpaid breaks during the twelve-hour shift. These

⁵The issue of whether lowering wage rates to offset overtime is legal under Walsh-Healey was raised by one company attorney, but to the best of our knowledge has not been litigated.

Figure 7
An Example of Holiday Pay Revisions for Firms Affected by
the Walsh-Healey Act

Pay Rates for 10 Holidays	Eight-hour Shift	Twelve-Hour Shift
Average 7.5 days worked x 8 hours x \$7.50 x 2.5	\$1,125.00	
Average 5.0 days worked x 12 hours x \$6.58 x 2.5		\$987.00
Average 2.5 days not worked x 8 hours x \$7.50 x 1.0	150.00	
Average 5.0 days not worked x 12 hours x \$6.58 x 1.0		263.20
	\$1,275.00	\$1,250.20
Δ = - \$24.80 yearly.		

breaks are arranged between workers and their foreman so as not to interfere with operations. The result (shown in Figure 8) is that over a two-week period workers are paid for 87.5 hours as opposed to 86 hours on eight-hour shifts, an increase in cost that the company feels is well within its predetermined limits.

Figure 8

Hours Revision for Firms Affected by the Walsh-Healey Act

Week 1	36	hours in plant
	33	hours worked
	24	at straight time
	9	at time and one-half
	<u>37.5</u>	total hours paid
Week 2	48	hours in plant
	44	hours paid
	32	at straight time
	12	at time and one-half
	<u>50</u>	total hours paid
Two-Week Total = 87.5		

Shift differentials. Shift differentials have presented no impediment to the change from eight-hour to twelve-hour shifts and have been approached in two ways. During a twenty-eight-day cycle, an eight-hour shift worker normally receives pay that includes shift differential for fourteen days—seven worked during evening shifts and seven during night shifts—for a total of 112 hours with shift differential. To equate pay received, the new number of hours payable with differential must simply be divided into the former total differential compensation figure. If the differential is, for example, 5 percent on evening and night shifts, the average differential for all three shifts is 3.33 percent. On a twelve-hour schedule, the night shift would then receive a differential of 6.66 percent.

One other option is to maintain differentials paid on eight-hour shifts. That is, on a twelve-hour shift, differentials might be structured as noted in Figure 9.

Figure 9

Example of Shift Differentials for Eight- and Twelve-Hour Schedules

Eight-Hour Schedule	Twelve-Hour Schedule
7 A.M.-3 P.M.—none	6 A.M.-7 A.M.—60¢
3 P.M.-11 P.M.—40¢	7 A.M.-3 P.M.—none
11 P.M.-7 A.M.—60¢	3 P.M.-6 P.M.—40¢
	6 P.M.-11 P.M.—40¢
	11 P.M.-6 A.M.—60¢

Although such a system maintains differential payments, it is cumbersome and adds unnecessary administrative difficulties.

Overtime manning. Although employers switching to a twelve-hour shift were able to prevent an increase in unscheduled overtime costs, they encountered many problems in manning. It is common practice, when necessary, to hold workers over after eight hours of work, but this is discouraged after twelve hours and is possible only up to a maximum of four additional hours.

Several systems for ensuring coverage have been established, but they have not been totally successful. One is the “spareboard” system, which requires certain workers to remain at home on their day off for one hour prior to the beginning of a shift and one hour following its end so that they are available should they be needed for coverage. One plant issues “beepers” to workers assigned to the spareboard, a practice that increases their flexibility somewhat. The disadvantage to this system, however, is that most employees feel that they do not actually have a day off if they must worry about the possibility of being called into work.

Unscheduled overtime. Another set of problems arises over the need to keep unscheduled overtime compensation constant with the shift to a twelve-hour schedule. To do so requires some sort of adjustment. The first and most popular method is simply to pay for overtime hours at one and one-half times the former eight-hour base rate. The second method (see Figure 10) involves using an appropriate multiplier which, when applied to the adjusted base rate, will

yield a sum equal to one and one-half times the former base rate.⁶

Figure 10

Examples of Overtime Premium Rate Adjustment

Former Rate	$\$7.50 \times 1.5 = \11.25
Adjusted Rate	$\$6.582 \times 1.7093 = \11.25

As indicated, there appear to be no adverse effects on costs of unscheduled overtime as a result of the modified workweeks. One Canadian plant experienced a decrease from 7.025 percent (total unscheduled overtime/straight time) during a year with eight-hour shifts to 4.1 percent during the first year on twelve-hour shifts. This decrease was attributed to four main causes:

1. Absenteeism decreased, thereby requiring fewer overtime replacements.

2. In “shutdowns” lasting nine to ten hours, it is normal procedure to have the same operator open and close the equipment; it was formerly necessary to hold an operator over in order to do so. With twelve-hour shifts, this overtime is generally eliminated.

3. During long “shutdowns,”⁷ three shifts were previously involved, whereas now there are two; thus, the possibility of errors in communication between shifts, and of the subsequent overtime, is decreased by one-third.

4. This particular location employed six operators-in-training after the change to the twelve-hour shift; consequently, there was less need to call in men to work overtime.

Thus, despite efforts toward minimizing difficulties, coverage of overtime remains a concern. Workers opt for twelve-hour shifts in order to obtain more usable leisure time, and the necessity of unscheduled overtime removes some of the attraction.

⁶This is the same adjustment as described previously for firms affected by the Walsh-Healey Act.

⁷Such “shutdowns” are used for major maintenance and preparation for new products. Production is shut down, but work is often heavy.

Union Relations

It is noteworthy that of the fifty plants visited only three were unionized and that, of these three, not one was organized by an AFL-CIO-affiliated union.⁸ At the union locations, the initial force behind the shift had been the unions themselves, although the independent union at one plant eventually balked when the leaders felt that management was undermining their power through the way it attempted to introduce the change. In general, organized labor has not favored a longer workday because it runs counter to the traditional union push for shorter hours—even though the twelve-hour shift does not result in any loss of weekly pay. Also, of course, the twelve-hour shift does not result in equal pay for *less* work, as does the union push for shorter weekly hours with no loss of weekly pay.

One of the three unionized plants visited is a large Canadian facility that had encountered some difficulty with a union over the new schedule. The plant had been in the process of starting production when it planned to begin use of the twelve-hour shift. Employees had elected representatives of a union that was not in favor of the schedule. Workers at the plant, however, threatened to decertify the union unless the schedule was agreed to; the result was a unionized plant using the twelve-hour schedule.

Although the managers interviewed felt that the major objection of unions to the shift was a philosophical one, a union representative felt somewhat differently. He claimed that unions’ major concern was the exposure of workers to unhealthy environments for long periods under the twelve-hour schedule. He questioned whether the Occupational Safety and Health Act of 1970 (OSHA) would allow exposures to dangerous environments to be tabulated on total weekly hours as opposed to daily hours and whether an increased daily exposure might sometimes prove harmful. He raised similar questions about the legality and desirability of overtime work and pay practices on a twelve-hour

⁸There are, however, a few AFL-CIO-unionized plants (that were not visited) on the twelve-hour shift.

schedule. Whether these concerns were real, or rationalizations of union policies, is not known. (The question of exposure is further discussed below.)

At many of the nonunion plants visited, management reported rather frequent, but unsuccessful, attempts at unionization. Management generally felt that moving to the new schedule was a positive factor in keeping workers satisfied and, therefore, allowed it to retain a flexible, union-free operation. In fact, it is likely that management sees the twelve-hour shift as a force in maintaining nonunion status, which is already widespread in the chemical and petroleum industries in North America.⁹

Nonwage Factors

A number of important nonwage factors—safety, absenteeism, turnover, applicant supply, and size of work force—were examined to determine the impact of the twelve-hour shift. A major consideration with the fewer, but longer, days associated with twelve-hour schedules is the fatigue factor and its relation to safety. None of the fifty locations surveyed in this study, however, reported increased accidents as a result of twelve-hour shifts. Management cites a number of factors responsible for the maintenance of safety. Because of prior fears about possible deterioration of safety performance, management placed increased emphasis on precautionary measures with the implementation of a twelve-hour schedule. Employees, too, recognized that they might be more likely to make mistakes because of fatigue. Whether this greater conscientiousness and good safety performance will remain over the years cannot, of course, be predicted.

Most firms were unable to supply hard data supporting these conclusions. Four locations, however, were experiencing the longest periods in their history without lost time because of injuries: for three, more

than 2 million manhours—and for one, 10 million manhours—without a lost-time injury.

One area of potential difficulty, already cited as part of union opposition, arises from OSHA's specified threshold limits of exposure to various substances in the work area and to noise levels, which are based on exposures of eight hours in length. A concern was expressed that OSHA regulations, which are not yet formulated for noise, might specify, for example, that exposure to 90 dBA (decibels) of sound would be acceptable for eight hours, but that, on a regular basis of twelve hours' exposure, the threshold limit would be 86 dBA. In some instances, a restructuring to meet OSHA's requirements would prove too costly and would result in a return to eight-hour shifts. This potential remains speculation at this time.¹⁰

Absenteeism and turnover. The majority of managers surveyed initially looked to the area of absenteeism for a possible benefit from the twelve-hour shift. In only six instances, however, were actual improvements cited, and in only one case was it considered significant. None of the plants, it should be noted, had serious absentee problems prior to the changeover to the twelve-hour shift.

Another expected benefit was improvement in turnover. Despite substantial sacrifice in wages and sometimes the forfeit of seniority, the movement of shift workers to days had been a steady occurrence in many plants under the eight-hour schedule. Plants attempted to balance shift crews by experience for efficiency as well as for training of the more junior workers during shifts. The steady migration made manning somewhat difficult, especially as more and more senior workers transferred, and both training and balance suffered. Plants surveyed generally revealed that final terminations have held constant and internal turnover,

⁹According to its chief personnel executive, "... Goodrich is installing three-day, 12-hour shifts per week at some of these [nonunion chemical] plants—but only after workers approve the idea by a two-thirds vote." "Embattled Unions Strike Back at Management," *Business Week*, December 14, 1978, p. 56.

¹⁰For an analysis of the effect of OSHA in the chemical industry, see Herbert R. Northrup, Richard L. Rowan, and Charles R. Perry, *The Impact of OSHA*, Labor Relations and Public Policy Series, Report No. 17 (Philadelphia: Industrial Research Unit, The Wharton School, University of Pennsylvania, 1978), pp. 171-418.

in the form of transfers from shift work to day work, have showed improvements in many cases.

Even when statistics were unavailable to show evidence of increased satisfaction, management felt that some usually existed on twelve-hour shifts. Actual percentages expressing total internal turnover changed in some cases; in others they remained approximately equivalent. There was even evidence of some day workers' desire to go to a twelve-hour shift. Management at a synthetic rubber operation stated that, of every four production workers on day work, one has asked to be transferred to shifts. In addition, two operating foremen at a textile fiber works location who requested transfers mentioned the long stretches of time off associated with "twelves," along with continued pay differentials, as the reasons for their requests. Additionally, both felt greater pressure during the day because changeover and heavier maintenance occurred then.

Applicant supply. Increases in applicant supply were reported by eight of the locations visited, these plants being located in areas where the twelve-hour shift was becoming prevalent. The improvements, however, were in no instance quantified. Most of these managements believed that the greater number of applications was attributed to their company's willingness to innovate and to the new schedule's relative attractiveness as compared with an eight-hour schedule.

Thirteen other plants visited reported no perceivable difference in their applicant supply. Thus, the reports suggest that an implementation of twelve-hour shifts will not harm applicant supply and may improve it.

The employment manager at one plant—the only one in its area with a twelve-hour shift—has had difficulty convincing applicants that a plant with a twelve-hour shift is a good place to work. After employees are hired and have experienced it, however, they become very supportive of the schedule.

Size of work force. In most cases, the work-week continued to average forty-two hours (alternating thirty-six and forty-eight-hour weeks) and the number of employees re-

mained the same with the introduction of the twelve-hour shift. Three of the fifty plants, however, actually reduced their shift work force by changing the average week from forty to forty-two hours. These plants let attrition shrink the number of workers to the new required level. Although wages per worker were increased commensurately, the cost increase was more than offset by the savings.

A fourth plant, which had used forty-four-hour weeks, decided to reduce unscheduled overtime rather than decrease the work force. During management-union discussions to formulate the new shift policy, the independent union that represented the workers at this plant had protested against any reduction in size of the work force. As a result, shift breakers were made part of the regularly shifting crews, causing some excess but allowing a corresponding decrease in overtime payments.

Most Canadian plants kept an average of forty- rather than forty-two-hour weeks through use of a "compensatory" or "extra" day off once every six weeks. Reliefs for workers on days off were built into each crew. One plant, with a modified schedule of forty weeks of forty-eight hours, actually increased its work force. There, the average hours in a week were 38.8, and 4.33 workers were required to man any one position continuously—an increase of 0.13 men over the previous 4.2 workers (approximately a 3 percent increase). Each employee's wages were reduced as a result of the shorter week, but total wages at the plant were increased. It should be noted that this plant was not unionized.

Productivity and efficiency. Productivity in the industries surveyed is dependent primarily on technology employed rather than manpower. Still, management felt that there was an improvement in the manner in which the workers discharged their duties, which was evident in several areas: improved shift relief, decreased turnover, and better employee attitudes. Communications, however, were not always better.

Shift relief was generally smoother because, for a three- or four-day period, only two crews were involved, and daily shift changes were decreased from three to two,

thereby decreasing the chance of error. Communications between the two crews gained greater continuity during the workday through mutual dependence and greater cooperation among workers. With only two crews involved, the crew relieved in the morning would relieve its replacement twelve hours later.

The area in which communications were most widely improved was the interaction between production and maintenance workers. On the previous schedule, regular maintenance would begin on the day shift. Since both maintenance and production began the workday at the same hour, the maintenance worker would often need to wait for the operator to shut down the machine. Once maintenance began, it frequently carried over into the next shift, with the equipment being restarted by an operator different from the one who had shut it down. The day-shift operator would feel no need to pay close attention to the maintenance undertaken, and the following-shift operator would not have been present during most of such activity.

With the twelve-hour shift, on the other hand, operators would most frequently arrive at the plant one or two hours prior to the regular maintenance day shift. Equipment scheduled for maintenance or needing repair could, therefore, be prepared prior to the arrival of the maintenance worker so that he could begin work immediately. Furthermore, since the operator realized that he would most likely be required to restart the machine, he paid more attention to the actual maintenance work.

In other areas, minor communications problems were cited. Interaction between shift workers and management and communications between shifts after the three- or four-day break were occasionally impaired. Whereas the eight-hour shift found workers in the plant for twenty-one of every twenty-eight days, the majority of twelve-hour shifts required only fourteen out of twenty-eight days. The former schedule made interaction between workers and administrators much more convenient because operators would be at work during normal hours on weekdays for ten days each month. With twelve-hour shifts, production

workers' hours in the plant coincided with management's only five days each month. The opportunity for contact, then, was decreased by 50 percent. It would have been necessary for administrators to come in at night or on weekends or shift workers to sacrifice part of their time off to keep communications at their former level.

A more serious difficulty arose as a result of the longer breaks between work periods. Days off ranged from two to as many as eight under some schedules. Eight-hour schedules provided for much shorter and less frequent time away from the plant, the longest period being three days, which occurred only once every twenty-eight days. After implementing twelve-hour shifts, it was found that there was a need for heavier reliance on written communications. A three- to eight-day stretch would occur, during which time two crews would have no idea of what had occurred at the plant. Additionally, the crews that relieved each other after such breaks were infrequently in contact with one another, and efficient passage of information was further impeded. During longer breaks, there was also a greater chance of a "forgetting factor" and, therefore, a need for some reorientation upon returning to work.

Management saw these factors as causing less continuity in the work flow and attempted to ameliorate the effects in various ways. The most common method was increased emphasis on log keeping. Supervisors were required to maintain in-depth records of all occurrences during their shifts in order to provide the relieving crew with a complete picture of production, maintenance, and special circumstances over their shift period, as well as planned operations for the near future. In some locations, tapes were used, as well as logs, giving greater assurance that all events would be recorded and making the record keeping somewhat easier for the supervisor. Supervisors were required to remain in the plant further into relief periods than previously to assure that all information was understood. In spite of these precautions, the relieving crew generally needed more time to become reacquainted with the operations, and continuity was affected.

It appears, therefore, that the gains and losses in efficiency are mainly a result of communications, and that those relative effects tend to balance. The enthusiasm, or lack thereof, for the modified schedule can be expected to have colored management's perceptions of the effects. It does appear, however, that where deleterious effects occurred, management was devising various corrective measures so as not to jeopardize the benefits derived from the new scheduling.

Moonlighting. Although not a major concern at any plant visited, moonlighting—holding a second job—was a factor in considering the possible effects of a twelve-hour shift. It was suspected that the longer consecutive days off might increase the number of workers seeking some supplement to their income. This seemed to be true in only two instances but the sole information source for gathering these data—the grapevine—does not inspire profound faith. Moreover, the experience is much too short to determine whether second jobs will prove more appealing.

Morale. Although the twelve-hour shift had varying effects on other factors, improved employee morale was noted by all the personnel directors interviewed as the major benefit of the new schedule. Shift workers reportedly stated that many of the onerous aspects of their work had been removed, that they were more satisfied with their company, and that they were generally enthusiastic in their support of the schedule.

Companies reported, however, that the degree of enthusiasm varied somewhat from group to group at different plants, with older workers being somewhat less fervent in their support. The most enthusiastic supporters of the schedule were young, unmarried workers who presumably had greater opportunities for socializing, sports, and hobbies. The least enthusiastic were the older workers who had developed life-styles suited to the previous schedules, which they found being disrupted. One difficulty mentioned was the early starting time. Whether this will continue to be a problem as the new schedule becomes old remains to be seen.

One side benefit that contributed to better morale was the decrease in commuting cost for many employees. One company calculated that an employee driving a round-trip distance of forty miles (the average for the company's employees) at \$0.14 per mile saved \$510 per year. Another plant reported that travel time was cut by a full 30 percent.

*Physical health.*¹¹ Management reported no increase in physical problems among workers on the twelve-hour shifts. Two plants that conducted surveys after more than one year's experience found that approximately 86 percent of the workers reported no change or some improvement in their physical stamina. Percentages indicating a change for the better varied somewhat, however; one plant found that 43 percent of the workers perceived a definite improvement, while the other discovered 80 percent in the affirmative. Variations may be attributable not only to differences between groups questioned, but also to differences in questionnaires used by the plants. In spite of this variance, it is clear that improvements of some degree occurred at the two locations.

In a DuPont plant in South Carolina that adopted the twelve-hour shift, 82 percent of the workers reported that they could sleep as well as, or better than, under the former schedule. This could be interpreted to mean either that they actually slept more or that the hours slept were more refreshing. A plant spokesman said that "it seems easier to get to sleep at 7:00 A.M., after a twelve-hour shift than at 9:00 A.M., after an eight-hour shift."¹² One worker in his middle thirties reported that, although he slept fewer hours, he felt more rested. On the eight-hour shift, after working the afternoon (4:00 P.M. to 12:00 P.M.) shift, he would sleep from 12:30 A.M. until 11:00 A.M. On the modified schedule, he would sleep from 6:30 A.M. until 11:30 A.M. and be every bit as rested.

¹¹For further insight into the effects of shift work on physical health, see Mott et al., *Shift Work*.

¹²David Robison, "DuPont's 12-Hour Shift Improves QWL and Employee Self-Esteem at Six Continuous-Process Plants," *World of Work Report*, Vol. 3, No. 2 (February 1978), p. 19.

Another interesting effect experienced by a number of workers was that they felt hungry more frequently. One said that the greatest effect he perceived of modified schedules was his own weight gain.

Although workers in their early middle age or younger reported physical improvements such as less fatigue, better appetites, and overall physical well-being, some older workers cited opposite effects. Such results may derive from the older person's lack of ability to adapt physically, as well as from the unwillingness to accept a change in schedule. Workers who had originally voted against trying the shift often were the ones who complained about its conditions, even though in some instances they did like the schedule more than they had thought they would prior to its implementation.

Management's Perception of the Twelve-Hour Shift

Corporate and plant management's views were influenced directly by workers' reactions to the newer schedule. Because management had instituted the change largely as a result of employees' desires to overcome some of their problems as shift workers, any benefits derived by management were regarded as a bonus. The prevailing attitude was one of accommodation, as evidenced by the willingness to give the new schedules a trial; management felt that, if employees were more satisfied and the plant continued to run smoothly, its job was made that much easier. Moreover, management clearly saw the twelve-hour shift, and the employee-employer cooperation in implementing it, as a bar to unionism. Nonetheless, in the transitional period the administration of the change was an additional burden to management.

At the same time, a few managers considered the desire for more convenient scheduling just the tip of an iceberg. They felt that continuing pressure to change working conditions would be brought to bear by workers whose attitudes regarding employment were changing. Thus, the institution of the modified schedule was seen as a step in the right direction for both management and employees. Few or no additional costs

were incurred, and workers felt they had shorter workweeks while working the same number of hours.

Management was also concerned about future developments under the Occupational Safety and Health Act. Although OSHA officials have not made any definitive ruling on this issue, most plants involved indicated that an adverse ruling would require immediate reversal to "eights."

Disadvantages commonly mentioned by management about the inherent qualities of the new shift agreed with those expressed by workers: the long number of hours in the plant and the fact that, though an improvement, it still had some limiting factors common to all shift schedules. Management's greatest concern remained the safety of the workers. As reported earlier, fatigue and accident rates were carefully observed during the first trial periods. The areas generally found to suffer during trials were communications, training, and overtime coverage, all of which have been discussed above.

Overall, the modified schedule, when implemented at employee request or with employee concurrence, reinforces management-employee solidarity. It is noteworthy that, at the one plant where the schedule was implemented without ascertaining employee attitudes, worker reaction was not favorable and resulted in the reinstatement of the former schedule. Managers who had witnessed this process felt that it was a result of management's forcing the new shift on employees.

Concluding Remarks

Twelve-hour shifts are not a total solution to the problems of working shifts, but as long as operations run continuously, no schedule will be able to remove the undesirability of late-shift and weekend work entirely. The importance of the modified schedule lies in its provision for fewer interruptions to the normal functioning of the workers' private lives. The social and familial advantages derived from this schedule have in many instances been the key to a more satisfied work force.

As with any system, however, there are some drawbacks. Older workers who have become accustomed to eight-hour shifts and are more susceptible to fatigue may be less than enthusiastic. Because double shifts cannot be used, overtime coverage must be a greater concern unless overtime practices are adjusted. Legislation may conceivably make the shift infeasible in the future through stricter standards of OSHA exposure limits or through extended coverage of the Walsh-Healey Act.

When disadvantages are weighed against advantages, however, the scale tips heavily in favor of the modified schedule. The major attribute in favor of the shift is the overall effect it has had on employee morale. Actual operations may have improved slightly in some areas, while difficulty arose in others, but in every case, morale was reported to be improved. The characteristics of the schedule have been important, but perhaps of equal note is the fact that employees initiated the change and usually played a major role in its implementation. Because the shift in use was chosen by employees, it could be expected that their reaction to it would be favorable.

One must remember that the twelve-hour schedule in its present arrangement is a relatively new phenomenon and that most workers employed under it can compare it to previous experience with the eight-hour schedule. As workers become used to "twelves," it is quite possible that new complaints will surface, based on long hours and night work, but it is unlikely that returns to eight-hour shifts will result except where shortened workweeks become prevalent.

Such changes would require a larger work force and substantially increased costs. Yet it is difficult to predict precisely what the situation will be when the "honeymoon" is over.

In the near future, twelve-hour shifts will probably continue to spread in the chemical and petrochemical industries. Other industries with similar work requirements may be attracted by the idea as well, but operations that require more fatiguing physical labor will probably prove more hesitant. The paper-manufacturing industry has begun to experiment with similar shifts, both in Canada and in the United States, indicating that the twelve-hour concept may be spreading into a highly unionized industry. If it does, unions may find it quite difficult to resist such change.

As shift workers become less tolerant of their situations, the demands for better schedules will increase. Shortened workweeks may be one approach, but new schedules hold much more potential. It is something of a paradox that workers seem very pleased to ameliorate their situation by returning to the disdained twelve-hour day of the past. Fewer of these days are worked, of course, than were worked in earlier years; so the picture is changed greatly. Still, as social values and modes of work change, innovation should not be hampered by historically held proscriptions. In its new form, the twelve-hour shift seems to have improved the lives of many workers. The success of such schedules depends on the willingness of management and workers to innovate together for their mutual good.