

# CIRCADIAN® Report

2019

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## Advantages and Disadvantages of 12-Hour Shifts A Balanced Perspective

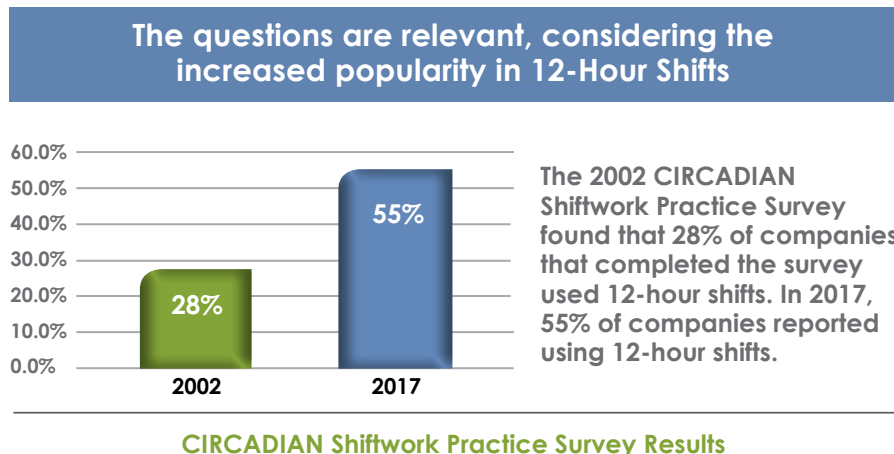


# CIRCADIAN®

24/7 WORKFORCE SOLUTIONS


## INTRODUCTION

Twelve-hour shifts are still one of the most frequently debated topics in shift work management. Managers, shiftworkers, union representatives, federal regulators, corporate policy-makers, and academic experts continue to question and debate how 12-hour shifts compare to 8-hour shifts. Are they safe? What is the impact on performance, productivity and quality? What effects do they have on shiftworker alertness, health and family life? Do they cause problems for management or shiftworkers?



In our role as the leading consulting firm in shiftwork management, CIRCADIAN is frequently asked whether the concerns about 12-hour shifts are justified and whether the enthusiasm of the proponents of 12-hour shifts is merited. We are also frequently asked to help plants solve the wide range of practical issues surrounding the successful implementation and management of 12-hour shifts, not the least of which is what schedule out of the myriad of 12-hour shift schedule possibilities, is the best one for their site.

Despite their popularity, there is still not a large amount of research evaluating 12-hour shifts in actual industrial operations. The first source of data was laboratory studies on alertness, sleep and human performance. Full scale simulation studies that we have conducted at the Institute for Circadian Physiology indicate that fatigue and loss of alertness are not increased with 12-hour schedules, as compared to 8-hour schedules. However, in reality it is almost impossible to recreate all of the variables of the workplace in a laboratory setting. Therefore, the experience and data from the workplace is the most important to consider.



CIRCADIAN data presented in this report are based on the shiftworker database, which includes surveys completed by over 50,000 shiftworkers and data from the Shiftwork Practices Survey.

CIRCADIAN consultants have gathered a great deal of first-hand information from surveying organizations who use 12-hour shifts, to learn about the practices, policies, results and impacts. Over the last two decades, CIRCADIAN has also collected considerable data on the benefits and complications of 12-hour shifts through our work with utilities, chemical plants, oil refineries, pulp and paper mills and other industries running 24 hours, 7 days a week. During this process, we have surveyed tens of thousands of shiftworkers and conducted interviews with thousands of managers, superintendents, supervisors, shiftworkers, regulators and shift schedule specialists. CIRCADIAN data presented in this report are based on the shiftworker database, which includes surveys completed by over 50,000 shiftworkers and data from the Shiftwork Practices Survey, that periodically collect information from managers of 24/7 operations.

We are often asked if we know of any places where 12-hour shifts failed and people returned to 8-hour shifts - and the answer is yes. In the few cases where this has occurred, it was usually a result of management making decisions without a careful consultation with the employees. As a result, the employees misunderstood and distrusted the motive for the change and did not provide the needed support to make the 12-hour shifts work. Employee support is required for any scheduling change to fully succeed, and this is true for 12-hour shifts as well, particularly when it comes to ensuring coverage for vacations and other absences. The other cause for returning to an 8 from a 12-hour shift is the use of excessive, mandatory overtime usually due to understaffing, which negates the advantage of 12's (i.e. more days and weekends off).

## ADVANTAGES OF 12-HOUR SHIFTS: A management perspective

The major advantages of 12-hour shifts from the management perspective, as experienced by Human Resource Managers, Shift Supervisors, Department Superintendents and Plant Managers are the following:

- **Increased productivity, reduced errors.** There are only two shift turnovers per 24-hour day instead of three. Thus, there are fewer opportunities for miscommunication when there is a changeover in shiftwork personnel. There is less disruption of ongoing operations and reduced potential for errors. Because productivity often drops significantly and error and accident rates increase in many operations during shift transition times, this simple difference between 8-hour and 12-hour shifts has been found to have a significant impact on productivity and error rates. Reducing these "high risk" low productivity and high error periods by one-third can have significant financial and efficiency benefits for the operation.
- **Increased continuity and accountability.** On most days, crew A turns the plant over to crew B at night, and then crew B turns the plant back to crew A the next morning. No one finding a problem can "pass the buck" to a third crew, as may occur with 8-hour shifts. Crews are motivated to "do as they would like to have done to them" which is to hand over and receive the plant with the problems fixed or at least identified and communicated.
- **Reduced adaptation time.** Many shiftworkers need a ramp-up period to get adjusted to each shift, i.e., adjusting monitors and organizing tools, etc. Some shiftworkers state that they are "in the groove" at the 8-hour point, and would rather continue than having to readjust to getting started again the next day.
- **Higher project completion rates.** A greater number of long tasks and projects can be completed within a shift, such as extended maintenance tasks. On 12-hour shifts, several more hours remain to accomplish the work plan; crews are able to complete more of the procedures that they begin. Most maintenance tasks require extensive lock out/ tag out procedures. If the tasks are not completed by the end of the shift, substantial time is lost in preparing for a safe crew change over. This can occur 3 times a day with an 8-hour shift and only twice a day with 12-hour shifts.
- **Reduced absenteeism.** Shiftworkers often "think twice" about taking a shift off, because doing so uses 12 hours of leave time. They also tend to feel more accountable to their crew or to the person who may need to be called in on a day off for 12 hours of relief. Thus, in plants where absenteeism is a problem, the introduction of 12-hour shifts can have a significant beneficial impact. The downside of this is that supervisors have noted that some shiftworkers who should stay home because of sickness will report for their 12-hour duty shifts. However, with more days off, there are fewer conflicts with personal and family issues that might promote absenteeism. There is more time to take care of personal needs such as doctor's appointments or a sick child. There is also a 50% chance that sickness will occur on days off, further decreasing absences and unscheduled overtime coverage, because people are only scheduled to work half the days of the year as compared to working 75% of the days with a standard 8-hour shift schedule. The 2017 CIRCADIAN Shiftwork Practices found that 63% of companies working 12-hour shift reported an absenteeism rate lower than 10%, compared to 51% of companies working 8-hour shifts.



### ABSENTEEISM: 12-Hour Shifts vs 8-Hour Shifts



CIRCADIAN Shiftwork Practice Survey Results

- **Lower attrition and turnover.** Shiftworkers usually have less interest in transferring to other plants, to non-shiftwork positions or to other occupations. Experienced employees are usually more readily retained. The increased number of days off is too compelling an incentive to encourage a return to 8-hour workdays. In an industry-wide survey of chemical plants, 96.5% of the employees working 12-hour shifts reported no interest in changing back to an 8-hour schedule. In the 2017 CIRCADIAN Shiftwork Practices 79% of companies working 12-hour shifts reported that their turnover rate was 15% or lower, compared to 69% of companies working 8-hour shifts.

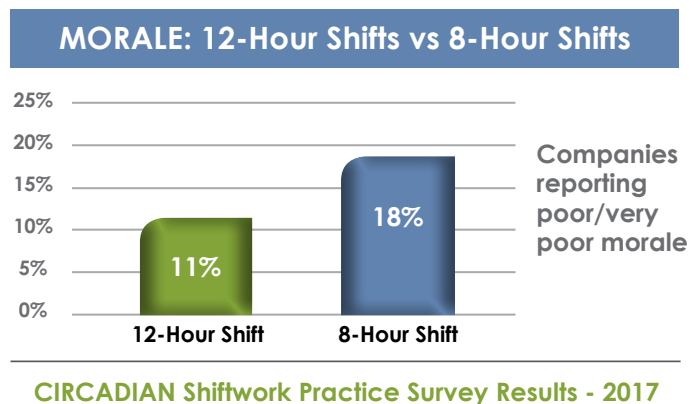
### TURNOVER RATES: 12-Hour Shifts vs 8-Hour Shifts



CIRCADIAN Shiftwork Practice Survey Results

## ADVANTAGES OF 12-HOUR SHIFTS: A Management Perspective

- **Improved morale.** Twelve-hour shifts typically prove more popular with both shiftworkers and their families. Stress is reduced, and the quality of work and home life is improved greatly. In the 2017 CIRCADIAN Shiftwork Practices 11% of companies working 12-hour shifts reported that employees had poor or very poor morale, compared to 18% of companies working 8-hour shifts.

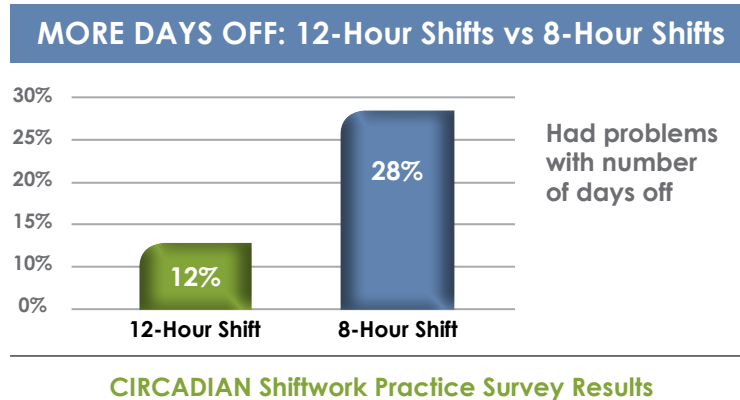


- **More “dedicated” employees.** On most days, crew A turns the plant over to crew B at night, and then crew B turns the plant back to crew A the next morning. No one finding a problem can “pass the buck” to a third crew, as may occur with 8-hour shifts. Crews are motivated to “do as they would like to have done to them” which is to hand over and receive the plant with the problems fixed or at least identified and communicated.

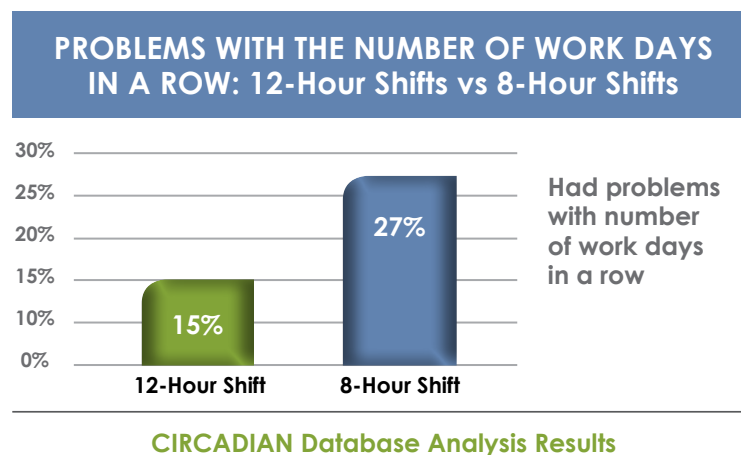
## ADVANTAGES OF 12-HOUR SHIFTS: A Shiftworker Perspective

### Major advantages from the perspective of shiftworkers and other employees working 12-hour schedules are:

- **More days off.** On a typical 4 crew 12-hour shift schedules, shiftworkers can virtually double the number of days off per year, as compared to an equivalent 8-hour shift schedule. Thus, the standard 2,184 work hours per year (42 hour average per week before factoring in vacations) can be accomplished in 182 work days instead of 273 work days with 8-hour shifts, and with 183 days off instead of 92 days off with 8-hour shifts. CIRCADIAN database analysis found that only 12% of shiftworkers on 12-hour shifts reported always/often problems with number of days off, compared to 28% of workers on 8-hour shifts.



- **Longer and better quality breaks.** There are typically 3 or 4 days off between blocks of work days instead of 1 or 2. Since there are so many more days off, the possibility increases of clustering them to provide extended time off without using up vacation days. It is even possible, with some 12-hour shift schedules to provide as many as thirteen 7-day breaks per year. In some situations, we even find shiftworkers “selling back” vacation days to the company, because a substantial portion of their needs for vacation time are satisfied by the long breaks built into the schedule. CIRCADIAN database analysis found that only 15% of shiftworkers on 12-hour shifts reported always/often problems with number of work days in a row, compared to 27% of workers on 8-hour shifts.



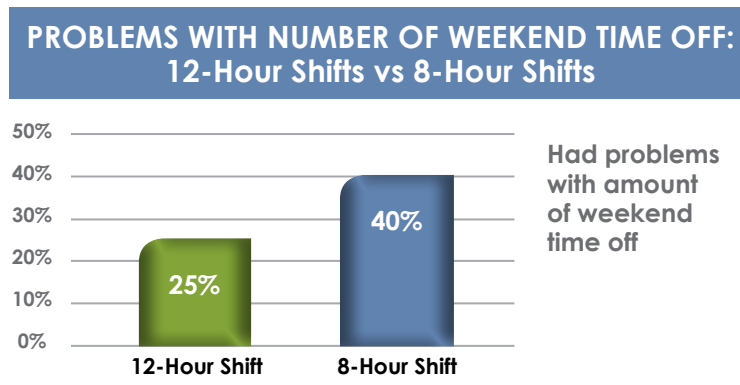
- **Fewer consecutive days worked.** Shiftworkers on 12-hour shifts typically work 2, 3 or 4 days in a row. The problems of stress and cumulative fatigue are thereby reduced, as compared to typically working 6 or 7 days in a row on 8-hour shifts. CIRCADIAN database analysis found that only 12% of shiftworkers on 12-hour shifts reported always/often problems with number of work days in a row, compared to 27% of workers on 8-hour shifts.

## ADVANTAGES OF 12-HOUR SHIFTS: A Shiftworker Perspective

- **Less commuting required.** Fewer days at work mean fewer days of driving to and from work. This represents substantial time saving and reduced transportation costs for employees with long commutes. For example, a 90 minute (82.5 mile) round trip commute and 91 fewer days to work per year means 136.5 fewer hours of commuting time annually (or the equivalent of seventeen 8-hour work shifts) and 7,507.5 fewer commuting miles. This represents \$4,354.35 in reduced transportation pre-tax costs per year.

- 82.5 miles driven a day x 91 fewer days to work = 7,507.5 less commuting miles driven a year.
- 7,507.5 miles x 58 cents = \$4,354.35 saved in driving costs.

*Jan. 1, 2019 standard mileage rates for the use of a car (also vans, pickups or panel trucks) will be 58 cents per mile driven for business use.*



**CIRCADIAN Database Analysis Results**

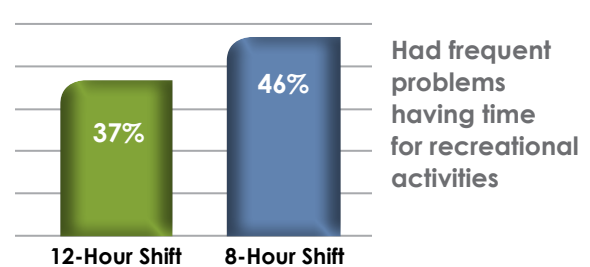
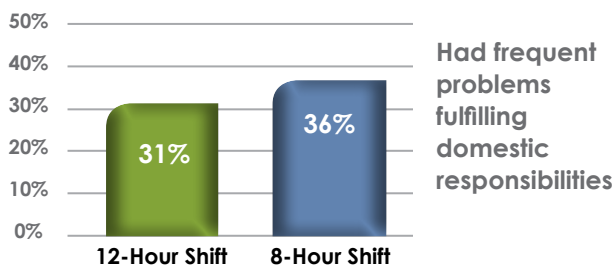
- **Twice as many weekend days off.** Shiftworkers typically have 2 out of 4 weekends off when working 12-hour shifts, vs. only 1 weekend off per month for most 8-hour schedules. Survey data shows that more weekend days off is a very high priority for shiftworkers and having only 1 weekend off per month keeps the shiftworkers further isolated from the rest of the Monday-to-Friday, daytime working world and his or her family. CIRCADIAN database analysis found that only 25% of shiftworkers on 12-hour shifts reported always/often problems with amount of weekend time off, compared to 40% of workers on 8-hour shifts.
- **Improved morale.** Having more days off relieves stress and improves shiftworkers outlook and attitude. Family members can often become more supportive, further helping morale.
- **Improved family and social life.** Shiftworkers often report improved family life because there are more “quality” days off to spend at home. CIRCADIAN database analysis found that 31% of shiftworkers on 12-hour shifts reported frequent problems fulfilling domestic responsibilities, compared to 36% of workers on 8-hour shifts, and 37% of shiftworkers on 12-hour shifts reported frequent problems having time for recreational activities, compared to 46% on 12-hour shifts.



The least desired shift on an 8-hour schedule is usually the evening shift which keeps the shiftworkers isolated from family and friends for extended periods of time.



### FAMILY AND SOCIAL LIFE: 12-Hour Shifts vs 8-Hour Shifts



### CIRCADIAN Database Analysis Results

## ADVANTAGES OF 12-HOUR SHIFTS: A Shiftworker Perspective

- **More frequent “recuperation” or “recovery” days.** These recovery days occur after blocks of scheduled shifts, so shiftworkers feel more alert and energetic both on and off the job. Many shiftworkers need a recovery day, particularly after working nights, to catch up on sleep. With an 8-hour schedule these recovery days can consume most of the days off, leaving too little quality time for family and friends and preventing the shiftworker from feeling well rested and energetic.
- **Better use of vacation time.** Although there are technically fewer vacation days on 12's versus 8's, by taking only 2, 3 or 4 vacation days at the appropriate time in the cycle, it is possible to have up to 12 consecutive days off. Thus extended vacations are possible several times per year. With 8-hour shifts it takes 5 vacation days to get a week off.
- **Increased utilization of personal time.** With 12-hour shifts, shiftworkers have more consecutive days off and more total days off. They report that they are able to get more done at home, take care of more personal business and shopping during the week, and schedule more family and social events. With 8-hour schedules, there are seldom enough consolidated blocks of time for extended home projects and social activities.
- **Elimination of double shifts and/or holdovers.** Sixteen-hour shifts on short notice (back-to-back 8-hour shifts) to cover for absences can be eliminated. On 12-hour shifts, shiftworkers usually know exactly how long they will be working, and they can prepare and pace themselves accordingly. This benefit is offset by the degree to which workers get called in unexpectedly on their days off to cover a 12-hour shift, which in turn depends upon the success of their voluntary overtime sign up list as well as overall plant staffing levels.
- **Little effect on overtime opportunities.** For continuous operations, 12-hour shift schedules do not add to or reduce the amount of real overtime required. In 24/7 operations, overtime is a function of staffing level rather than the shift schedule, since all positions have to be filled regardless of shift length.
- **Elimination of evening shifts.** The least desired shift on an 8-hour schedule is usually the evening shift which keeps the shiftworkers isolated from family and friends for extended periods of time. 12-hour shifts minimize this problem because shift changeover times usually allow more contact with the family in the evenings. For example, a typical 8-hour evening shift runs between 3-11 p.m. and provides little to no family time in the evening. In comparison, a typical 12-hour schedule has shift start times between 6-8 a.m. and 6-8 p.m. Thus, most shiftworkers can spend some amount of quality time with their family either before or after the shift.



### Summary of Features for 8 and 12-Hour Shift Schedules


#### FEATURE 8-Hour Shift and 12-Hour Shifts

Consecutive shifts	5, 6, or 7	2, 3, or 4
Length of breaks	1-4 days	2-8 days
Frequency of breaks	Every 5-7 days	Every 2-4 days
Direction of rotation	Forward/Reverse	Forward Only
Speed of rotation	Fast or Slow	Fast or Slow
Fixed shift possibilities	Few	Many
# of shifts worked a year	274	182.5
Total days off a year	91	182.5
# of days worked/cycle	21/28	14/28
# of days off/cycle	7/28	14/28
Weekends off /year	6-13	26
# of days between weekend time off	25-91	11-35
Total hours worked a year	2184	2184
Average hours worked a week	42	42

## DISADVANTAGES OF 12-HOUR SHIFTS: A Management Perspective

### The major disadvantages of 12-hour shifts from a management perspective are:

- **Greater challenge to sustain vigilance.** Twelve hours may simply be too long for someone on monitor duty to maintain constant vigilance. A machine or console operator whose sole responsibility is to monitor a process for 12 hours may be approaching or going beyond the limits of his or her ability to maintain complete effectiveness. The difficulties to sustain alertness would present a concern in safety sensitive jobs, and some studies have found increased risk of making errors in nurses working 12-hour shifts. Other studies have not found problems for most jobs, the exception being for extremely physically demanding jobs with high task repetitions. Possible solutions in these cases include introducing less physical tasks or rotating job assignments during shifts between crew members, or re-engineering the job or work station.
- **Extended exposure to work-related stress.** For certain shiftworkers, the day shift often provides high demands of work related activity and distraction, and involves a high number of interactions with maintenance, instrumentation engineers, contractors and other support staff who work straight day shifts. This is especially true on week days. Twelve continuous hours may be a long time for an employee to deal with the stress associated with these conditions. While 4 consecutive 12-hour day shifts could be particularly fatiguing and stressful, reports to date have indicated only isolated problems in this area despite widespread conversion to 12-hour schedules.
- **Diminished communication and/or personal interaction.** Management personnel have less opportunity for interaction with crews working 12-hour shifts. Rotating 12-hour shiftworkers may only be on day shift duty for seven days during each 28-day cycle, thus decreasing exposure to day management. Shiftworkers' contacts with training staff and their availability for meetings involving management, human resources, medical and other personnel may also be reduced. Management may have to be more flexible with their own work hours in order to achieve the desired employee interaction.
- **Unequal distribution of work hours.** Over each 7-day pay period 12-hour schedules vary between 48-and-36-hour work weeks. Since Federal Law requires overtime pay for more than 40 hours work in a week, an adjustment in payroll structure and base pay rates may be required to maintain cost neutrality. Existing collective bargaining agreements can complicate this process, although this has been readily resolved with provisional amendment letters based on mutual agreement.
- **Increased risk of getting out of touch.** Long breaks away from the plant may be good for shiftworker's personal life, but not necessarily for plant operations. Too many consecutive days off may result in decreased familiarity with changes in the operation, and shiftworkers may need a period of readjustment after returning from a long break. They may need to re-familiarize themselves more often with the "big picture" of plant operations after long breaks to ensure operational "continuity."



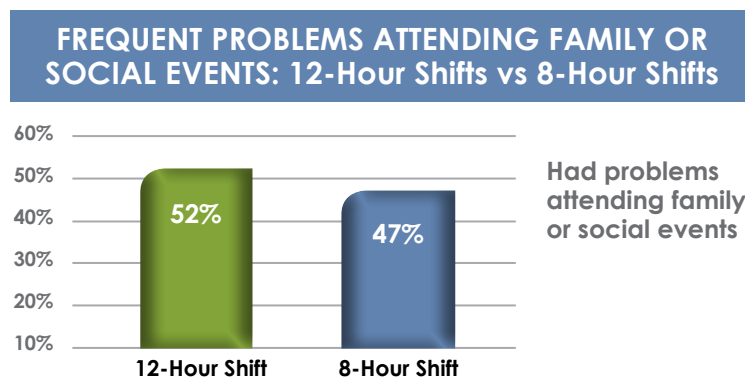
Job processes and job rotation might have to be reexamined and altered in order to reduce the physical strain on employees.

- **Potential compromise in alertness and performance.** Shiftworkers may be willing to compromise their alertness and performance on the job in order to get more consecutive days off. Some shiftworkers can lose their objectivity concerning the potential drawbacks of 12-hour shifts, and some studies have reported reduced performance with 12-hour schedules.
- **Increased “moonlighting”.** The concern that some shiftworkers will use the extra days off provided by 12-hour shifts to take second jobs, especially physically demanding construction and farming jobs, has created the perception that this will undermine the advantage of recovery days. However, there is usually only a small percentage (less than 10%) of shiftworkers that engage in this practice.
- **Increased ergonomic risk.** Potential injury problems may occur with shiftworkers who have physically demanding jobs. Although these “hands on” jobs now comprise only 16% of the total workforce, the strain of working such jobs on a 12-hour shift instead of an 8-hour shift could potentially increase physical complaints, such as back trouble and carpal tunnel syndrome. Job processes and job rotation might have to be reexamined and altered in order to reduce the physical strain on employees. Ergonomics issues need to be identified and addressed.
- **More difficult absence coverage.** Since it is not advisable to assign shiftworkers overtime hours on scheduled work days, and thereby lengthen the work days beyond 12 hours, it is necessary to establish procedures to cover unexpected absences. Depending upon the effectiveness of methods such as a volunteer overtime list supported with a scheduled (annual) call-out list, coverage for vacations and absences can become more difficult, as can scheduling for training and planned overtime.
- **Difficulties of change.** The selection and conversion to any new schedule is complex and time consuming. Effort by management to educate shift workers on the many issues associated with 12-hour shifts is often necessary to ensure informed decision-making, help ease the transition, and improve worker morale.

## DISADVANTAGES OF 12-HOUR SHIFTS: A Shiftworker Perspective

### The major disadvantages of 12-hour shifts from a shiftworker perspective are:

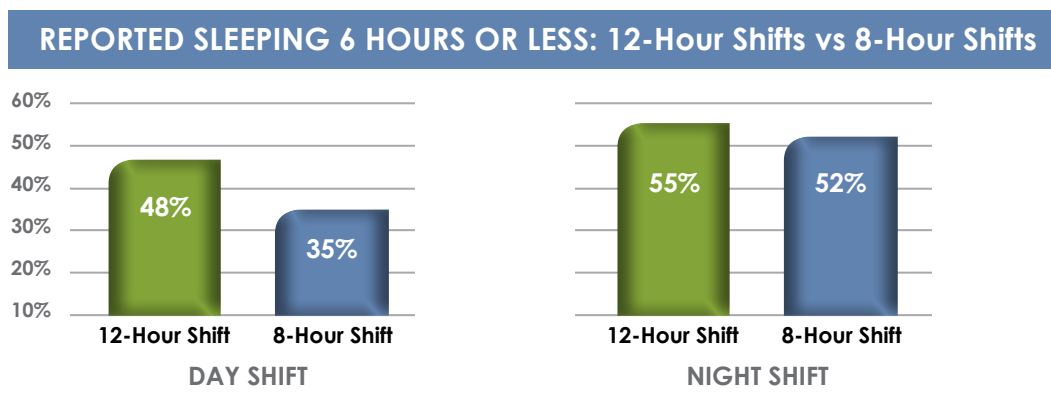
- **Limited family and social time during working days.** Shiftworkers may have less opportunity to see their spouses and children on working days. Child care and day care conflicts may also occur, since many babysitters may be unable to extend their hours and the hours of child care facilities do not correspond with shift schedules. Single workers may find it more difficult to schedule dates and activities with friends. CIRCADIAN database analysis found that 52% of shiftworkers on 12-hour shifts reported frequent problems attending family or social events, compared to 47% of workers on 8-hour shifts.



CIRCADIAN Database Analysis Results

- **Irregular pay weeks.** Most 12-hour schedules have alternating pay weeks of 36 and 48 hours. This can make it more difficult for a worker to budget his or her finances, since most people plan their finances based on a 40 hour week.
- **Concerns of older workers.** Older shiftworkers respond less favorably toward 12-hour shifts than younger workers. Many older workers are less enthusiastic about making any schedule changes, because this may disrupt their established work and social routines. They may also feel that 12 hours is simply too long for a regularly scheduled work period. In fact, it is physiologically more difficult for someone in their mid 50's or 60's to sustain vigilance for longer periods of time than it is for someone younger. There also may be fewer reasons for the older shiftworker to want to compress the work week by working longer hours; i.e., they no longer have children living at home, and frequent vacations or long breaks may be less important.
- **Reduced tolerance of long commutes.** With a 1-hour commute to work (each way), the actual time away from home for the shiftworker may approach 14 hours or more. This leaves time for sleeping and meals and little else. Daily recreational activity and exercise regimens may be compromised. Distance from home to the workplace may thus become more important on 12-hour shifts.

- **Sleep schedule inflexibility.** Hours away from work during a work day are limited, so a shift worker's optimal timing and amount of sleep may be a challenge to achieve. Sleep schedule disruption can potentially occur because of the reduced flexibility for sleep time. In contrast, on an 8-hour schedule, night shift workers can choose to sleep in the morning when they return home or stay up in the morning and sleep later in the day, depending on their sleep physiology. Twelve-hour shiftworkers do not have this flexibility, and when working nights they need to condition themselves to sleep in the morning and into the early afternoon. CIRCADIAN database analysis found that 48% of shiftworkers on 12-hour shifts reported sleeping 6 hours or less while working day shift, compared to 35% of workers on 8-hour shifts. On night shift, 55% of shiftworkers on 12-hour shifts reported sleeping 6 hours or less, compared to 52% of workers on 8-hour shifts.



CIRCADIAN Database Analysis Results

- **Difficulties in scheduling meetings.** Twelve hours is typically as long as most workers want to be on-site. Thus, if shiftworkers are asked to stay over after the night shift for training or plant meetings, the workday may be unacceptably lengthened. Consequently, many employers with 12-hour schedules conduct training and other meetings on "scheduled days off." Survey data and anecdotal information suggests that the majority of shiftworkers prefer coming in on days off for meetings (rather than staying after a shift), as long as the meetings are planned well in advance, don't last more than four hours, and occur no more than once during a four-week period.
- **Reduced tolerance to physically demanding jobs.** Such jobs can be more difficult on 12-hour shifts. Unless counter measures are taken to alleviate the problem, there may be an increase in work-related injuries and a rise in general discomfort, such as aching feet and backs. Solutions include reworking certain job processes or rotating jobs during a shift.
- **More pay lost when a day is missed.** On occasions when shiftworkers take an unpaid day off, they may lose the equivalent of 33% more pay during their absence as compared to 8-hour shifts. This magnifies their personal financial loss from absences. However, the increased number of days off means that sickness has a better than 50% likelihood of occurring during a day off, instead of on a work day.

## DISADVANTAGES OF 12-HOUR SHIFTS: A Shiftworker Perspective

### The major disadvantages of 12-hour shifts from a shiftworker perspective are (cont.)

- **Driver fatigue returning home.** Drowsiness when driving is always a concern, since it is not uncommon for workers on any type of schedule to feel drowsy or to “fight” sleep while driving home. The already difficult task of staying awake while driving home after working an 8-hour midnight shift might be assumed to be even more difficult after working a 12-hour shift. However, this concern is linked much more strongly to the time of day of commuting than to the length of the shift. Thus alertness training and other precautions can help reduce the risk of driver fatigue.
- **Fast-rotating 12-hour schedules.** Certain schedules can cause sleep problems when “flip-flopping” from nights to days, because it's hard for one's body to adjust to frequent changes. This problem can be minimized with a well-designed, biocompatible schedule that provides for sufficient recovery time between rotations.
- **Longer hours away from home in the evenings.** Extended work hours may be undesirable from the standpoint of family and home security. Watchdogs, alarm systems, and networks of telephone friends can alleviate these concerns.
- **Increased percentage of night shifts.** Instead of only one-third of work shifts being night shifts on an 8-hour schedule, one-half of the shifts are night shifts on a 12-hour schedule. This is of course counter-balanced by the reduced number of shifts worked, and also by the fact that half of the work time will occur during the day shift.

## CONCLUSION

The assessment of the merits of 12- vs. 8-hour shift schedules is a complex issue that does not have a simple answer. Clearly, there are compelling advantages for 12-hour schedules such as more time off and more weekend days off, but these are balanced by the longer working days and the questions of mental and physical fatigue. Nevertheless, the growing trend towards conversion to 12-hour schedules in most continuous, round-the-clock operations has had positive results. In fact, 12-hour shift schedules have proven to be safe, productive, and agreeable to most shiftworkers who have made the conversion from conventional 8-hour shifts. For example, in an industry-wide survey of chemical plants in the US, 96% of all shiftworkers who have converted to 12-hour schedules reported that they would not want to return to an 8-hour schedule.

Nevertheless, 12-hour shift schedules are not for everybody and not for every situation. Jobs that require heavy physical labor may not be desirable due to the possibility of fatigue and ergonomic injuries. Similarly, 12-hour schedules may be harder on older work groups and those who have to commute long distances. Moreover, there are certain types of 12-hour schedules that are extremely difficult to adapt to in terms of circadian (sleep/ wake) physiology. All 12-hour schedules are not created equal, so it is extremely important to take the time and effort necessary to determine the best possible schedule for your given shiftwork population. In the final analysis any schedule (8's, 10's or 12's) is most effective when “owned” by the employees who have to work it.



In any rescheduling endeavor, the key objective is to achieve the "best" schedule. This requires providing appropriate education to the workforce to ensure that informed decisions can be made, and involving your employees in the selection process. It is also critical that all options and alternatives (i.e. 8's, 12's, and combinations of 8 and 12-hour shifts) be thoroughly evaluated by both management and the hourly employees who have to work the new schedule. With employee involvement, it is possible to achieve a win-win situation in which the company can achieve a positive improvement in employee morale, performance and operating efficiency, while shiftworkers can enjoy the benefits that an "optimum" shift schedule can provide for their health, safety, and quality of life.

Circadian Technologies, Inc. has been helping 24/7 operations and their workers resolve these scheduling issues for over 35 years. Over that period Circadian has developed a proven approach for determining the best schedule for any given workforce. If you are interested in learning more about shift scheduling, please visit [www.circadian.com](http://www.circadian.com), email us at [info@circadian.com](mailto:info@circadian.com) or call Circadian at 1-800-284-5001.

## ABOUT THE AUTHORS

**Dr. Martin Moore-Ede** is recognized as a world leading authority and visionary on how businesses can compete successfully, and assure their employees thrive, in the emerging 24/7 economy. As a professor at Harvard Medical School he pioneered the research on how to adapt the human body to working around the clock. As founder and CEO of Circadian Technologies, Dr. Moore-Ede lectures and consults business leaders and managers around the world on the extraordinary rewards that can be gained by executing 24/7 operations with excellence.

He has published over 145 scientific articles and 10 books on the human aspects of 24/7 operations. Dr. Moore -Ede's best-selling book *The Twenty-Four-Hour Society: Understanding Human Limits in a World That Never Stops*, has been published in the United States, United Kingdom, Germany, Australia, Japan and China.

He has appeared on the CBS Evening News, Good Morning America, Today, CNN Business News, 20/20, Dateline, Oprah, and BBC-TV and PBS documentaries. He has also received numerous academic honors and awards, including recognition as one of the outstanding teachers at Harvard Medical School. Dr. Moore -Ede received his medical degrees from the University of London and Guy's Hospital Medical School, and his Ph.D. in Physiology from Harvard University.

**Bill Davis** is Vice President of Operations for CIRCADIANTM. He is responsible for management oversight on all Boston based global consulting projects, including fatigue management, scheduling optimization, and other employee health, safety and productivity initiatives.

Bill and his operations team have successfully completed many complex shiftwork related assignments for a wide spectrum of industries in the UK, Europe, South America, Africa, Australia, Russia, Asia (Indonesia, Singapore, China) and throughout the US, Canada and the Caribbean. In addition to his personal involvement in hundreds of shiftwork-related projects, Bill has extensive experience with fatigue management programs and human error reduction initiatives. These projects have been as diverse as evaluating the effects of high altitude mining (5000+ meters in the high Andes) on the health, safety and performance of heavy equipment operators, to analyzing the

## ABOUT THE AUTHORS (*Continued*)

physiological and sociological effects of working 24-hour shifts in a large, metropolitan emergency medical response force.

Prior to his tenure at CIRCADIAN®, Bill spent 10 years with International Paper as a Corporate Safety Manager and as a Plant Manager. He also spent nearly a decade with Jones and Laughlin/LTV Steel, starting as a steel mill shiftworker and working his way up the safety management ranks. This real-world industrial background provides Bill with a natural rapport with managers and employees at all organizational levels.

**Acacia Aguirre, Md, Ph.D.** Dr. Aguirre has over 25 years of experience focused on research and consulting on shift work operations with a focus on safety, health and alertness.

While working at CIRCADIAN, Dr. Aguirre has provided training and consulting support on major client engagements, including fatigue risk assessments, fatigue risk management system design, workload analysis, evaluation of employees' alertness, health and safety, scheduling and implementation of fatigue countermeasures. She has also been actively involved in publishing educational materials for shift workers and technical reports for management of 24/7 operations.

Prior to joining CIRCADIAN, Dr. Aguirre practiced as a sleep disorder doctor at one of the major teaching hospitals in Paris (France). She was also part of a research team specializing in circadian rhythms and their relationship to sleep disorders and shift work.

Dr. Aguirre received her MD from the University of Valladolid (Spain). She earned her Ph.D. in Neuroscience from the University of Paris VI (France). Dr. Aguirre has published more than 50 scientific articles and book chapters.

## ABOUT CIRCADIAN™

CIRCADIAN is the global leader in providing 24/7 workforce performance and safety solutions for businesses that operate around the clock. Through a unique combination of consulting expertise, research, software tools and informative publications, CIRCADIAN helps organizations in the 24-hour economy optimize employee performance and reduce the inherent risks and costs of their extended hours operations.

Working from offices in North America, Europe and Asia, CIRCADIAN experts ensure that over half the Fortune 500, and other leading international companies, thrive in the global 24/7 economy.

CIRCADIAN's core expertise is the staffing, scheduling, training and risk management of their most vital asset - the 24/7 workforce. Founded in 1983 by Dr. Martin Moore-Ede, a former professor at Harvard Medical School and author of the best-selling book "The Twenty-Four Hour Society", CIRCADIAN has led the development of innovative new technologies and tools to enable employees to successfully adapt to today's high performance 24/7 workplace.

## REFERENCES

- Amendola K, Weisburd D, Hamilton E et al. Shift Length Experiment: What We Know About 8-, 10-, and 12-Hour Shifts in Policing. The Police Foundation. 2011.
- Baker A, Heiler K, Ferguson S. THE EFFECTS OF A ROSTER SCHEDULE CHANGE FROM 8- TO 12-HOUR SHIFTS ON HEALTH AND SAFETY IN A MINING OPERATION. *J. Human Ergol.*, 30: 65-70, 2001
- Caruso C, Hitchcock E, Dick R et al. Overtime and Extended Work Shifts:Recent Findings on Illnesses, Injuries, and Health Behaviors. NIOSH. 2004.
- Geiger-Brown J, Trinkoff A. Is It Time to Pull the Plug on 12-Hour Shifts? Part 1. The Evidence *JONA* 40(3), 100-102. 2010.
- Geiger-Brown J, Trinkoff A. Is It Time to Pull the Plug on 12-Hour Shifts? Part 3. Harm Reduction Strategies if Keeping 12-Hour Shifts. *JONA* 40(9), 357-359. 2010.
- Geiger-Brown J, Rogers VE, Trinkoff AM et al. Sleep, sleepiness, fatigue, and performance of 12-hour-shift nurses. *Chronobiol Int.* 2012 Mar;29(2):211-9.
- Griffiths P, Dall'Ora, C, Simon M et al. Nurses' Shift Length and Overtime Working in 12 European Countries. The Association With Perceived Quality of Care and Patient Safety. *Med Care* 2014;52: 975-981
- Knauth P. Changing schedules: shiftwork. *Chronobiology International.* 14(2), 159-171. 1997.
- "IRS Issues Standard Mileage Rates for 2019." Internal Revenue Service, [www.irs.gov/newsroom/irs-issues-standard-mileage-rates-for-2019](http://www.irs.gov/newsroom/irs-issues-standard-mileage-rates-for-2019).
- Richardson A, Turnock C, Harris L et al. A study examining the impact of 12-hour shifts on critical care staff. *J Nursing Management* 2007.
- Rosa R. Extended work shifts and excessive fatigue . *J. Sleep Research* 4 Supl. 2, 51-56. 1995.
- Rosa R, Colligan M, Lewis P. Extended workdays: effects of 8-h and 12-h rotating shifts schedules on performance, subjective alertness, sleep patterns and psychosocial variables. *Work and Stress* 3, 21-32. 1989.
- Stone P, Du Y, Cowell R et al. Comparison of nurse, system and quality patient care outcomes in 8-h and 12-h shifts. *Medical Care* 42(12), 2006.

## PUBLISHER'S NOTES

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