Shift Work Schedules

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CCOHS CCHST

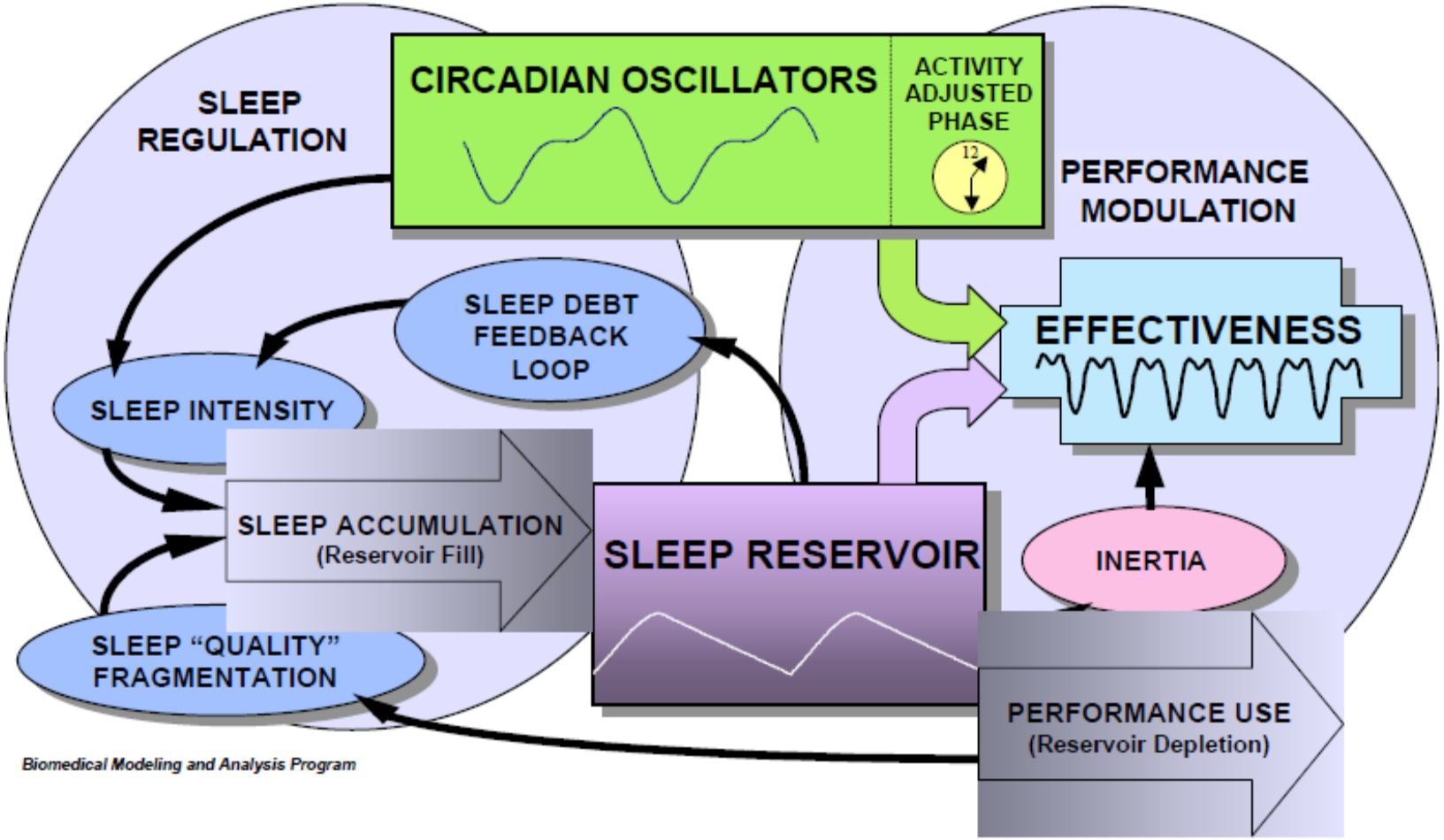
Canadian Centre for Occupational Health and Safety | Centre canadien d'hygiène et de sécurité au travail

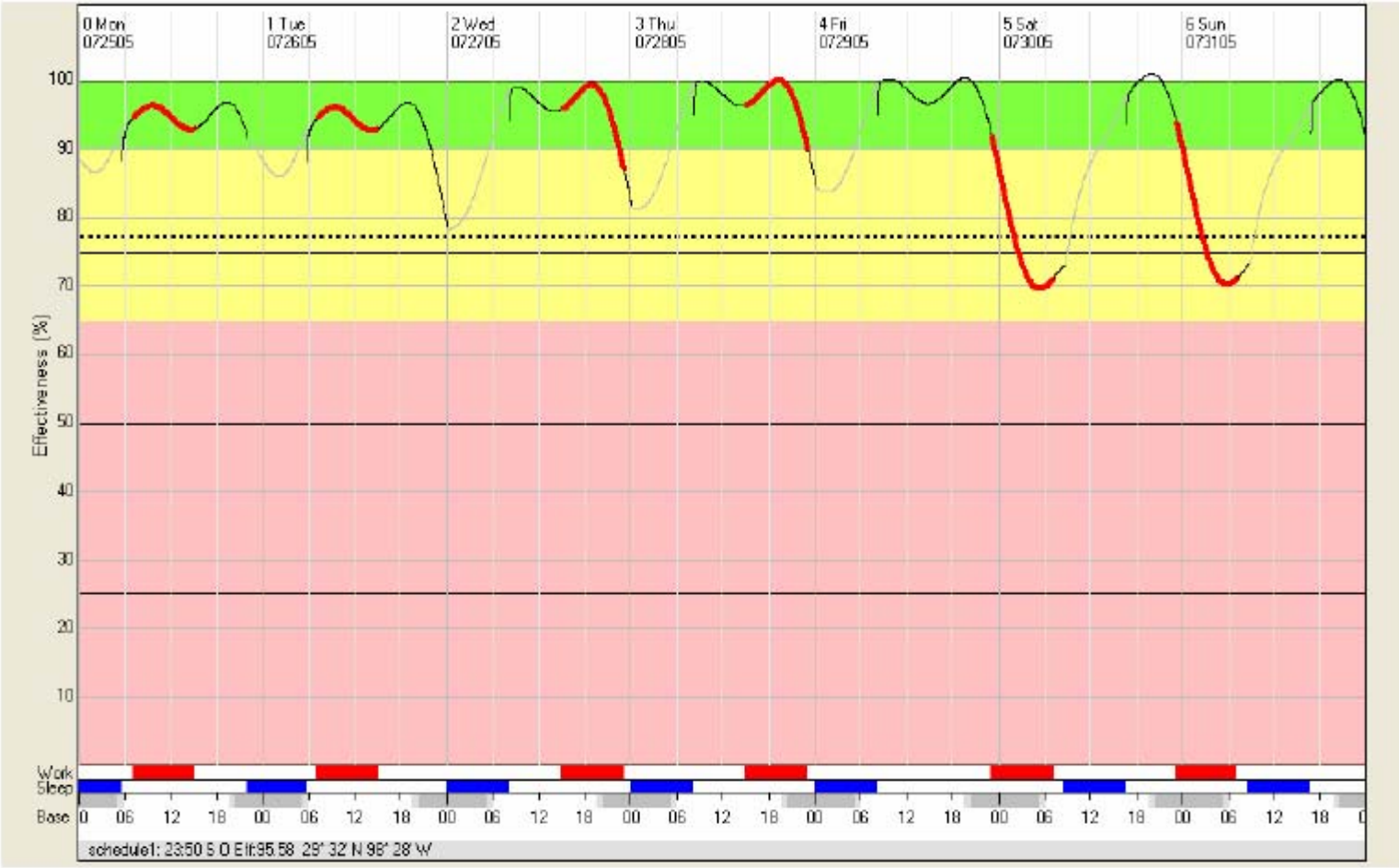
Overview

1. *A model of alertness and fatigue*
   - Examples
2. *Shift schedule dynamics*
   - Speed of Rotation
   - Direction of Rotation
   - Length of Shifts
3. *Two examples of schedules*

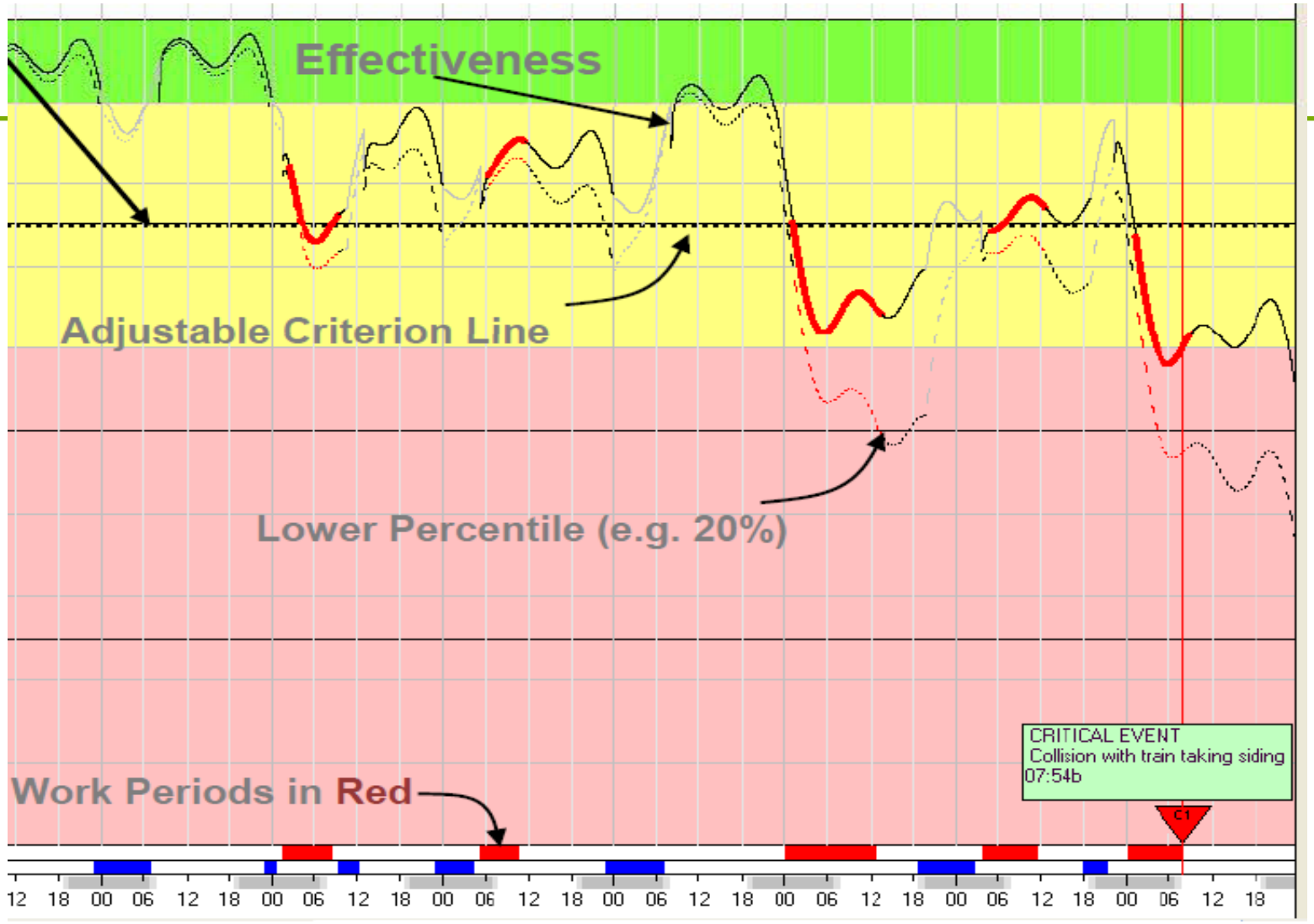
Schematic of SAFTE Model

Sleep, Activity, Fatigue and Task Effectiveness Model

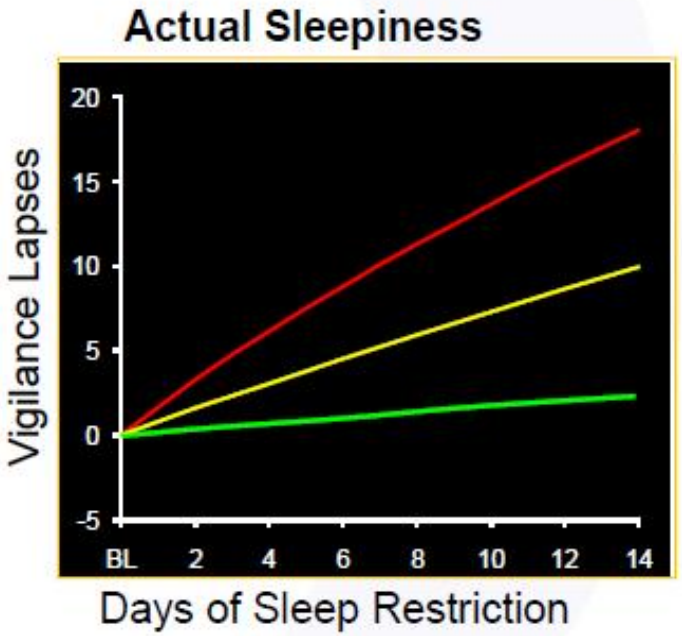



0 Mon
072505
1 Tue
072605
2 Wed
072705
3 Thu
072805
4 Fri
072905
5 Sat
073005
6 Sun
073105
100
90
80
70
60
50
40
30
20
10
Effectiveness (%)
Work
Sleep
Base
0 06 12 18 00 06 12 18 00 06 12 18 00 06 12 18 00 06 12 18 00 06 12 18 00 06 12 18 0
schedule1: 23:50 S O Elf:95.58 29° 32' N 98° 28' W

Application of Model to a Railroad Collision



People are not good at judging their own sleepiness



Van Dongen, Maislin, Mullington, & Dinges (2003). The cumulative cost of additional wakefulness: dose-response effects on neurobehavioral functions and sleep physiology from chronic sleep restriction and total sleep deprivation. *Sleep*, 26, 117-126.

Shift Work Good Practices
(Fatigue and Effectiveness)

1. *Minimize disruption to circadian rhythms*
2. *Forward rotation of shifts*
3. *Short shifts – not longer than 8 hours*
4. *Minimize consecutive night shifts*
5. *At least 24 hours off after night shifts*
6. *Avoid long periods of sleeplessness*
7. *At least 2 days off each week on average*

Shift Work Good Practices
(Psychosocial)

1. *Predictable shifts*
2. *Maximize free days on weekends*
3. *Good quality time off*
4. *Equity for all workers*
5. *Flexibility*
6. *Employee participation in design and implementation*
7. *Education and training*

These good practices cannot all be achieved simultaneously in practice!

Types of Shift Work

- Fixed or permanent
  - All Days (e.g., 7 am to 3 pm)
  - All Afternoons or evenings (e.g., 3-11 pm)
  - All Nights (e.g., 11 pm to 7 am)
- Rotational (Day -> Afternoon -> Night)
- Split (e.g., 5-9 am, then 2-6 pm)
- Irregular

Shift Work Design Considerations

Characteristics of the work done on shift

- Intensity
- Pace
- Physical load
- Mental load
- Consequences of error
- Breaks, rest, relief, meals

- Shorter shifts (8 hr) for higher loads

Number of Consecutive Shifts (Speed of Rotation)

- ***Fast Rotations:*** *up to* 3 shifts in a row of the same time period (days, evenings, or nights)
- ***Slow Rotations:*** 4 – 10 shifts in a row of the same time period
- ***Very Slow Rotation:*** > 10 shifts in a row of the same time period

Consecutive Shifts
Speed of Rotation

- Fast rotation (2–3 shifts before change)
  - 2-3 consecutive night shifts have least effects on circadian rhythms
  - No adaption occurs
  - Small sleep deficit
  - Reduced performance on night shift
  - No adaption means days off are OK

Consecutive Shifts
Speed of Rotation

- Slow rotation (4-10 shifts in a row)
  - Some adaption occurs at wrong time (end of sequence)
  - Accumulation of sleep deficit
  - Desynchronized on days off
  - Reduced performance on night shift

Consecutive Shifts
Speed of Rotation

- Very slow rotation (11 or more shifts in a row)
  - Adaption occurs, not complete
  - Sleep deficit can be minimized
  - Performance on night shifts increases after the 4 day lull
  - Can be serious psychosocial effects

Consecutive Shifts
Speed of Rotation

Summary

Shift type	*Fast Rotation*	*Weekly (slow) Rotation*	*Very slow Rotation*
Disruption of Circadian Rhythm	*Least*	*Worst*	*Some*
Accumulation of sleep deficit	*Minimal*	*Worst*	*Maybe*
Weeks without free evenings	*No*	*Yes*	*Yes*
Performance during night shift	*Reduced*	*Reduced*	*Better*

Permanent Shifts

Employee:

- Adaptation (incomplete) occurs
- Very predictable -- plan social and family obligations
- Social isolation
- Circadian disruption on days off

Employer:

Advantages

- Easier to change coverage to match skills or number of staff

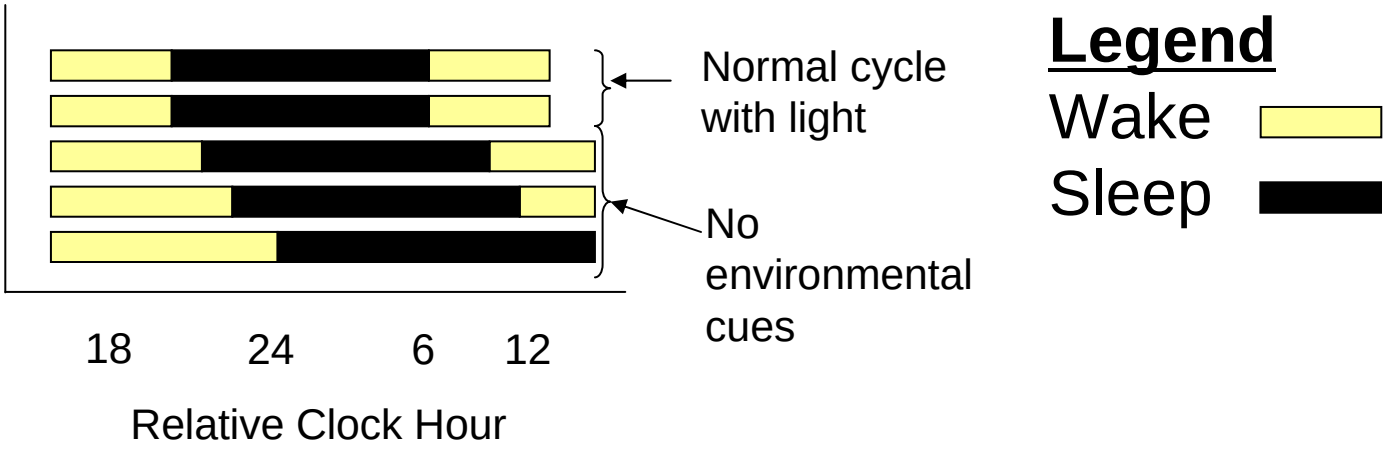
Disadvantages

- Reduced management interaction & communication
- Scheduling training
- Unbalanced workforce
- Recruiting

Direction of Rotation

Body Clock

- For most people, the internal body clock is slightly longer than 24 hrs



Direction of Rotation

- It is easier to stay up later than to get up earlier
- For most shift-workers, adaption to a forward moving schedule is easier than a backward moving schedule.

Day -> Afternoon -> Night is preferred

Longer Shifts

Longer Shifts (e.g., 12 hours)

- For work with variable or lower load
- Need structured breaks and meal times

Advantages

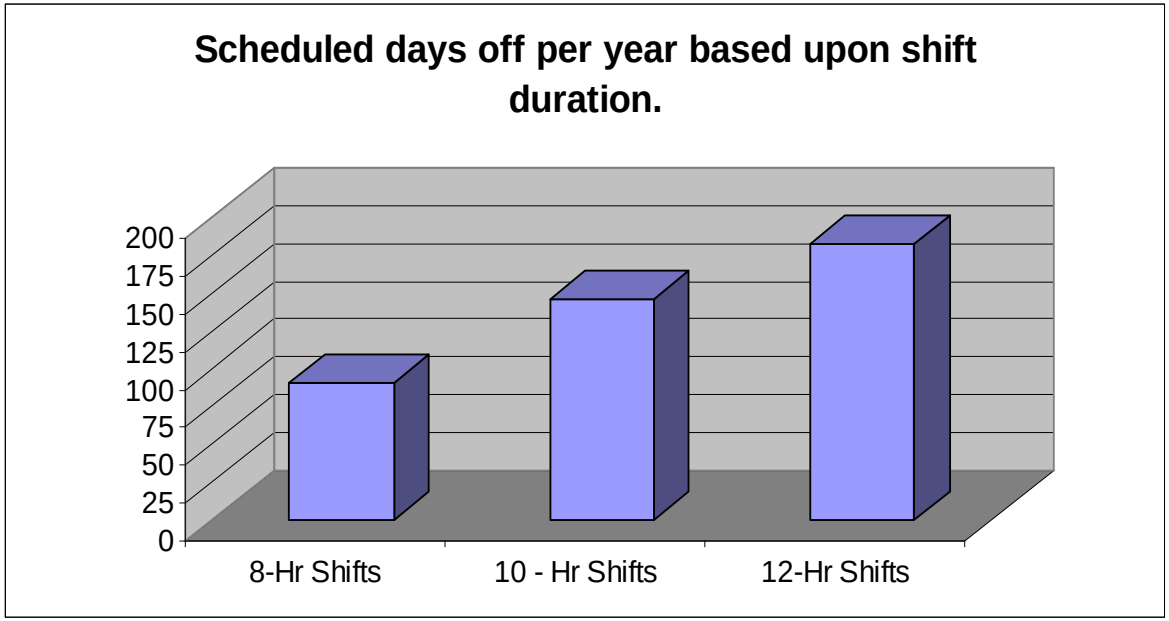
- More days off and more free weekends
- Less commuting
- Fewer shift changes and less downtime

Disadvantages

- Reduced management interaction
- Training and meetings
- More fatigue
- Higher risk of incidents

Days Off

Employee time off based on duration of shift



Types of Schedules

Common Patterns:

- *8 hours: 2-2-3 or 2-2-2-3*
- *12 hours: 3's and 2's or 4's and 5's*
- *10 hours: 3-2-2 (better for uneven coverage - police)*
- *24 hours: 1-xxx-1-xxx or 1-xx-1-xxxx (fire and EMS)*

Note: these patterns work for evenly balanced requirements. Once the balance is gone, patterns must be adjusted.

Case 1: Hospital

- A common nursing schedule
- Shift pattern is called 3's and 2's
- 12 hour shifts for 24 hour coverage
- Advantage: 3-day weekends
- Problem: long sequence of nights; long work weeks

	M	T	W	Th	F	Sa	Su	Hrs
Week 1	X	X	N	N	X	X	X	24
Week 2	D	D	X	X	D	D	D	60
Week 3	X	X	D	D	X	X	X	24
Week 4	N	N	X	X	N	N	N	60
Average Hours								42

Case 1: Hospital

Alternative Schedule

- Interchange nights and days from weeks 2 and 4
- Avoid long sequence of nights (circadian disruption)
- Still have long work weeks

	M	T	W	Th	F	Sa	Su	Hrs
Week 1	X	X	N	N	X	X	X	24
Week 2	D	D	X	X	N	N	N	60
Week 3	X	X	D	D	X	X	X	24
Week 4	N	N	X	X	D	D	D	60
Average Hours								42

Case 2: Manufacturing

- 8-hour shifts (D, A, N)
- 9-week cycle
- Staff needed = 9
- 2 people per shift
- Rapid forward rotation
- Only 2 full weekends
- 2 long work weeks

	M	T	W	Th	F	Sa	Su	Hrs
Week 1	D	D	A	A	N	N	X	48
Week 2	X	X	D	D	A	A	N	40
Week 3	N	X	X	X	D	D	A	32
Week 4	A	N	N	X	X	X	D	32
Week 5	D	A	A	N	N	X	X	40
Week 6	X	D	D	A	A	N	N	48
Week 7	X	X	X	D	D	A	A	32
Week 8	N	N	X	X	X	D	D	32
Week 9	A	A	N	N	X	X	X	32
Average Hours								37.3

Case 2: Manufacturing

Alternative Schedule

- 8-hour shifts (D, A, N)
- 5-week cycle
- Rapid forward rotation
- Staff needed = 5
- 1 person per shift
- More full weekends
- No long work weeks
- Fewer weekly hours

	M	T	W	Th	F	Sa	Su	HRS
Week 1	D	D	X	X	A	A	A	40
Week 2	N	N	X	X	X	D	D	32
Week 3	X	X	A	A	N	N	N	40
Week 4	X	X	D	D	D	X	X	24
Week 5	A	A	N	N	X	X	X	32
Average Hours								33.6

Final Words
Shift Scheduling

- Complex process
- Use scheduling software to investigate alternatives
- Consider work load, pace and breaks
- Consider fatigue and effectiveness models
- Consider specific psychosocial factors
- Involve workers and supervisors
- Ensure employees trained and knowledgeable about risks and trade-offs

References

1. *Waage, S. et al., 2012: Subjective and objective sleepiness among oil rig workers during three different shift schedules. Sleep Medicine, 13 (64-72).*
2. *Knauth, P. et al., 1983: Reduction of Nightwork by Re-designing of Shift-rotas. Int. Arch. Occup. Environ Health 51, (371-379).*
3. *Johnson, M. P. et al., 1992: Short-term memory, alertness and performance: a reappraisal of their relationship to body temperature. J. Sleep Res. 1, (24-29).*
4. *Knauth, P. 1996: Designing Better Shift Systems. Applied Ergonomics, 27 (1): (39-44).*
5. *Dijk, D., Duffy, J. F., and C. A. Czeisler. 1992: Circadian Sleep-Wake dependent aspects of subject alertness and cognitive performance. J. Sleep Res. 1, (112-117)*
6. *Knauth, P. 1997: Changing Schedules: Shiftwork. Chronobiology International, 14(2): (159-171).*

References

7. *Wallace, LA., and S. Pierson. 2008: A Case Study: The Initiative to Improve RN Scheduling at Hamilton Health Sciences. Innovation in Leadership, 21(4), (33-41).*
8. *Costa, G. 2003: Shift work and Occupational Medicine. Occupational Medicine, 53 (83-88).*
9. *Health and Safety Executive, 2006: Managing Shift work, 45 pp.*
10. *Liebert, D. R., and R. Miller. 2003: Staffing Analysis Workbook for Jails. 2nd ed., US Department of Justice, National Institute of Corrections. pp. 47.*
11. *Helander, M. 2006 (2nd ed): Shift Work. A Guide to Human Factors and Ergonomics. Nayang Technological University, CRC Press Taylor Francis Group, pp 292-301.*

Resources

CCOHS OSH Answers

- Rotational Shift work http://www.ccohs.ca/oshanswers/ergonomics/shiftwrk.html
- Extended Workday http://www.ccohs.ca/oshanswers/ergonomics/workday.html

Carex Canada

- Shift Work Occupational Exposure Profile http://www.carexcanada.ca/en/shiftwork/occupational_exposure_estimates/phase_2/
- http://www.carexcanada.ca/en/shiftwork/

Dietitians of Canada

- Nutrition for Shift workers http://www.dietitians.ca/getattachment/7e936b10-0fcc-4f62-ae70-5aeeb3b50a15/FactSheet---Special-Nutritional-considerations-for-Shift-workers.pdf.aspx

Government of Nova Scotia

- Healthy Eating - Shift workers http://www.gov.ns.ca/psc/pdf/employeeCentre/healthyWorkplace/healthyEating/03_16_ShiftWork.pdf

Resources

NIOSH

- Plain Language about Shift Work
  http://www.cdc.gov/niosh/pdfs/97-145.pdf

National Institute of General Medical Science

- Circadian Rythms
  http://www.nigms.nih.gov/Education/Factsheet_CircadianRhythms.htm

Occupational Health Clinics for Ontario Workers

- Shiftwork: Health Effects & Solutions
  http://www.ohcow.on.ca/resources/handbooks/shiftwork/shiftwork.pdf

Resources

National Center for Intermodal Transportation

- Union Pacific: Fatigue Risk Management Symposium, May 11-13, 2010. Speakers' Presentations
  http://www.ncit.msstate.edu/events/events_10.html

North Atlantic Treaty Organization

- Application of Shift Work Scheduling Principles and Tools for Optimizing Console Based Operations.
  http://ftp.rta.nato.int/public//PubFullText/RTO/MP/RTO-MP-HFM-124///MP-HFM-124-26.pdf

National Institute for Occupational Safety and Health (NIOSH)

- Overtime and Extended Work Shifts: Recent Findings on Illnesses, Injuries and Health Behaviors
  http://www.cdc.gov/niosh/docs/2004-143/

Thank You

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