

Working Time Society consensus statements: Regulatory approaches to reduce risks associated with shift work—a global comparison

Johannes GÄRTNER¹, Roger R. ROSA², Greg ROACH³,
Tomohide KUBO⁴ and Masaya TAKAHASHI^{4*}

¹XIMES, Austria

²National Institute for Occupational Safety and Health, USA

³CQUniversity, Australia

⁴National Institute of Occupational Safety and Health, Japan

Received after WTS symposium comments: September 5, 2017

Received after editors' revisions: November 15, 2017

Received after external review: July 9, 2018

Received after expert panel (Final accepted): August 24, 2018

Published online in J-STAGE January 31, 2019

Abstract: A large number of workers worldwide engage in shift work that can have significant influences upon the quality of working life. For most jurisdictions, setting and enforcing appropriate policies, regulations, and rules around shift work is considered essential to (a) prevent potentially negative consequences of shift work and (b) to improve worker health and well-being. However, the best ways to do this are often highly contested theoretical spaces and often culturally and historically bound. In this paper, we examine the regulatory approaches to regulating shift work in four different regions: Europe, North America, Australasia, and East Asia (Japan, China, and Korea). Despite the fact that social and cultural factors vary considerably across the regions, comparing regulatory frameworks and initiatives in one region can be instructive. Different approaches can minimally provide a contrast to stimulate discussion about custom and practice and, potentially, help us to develop new and innovative models to improve worker well-being and organizational productivity simultaneously. In this paper, our goal is not to develop or even advocate a “perfect” sets of regulations. Rather, it is to compare and contrast the diversity and changing landscape of current regulatory practices and to help organizations and regulators understand the costs and benefits of different approaches. For example, in recent years, many western countries have seen a shift away from prescriptive regulation toward more risk-based approaches. Advocates and critics vary considerably in what drove these changes and the benefit-cost analyses associated with their introduction. By understanding the different ways in which shift work can be regulated, it may be possible to learn from others and to better promote healthier and safer environments for shift-working individuals and workplaces.

Key words: Worker health and safety, Work schedule, Fatigue, Transportation, Communication and participation

*To whom correspondence should be addressed.

E-mail: takaham@h.jniosh.johas.go.jp

©2019 National Institute of Occupational Safety and Health

Consensus Statements

- 1) Regulatory approaches are fundamental to protecting worker health and safety.
- 2) Regulatory approaches should be data-driven.
- 3) Regulatory approaches based on payment and cost should be checked to avoid unintended consequences on schedules (e.g., making unhealthy schedules more attractive than feasible healthier options).
- 4) Good communication and participation among stakeholders including employees and employers (and/or their representatives) are key factors for making the regulatory approaches success.
- 5) Regulations from other countries or regions can often be adapted as a basis for regulations in a new setting.
- 6) Regulatory approaches to reduce fatigue risks associated with shift work should be based on (a) prescriptive rule sets, (b) risk-management principles, or (c) a combination of the two.
- 7) Prescriptive approaches should include (a) maximum duty limits for a single shift and for a 1–4-wk period, and (b) minimum rest limits for time off during a shift and for time off between consecutive shifts. Maximum duty limits for a single shift, and minimum rest limits for time off between consecutive shifts, should vary based on the time-of-day that the duty/rest occurs.
- 8) Risk-based approaches should employ processes to ensure that fatigue-related hazards are identified, assessed, and mitigated. Fatigue-related hazards should be identified using a combination of (a) predictive processes, e.g., biomathematical modeling of rosters, (b) proactive processes, e.g., discussion with employees and their representatives, and (c) reactive processes, e.g., determination of the contribution of fatigue-related hazards to incidents/accidents.

Consensus statements review expert panel: Claudia RC MORENO¹(Chair), Claire CARUSO², Mikko HÄRMÄ³

¹University of São Paulo, Brazil

²National Institute for Occupational Safety and Health, USA

³Finnish Institute of Occupational Health, Finland

Full consensus among panel members on all statements.

Introduction

This manuscript is part of a series of consensus papers developed by the Working Time Society, as commissioned by the International Commission on Occupational Health. The goal of this series is to provide guidance for a broad, international audience of researchers, industry representatives, workers, labor representatives, policy makers, and other stakeholders on managing fatigue associated with non-standard working hours and ensuring worker health and safety. Collectively, the papers provide overviews of the current state of research, identify health and safety risks, make recommendations for effective interventions, and suggest future research directions. Each paper presents a number of consensus statements, developed through the procedures outlined in Wong *et al.*¹⁾, and describes the background information on which the consensus statements are based. The present paper describes different regulatory approaches taken around the world regarding

the management of fatigue-related risk in shift work systems and, more broadly, in working time arrangements.

Regulatory approaches to reducing the risks associated with shift work vary widely between regions, cultures, countries, industry sectors and companies. This may be influenced by cultural questions of what is, or was, considered a risk in the formulation of regulation (e.g., in 19th century Austria it was a religious risk to miss mass on Sunday, in Qatar rules regarding Ramadan can be relevant to the timing of shifts) and who are the stakeholders (e.g. are worker representatives relevant contributors or not? Is the community to be represented or not?).

As described in Fig. 1, regulations vary in at least two dimensions: firstly, the types of rules that are used and secondly the focus of regulation regarding risks.

Many European regulations try to mitigate risk by setting limits on specific features of schedules (e.g., maximum working hours per day or minimum breaks between sequential shifts) and by defining procedural rules

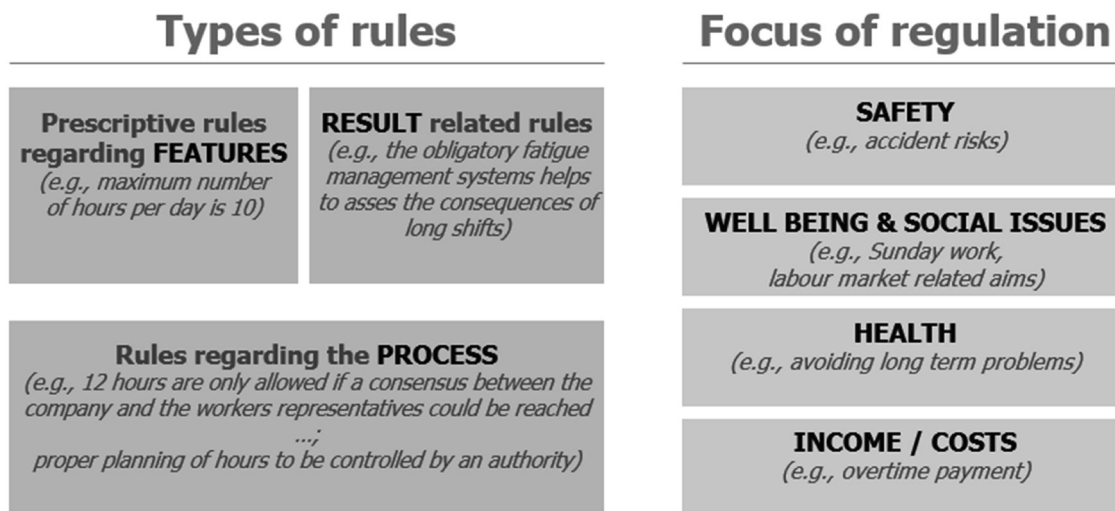


Fig. 1. Types of rules and foci of working time regulation.

regarding social partner involvement. For example, should any schedule be acceptable if the workers representatives agree? (See section on Europe (European Union)). Moreover, the focus (i.e. outcome criteria) for regulation may not be explicitly stated in the laws but implicit within ‘custom and practice’.

By contrast, other regions and countries may focus more strongly on outcomes, especially for safety issues in different modes of transportation (e.g., United States, Australia) and often apply processes that focus more on legal and statutory responsibilities around the requirements to operate a safe system of work and risk management, and less on consensus building among stakeholders.

Sometimes, income and costs play a pivotal role. One important issue is overtime: When does an employer have to pay supplements? Often, work hour limits can have substantial impact on scheduling. For example, in the USA, certain categories of workers are required to receive overtime premium pay for work exceeding 40 h per wk. As such, rotating schedules that optimize weekends and average out working hours over the cycle are highly popular in Europe and come without extra costs for employers. These schedules might be considered very expensive for some employers in the USA.

Another important but hidden cost factor is health insurance. In Europe, insurance fees are often calculated as a percentage of income. As such, some employers have similar labor costs (i.e., income + insurance) when hiring more staff, but reducing weekly working hours *per employee*. However, in some countries health insurance costs are calculated as a flat rate per employee, thus creating an

incentive for employers to keep staff numbers to a minimum, leading to the need for nonstandard work schedules (e.g., shift work, extended working hours).

This paper examined the regulatory approaches towards shift work by comparing those among four different geographical regions: Europe, North America, Australia, and Asia (Japan, China, and Korea). As discussed above, these regulatory approaches differ fundamentally in aims, mechanisms, and scope. Therefore, we decided to describe them independently.

Europe (European Union)

Regulation to reduce risks in shift work in the European Union—at least in Central Europe—is not comprised of a clear set of rules and varies regarding the risks to be considered (e.g., workers’ safety, hygiene and health by The EU’s Working Time Directive²; social factors by the Austrian Working Time Law³). While there are regulations and laws pertaining to working time arrangements, many adaptations or exceptions have been implemented at national, sectorial, and company levels, and only in a few cases, are these EU-regulations (also having long lists of exceptions) directly applicable. Consequently, focusing only on EU-regulation would mislead highly strongly.

Working time arrangements are shaped by a number of government, industry and labour stakeholders (e.g., national parliaments, political parties, trade unions, shop stewards, employers’ federations, supervisory agencies). Each advances their own agenda, but do not strictly adhere to hierarchical networks (individual, company, branch,

and national) of political arenas which have their own sets of rules and actors. Rules defined in one arena are often transformed or interpreted differently in another.

In addition, the level of adherence to regulation varies between countries (on different levels throughout Europe) and the level of enforcement may depend on the history, culture and current politics influencing the respective actors and stakeholders. Needless to say, these groups are subject to various social and political influences, and what they consider to be legitimate can be shaped by the public and scientific discussion. Not surprisingly, scientifically supported evidence can be a powerful but often highly contested source of legitimizing calls for changes to the working time arrangement.

Examples for adaptations

Exceptions from regulations are the dominant form of adaptation. Besides regulating different aspects of working time, e.g., the maximum length of a work day, the Austrian working time law also defines shift scheduling rules. However, the scope of this law includes many, but not all employees (e.g. there are other laws for working time for large parts of public sector). A further exception concerns the length of the working day: §3 of the Austrian Working Time Law³) states a maximum of 8 h 'normal' per 'work day' ('normal' in contrast to overtime hours that typically bring a pay-supplement of 50% or more and lesser restrictions regarding length; 'work day' may differ from a 24 h period). However, §4 allows deviations of this maximum at the company level, where a 'normal' work day can extend from 8 h (basic regulation) to 10 h if sector partners (i.e., trade unions and mandatory employers' federations) agree. Long lists of such exceptions—typically with additional conditions and need for consent on sectorial or company level—may allow for even longer planned (or overtime) work.

Other forms of adaptations may work the other way around. For example, in the Netherlands a broad framework with few exceptions is used, and it is the responsibility of trade unions and employers organizations to define stricter localized rules if necessary but not exemptions. Australia also uses such an approach in the Enterprise Bargaining System.

The arenas for adaptation

In European countries, there are typically high numbers of collective agreements (e.g., hundreds in Austria with a working population of only 3.5 million) and the topic of regular working hours is one of many elements discussed

within a collective agreement. Trade union and employer representatives are often employee representatives (work council and or shop stewards) or managers who can influence the politics of union/employer organizations. Given that employee representatives are elected into their roles by their peers, they uphold the interests and needs of the employee collective (who not infrequently choose to prioritize short-term income over long-term health). When trade unions and employer organizations work together on a national level, they are often able to extend their political and industrial agendas into subsequent legislation. On the other hand, law-making is debated in public and parliament which provides opportunities for experts and interested parties to address associated risks of health, safety or well-being associated with proposed changes of working hours (Fig. 2).

A generalization

The specific mechanisms and approaches to shape and enforce regulations differ between European countries. For example, in Germany, there are more unions (often within the same sector or company) compared to Austria. Compared to Germany, Austrian unions have more political clout with political parties. Sometimes these mechanisms differ between sectors or even between occupations in one country.

Additionally, public authorities vary in their level of control over the execution of regulations. For example, in Switzerland some shift schedules are inspected by the public supervisory institution (SECO) before implementation. Whereas in Austria, federal inspectors check the actual rest times through field visits (partially random, other part when somebody complains). Unsurprisingly, the level of expertise and thus the quality and consistency of decision-making in these visits may vary considerably.

These varying options for adaptations (e.g., national, sector, company-levels) and participation (by managers and worker representatives) have several outcomes. Firstly, they allow for reasonable changes (e.g., more rest breaks if work is demanding). Secondly, they allow for 'deals' or compromises (e.g. increased compensation for unhealthy/unsafe work hours). For example, while national working time laws for physicians clearly exceeded EU-regulations for years in Germany and Austria, they were attractive for employees in terms of pay. Thus, reinstating physician working hours to match the EU regulations was a prolonged process and required enforcement with the EU judicial system. Thirdly, adaptations or exceptions can result in low adherence to working hour regulations.

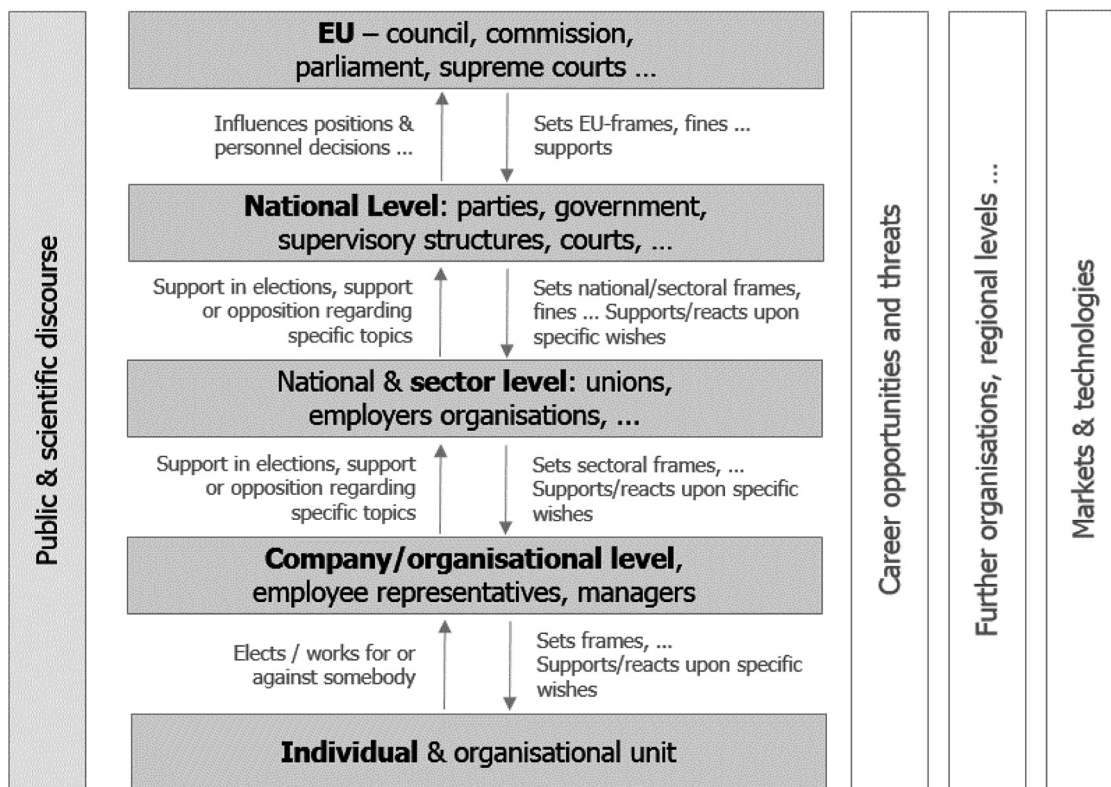


Fig. 2. The most important actors and mechanisms to shape local shift schedule organization.

Fines are usually administered only when infractions are reported and prosecuted. Finally, regulations also reflect the ‘soft’ political power of different groups of employees. For example, working hours for cleaning personnel can be changed on shorter notice without additional payment in Austria, compared to professional occupational groups⁴).

Historical development of regulations

It is difficult to judge whether overall regulations in the countries of the EU have become more restrictive over the years (e.g. working time of physicians in hospitals has been reduced) or more lenient (e.g. retail has been de-regulated). However, what is clear is that working time regulation became more complex in many EU countries over the last couple of decades (with some exceptions, e.g. Netherlands). Even specialists (e.g., lawyers and management consultants focusing on working hours) experience some difficulties assessing the legal aspects for a company. It is not easy to simplify regulation because of the interaction between organizational, legal, remuneration, social, local, sectorial, etc. aspects of shift labor and the number of actors and networks involved. It will be interesting to see the development in the future and whether research

can (a) strengthen its voice in those discussions on basic and adapted regulations or (b) become increasingly marginalized as the working time arrangements diversify and evidence-based policy becomes less definitive due to lack of evidence or poor generalizability between studies.

Examples of types of regulation

Given the myriad of working time arrangements, some examples of regulations are provided and not a comprehensive overview.

In summary, ‘the European approach’ to regulation is predicated on a ‘social dialogue’ between many different stakeholders. It is a highly adaptive approach that is able to consider specifics at the company level. At the same time, its success also depends on a strong voice from researchers promoting a public discourse to improve safety, health and well-being. In this context, the communication between researchers and the political system may become even more important. As such there may be multiple roles for researchers. While it is important to continue in disseminating/consolidating research findings and assisting in the understanding of existing rules and their consequences, there may also be a need for researchers to better under-

Table 1. Examples of types of regulation

Type of regulation	Example for regulation (mainly from Austria)	Remark
Restriction of length of shift	max 9 h per shift	myriad of exceptions up to 24 hours or even more
Restriction of hours per week	max 40 h	myriad of exceptions up to 72 hours, e.g. in order to provide better time off and/or flexibility for companies
Restriction of number of specific types of shifts	max 5 shifts in a row	Not often used
Rest hours between shifts	Typically 11 h	Can be reduced in some cases
On call duties	Max 10 d per month	
Minimum breaks	30 min if a shift is longer than 6 h	Sometimes additional breaks
Driving time	e.g. 45 min breaks after max 4,5 h for buses in regular courses	Myriad of exceptions for other types of driving or other arrangements
Weekend work	only one out of two weekends work	
Additional time off for specific times	2 h off per night shift	Not very broadly used
Earlier retirement	For night shift work	
Health checks	Mandatory for night work	
Better food	Some companies	
Drinks	Some companies	
Gymnastics	Some companies	
Overall outcome	If 24 stand-by shifts are better for employees from a health perspective than	
Involvement of workers representatives	If they agree work hours may be distributed differently to allow for better times off in conjunction with bank holidays.	

stand the mechanisms of and options for regulation and work on more integrated perspectives in evaluation.

North America

In contrast to Europe, the USA (and Canada to a lesser extent) is a relatively unregulated environment with respect to working time arrangements. That being said, the regulatory approach is predominantly prescriptive with little focus on performance-based regulation outside of the aviation sector and to a lesser extent rail. Prescriptive North American regulations in working hours apply primarily to transport (i.e., commercial aviation, road, rail, and maritime). U.S. Federal regulations also cover nuclear power plant operators. Otherwise, there are few national regulations on working hours aimed at reducing excessive fatigue and protecting safety and health. Existing regulations may include: (1) one or more maximum daily limits on time on-duty and, within the daily limit, further limits on permissible time for tasks such as vehicle operation; (2) a minimum period of rest between days on-duty and rest periods within on-duty periods; (3) aggregate maximum work hours across a maximum number of successive days on-duty, followed by a required minimum period or rest/free time; and (4) exceptions for safety or operational in-

tegrity, specified operations or job titles, presence of additional crew, or implementation of fatigue risk management programs. Some of these features are presented in Table 2 across industries and countries.

Highway

The most recent U.S. regulations date to a 2011 rule by the U.S. Department of Transportation (USDOT), Federal Motor Carrier Safety Administration. The regulations establish different limits for drivers of property-carrying vehicles in interstate commerce that weigh 10,001 pounds or more and passenger-carrying vehicles (49 CFR Parts 385, 386, 390, and 395)^{5–8}. For property-carrying drivers, time on-duty is limited to 14 h with driving limited to 11 h. Under ‘adverse conditions’ up to two additional hours of driving are permitted in order to bring the vehicle to a safe destination. At least 10 h off-duty are required between on-duty periods. A 30-min rest break within an on-duty period is required after up to eight h of driving time. At least eight consecutive hours in a sleeper berth, accompanied by two additional off-duty hours, can substitute for the 10 h off-duty. Property-carrying drivers also must take 34 h of time off-duty following either 60 h of driving in seven d or 70 h of driving in eight d.

Passenger-carrying drivers are limited to 15 h on-duty

Table 2. Major features of regulatory limits on hours of service in the United States and Canada^{1,2}

		Shifts				Cumulative	
		On-duty (Maximum)	Operation (Maximum)	Break between (Minimum)	Break within (Minimum)	Across days (Maximum)	Break following (Minimum)
Highway							
USA	Property	14	11	10	0.5	60 per 7 d or 70 per 8 d	34
	Passenger	15	10	8	Not specified	60 per 7 d or 70 per 8 d	Rolling average
Canada	South of 60°N latitude	14	13	8–10	0–2	Not specified	Not specified
	North of 60°N latitude	12–18 depending on duty cycle	15	8–12 depending on duty cycle	Not specified	80 per 7 d	24–36 depending on duty cycle
Aviation							
USA	Pilots	9–14 depending on day or night start	8–9 depending on day or night start	10	Not specified	60 per 7 d or 672 per 28 d	30 per 168 h
	Flight Attendants	14 with 2-h increments given additional crew	Not specified	8–12 depending on crew size	Not specified	Not specified	Not specified
Canada	Pilots	14	8	10	Not specified	120 per 7 d or 300 per 90 d or 1,200 per 365 d	24–72 depending on duty cycle
Railway							
USA	Freight	12 per 24 h	Not specified	10	Not specified	6–7 d	48 per 6 d or 72 per 7 days
	Passenger	12 per 24 h	Not specified	10	Not specified	6 or 13 d	24 after 6 d or 2 full days after 13 d
	Signal Dispatch	12 per 24 h 9–12	Not specified Not specified	10 Not specified	0.5 1	Not specified Not specified	Not specified Not specified
Canada	Not specified	12 generally or 16 h for work train service	Not specified	6–8	Not specified	18	8
Maritime							
USA	General	14	Not specified	6–10	0–4	Not specified	77 cumulative per 7 d
	Watch	8–15	9–16	Not specified	Not specified	36 per 72 h	Not specified
Canada		14–18	6–10	Not specified	Not specified	72–77 per 7 d	77 per 7 d in some operations
Nuclear Power							
USA	Safety-critical	See cumulative values across days	8–10	Not specified	Not specified	16 per 24 h or 26 per 48 h or 72 per 7 d	34 per 9 d
Canada	Not specified	Not specified	Not specified	Not specified	Not specified	Not specified	Not specified

¹Features may vary for safety or operational integrity, specified operations or job titles, presence of additional crew, or implementation of fatigue risk management programs or systems.

²All units are in hours unless stated otherwise.

with driving limited to 10 h. At least eight h off-duty are required between on-duty periods. Eight h in a sleeper berth can count for time off-duty; this can be split into two periods, neither less than two h. Up to two additional hours of driving under ‘adverse conditions’ are permitted in

order to bring the vehicle to a safe destination. Passenger-carrying drivers also are limited to 60 h of driving in any 7-d period (if not driving every day) or 70 h of driving in any 8-d period (if driving every day) and may not resume driving until the totals fall below 60 over seven d or 70 h

over eight days. Exceptions apply to some locations (e.g., Alaska, Hawaii) and types of jobs (e.g., emergency response).

Work-hours limits for driving of commercial motor vehicles in Canada were last amended in 2009 (SOR/2005-313)⁹⁾. South of 60°N latitude, driving is limited to 13 h within a 14-h on-duty period. Ten h off-duty per day are required with at least eight consecutive hours off-duty between duty periods. No driving is permitted after 16 h from the end of the last 8-h free period. Above 60°N latitude, driving is limited to 15 h within an 18-h on-duty period. At least eight consecutive hours off-duty are required between duty periods and no driving is permitted after 20 h from the end of the last 8-h rest period. At least 24 h off duty per 14-d period is required. For seven-d duty cycles, time on-duty is limited to 80 h. The seven-d cycle can be reset after 36 h off-duty. For 14-d duty cycles, time on-duty is limited to 12 h. The 14-d cycle also requires 24 h off-duty after 80 h on-duty. The 14-d cycle can be reset after 72 h off-duty. The overall limits in Canada may vary under emergency conditions or if a sleeper berth or team driving is available.

Aviation

U.S. pilots

U.S. regulations, last promulgated in 2012 by the USDOT, Federal Aviation Administration (FAA), include daily restrictions for total time on-duty, with shorter hours of actual flight time within those times on-duty (14 CFR Part 117)¹⁰⁾. For two-pilot crews, daily on-duty limits vary by the start time and number of flight segments. In general, overnight start times limit pilots to nine or 10 h on-duty and daytime start times limit them to 12 to 14 h on-duty. Maximum actual flight time for two-pilot crews is eight hours for evening or nighttime starts and nine h for daytime starts. If on-board rest facilities are available, on-duty time may be extended to a maximum of 17 h with 13 h of actual flight time (among all crew members) for three-pilot crews, and a maximum of 19 h with 17 h of flight time for four-pilot crews (among all crew members). For all crew sizes, a rest period of at least 10 h that allows an eight-h opportunity for sleep is required between each on-duty period. Extensions to duty and flight time for unforeseen circumstances are permitted.

Other limitations include a maximum of 60 on-duty hours in a 168-h (seven-d) period and 192 h in a 672-h (28-d) period, and a maximum of 100 h actual flight time in a 672-h (28-d) period and 1,000 h over 365 calendar days. At least 30 consecutive hours of free time are

required in any 168-h period. Consecutive nights of operation are limited to a maximum of five if suitable accommodations for rest are provided. Exceptions are permitted in some circumstances (e.g., government or emergency response operations). The FAA also requires all scheduled air carriers to submit a “fatigue risk management plan” that documents fatigue countermeasures and continued efforts to improve regulatory compliance. Carriers may also develop optional “fatigue risk management systems” for instances in which they propose to operate outside regulatory limitations.

U.S. flight attendants

Duty hours regulations for U.S. flight attendants date to 1994 and only cover daily duty and free time between duty periods (14 CFR Part 91.1062)¹¹⁾. Daily time on-duty is limited to a maximum of 14 h with nine hours rest for a standard crew in a particular operation. Eight hours of rest are permitted if the next rest period is increased to 10 h. Maximum time on-duty can be increased in increments of two hours if additional flight attendants are added. A 16-h maximum duty period requires one additional flight attendant, an 18-h period requires two additional attendants, and a 20-h duty period requires three additional flight attendants. The 20-h maximum duty period requires a subsequent rest period of at least 12 h that may be reduced to 10 h if the next rest period is increased to 14 h. If, in the latter case, the rest period is reduced to 10 h then the next duty period must be limited to 14 h maximum.

Canadian flight limits

Limits in Canada vary somewhat by aircraft and operation (SOR/96-433 Part VII Subsection 700)¹²⁾. Single-pilot flights are limited to eight hours per 24 h and, depending on aircraft and operation, 40 or 60 h per seven-d period. Other flight limits are 120 h in 30 d, 300 h in 90 d, or 1,200 h in 365 d. On-duty time may not exceed 14 h per 24-h period. For some operations, 24 h of free time are required after three consecutive assignments that exceed 12 consecutive hours each unless at least 24 h of free time are permitted between each assignment. In addition for some operations, 36 h of free time per 7 d, or at least three consecutive calendar days per 17 d are required.

Railway

Most U.S. hours of service limitations for rail employees are established by legislation, which was amended most recently in 2008; rules for passenger-train employees were amended by regulation in 2011. The rules vary

somewhat among freight train employees, passenger train employees, signal employees, and dispatching service employees (49 U.S. Code, Chapter 11; 49 CFR 228; 49 CFR Part 228, Subpart F)^{13–15}. In most instances, a single tour is limited to a maximum of 12 h of time on-duty and at least 10 h of off-duty time in a 24-h period for freight, passenger, and signal services. Dispatching service time on-duty is limited to nine hours maximum where two shifts are employed and 12 h maximum where one shift is employed. There is no explicit minimum rest period for dispatching service employees. Freight and passenger services employees are permitted four additional hours of off-duty at “designated terminals.” Signal service employees receive 30 min and dispatcher service employees receive one hour off-duty within a single tour. Freight train employees must be allowed 48 h off-duty after six consecutive days on-duty, and 72 h off-duty at their home terminal if on-duty a seventh consecutive day. In some assignments, passenger service employees are permitted 13 consecutive calendar days on-duty within a 14-d period to be followed by two d off-duty. In other assignments, passenger service employees are permitted six consecutive calendar days on-duty to be followed by 24 h off-duty. Freight train employees only are limited to 276 h on-duty in any calendar month. In emergencies, freight, passenger, and signal service employees may work up to four additional hours in a 24-h period, and dispatching services are limited to four additional hours for no more than three days in a seven-d period. Passenger services also must use a “biomathematical” model to analyze work schedules in order to minimize the risk of excessive fatigue.

Maximum on-duty time for “a single tour of duty” in Canadian regulations is 12 h, in most cases, or 16 h for “work train service” (Transport Canada TC O 0-140)¹⁶. Maximum on-duty time for more than a single tour of duty is 18 h between “resets.” Eight h off-duty at a home terminal, or six h off-duty at another terminal, is required to reset a tour. In addition to observing work hours limits, railway companies in Canada must implement fatigue management plans.

Maritime

Work and rest hours in the U.S. maritime industries conform to the Standards of Training, Certification, and Watchkeeping (STCW) for Seafarers, established in 1978 and set in regulation by the U.S. Coast Guard in 2010 (46 CFR Part 15.1111)¹⁷. In general, merchant mariners are required to receive a minimum of 10 h rest within a 24-h period. This may be divided into two periods, one

of which must be at least 6 h. Ten hours of rest may be reduced to 6 h for up to two days but a minimum of 77 h of rest must be maintained for each seven-day period. Limits may be extended under emergency, drill, or other overriding conditions. Watch schedules vary with vessel type and range from 8–15 h of maximum duty time within a 24-h period. Watch personnel also may be limited to a maximum of 36 h on-duty in any 72 h.

Working-hours regulations for the maritime industry in Canada depend on vessel type and location of operations (SOR/2007-115)¹⁸. In some instances, at least six hours of rest per 24-h period are required with no more than 18 h between consecutive rest periods. In other instances, vessel personnel may not work more than 14 h per 24-h period or no more than 72 h in a seven-d period. Those personnel also must be permitted at least 10 h of rest per 24-h period and at least 77 h of rest in a seven-d period. Daily rest may be divided into two periods but one period must be at least six h. The interval between rest periods must not exceed 14 h.

Nuclear power

Last updated in 2011, U.S. work-hours limits for safety-critical personnel are set by the U.S. Nuclear Regulatory Commission (10 CFR Part 26.205)¹⁹. Time on-duty is limited to 16 h in any 24-h period, 26 h in any 48-h period, and 72 h in any 7-day period. A required ten hours minimum of free time between duty-periods may be reduced to 8 h under certain circumstances. A 34-h break in any 9-d period also is required. Averaged over the shift cycle, 8-h shift schedules require at least 1 d off per week, 10-h shift schedules require at least 2 d off per week and, depending on job duties, 12-h shift schedules require two, 2.5, or 3 d off per week. These rules may vary during system outages with provision of free days at certain intervals. Canada has no regulatory limits to work hours for the nuclear power industry.

In summary, regulations across industries and countries consistently address maximum time on-duty per shift followed by frequent consideration of minimum off-duty time between shifts, cumulative limits across a series of shifts, and extended time off-duty after a series of shifts (Table 1). Most regulations also permit exceptions for unforeseen circumstances. Maximum limits for specific operations and minimum break time within time on-duty show the most variation. Taken together, the degree of variation evident in this small set of industries illustrates the challenges in setting policy in balance with operational demands. The existing regulations suggest that other

Table 3. Summary of the main duty/rest limits in the prescriptive rule sets for the Australian transport industries

	Maximum duty limits	Minimum rest limits	Cumulative duty limits
Truck/Bus/Coach drivers	5.25 h in any 5.5 h period 12 h in any 24-h period	solo driver – 7 h continuous in 24h two-up driver – 5 h continuous in 24 h	solo driver –72 h in 7 d two-up driver– 60 h in 7 d
Train drivers	1-driver operations – 8–10 h per shift 2-driver operations – 12 h per shift	away – 7-8h between shifts at home – 11–12 h between shifts	12 shifts in 14 d
Airline pilots	flying time (no extra pilots) – 7–10 h per duty period duty time (no extra pilots) – 8–14 h per duty period flying time (1–2 extra pilots) – 9–16 h per duty period duty time (1–2 extra pilots) – 11–18 h per duty period	away – 10 h between duty periods at home – 2 h between duty periods unacclimatised body clock – 14 h between duty periods	flying time – 100 h in 28 d duty time – 60 h in 7 d

industries considering a regulatory approach might choose maximum daily time on-duty and minimum daily rest as the most desirable starting points.

Australia

In Australia, most regulatory approaches lie somewhere on a continuum, with more traditional prescriptive rule sets at one end, and fully-articulated risk management systems at the other. Historically, a prescriptive approach has been the norm, whereby fatigue risk is minimized by adherence to prescriptive rule sets based on maximum work limits and minimum rest limits (Table 3). However, it is now recognized that prescriptive rule sets are almost always imperfect—there are some situations where the rules allow patterns of work that are likely to lead to elevated levels of risk, and other situations where the rules disallow patterns of work that are unlikely to lead to elevated risk²⁰. In response, an alternative approach based on risk management principles has been developed, whereby shift work related risk is minimized through a process of identifying, assessing, and mitigating hazards, rather than by adherence to, or compliance with, a prescriptive rule set.

There are two major areas of regulation that potentially impact on the working time arrangements—the industrial (labour) relations system and the workplace health and safety (WHS) system. These two areas are summarized in the next two sub-sections.

The industrial (labour) relations system

Since 1 July 2009, most Australian workplaces have been subject to a workplace relations system created by the Fair Work Act 2009²¹. The Act contains the National Employment Standards, which are ten minimum employment entitlements that must be provided to all employees. With respect to reducing the risks associated with shift work, the most relevant of the minimum employment

entitlements is the one related to weekly hours of work. According to the Act, any work up to 38 h in a week is considered ‘ordinary hours’, any work over that amount is considered ‘additional hours’, and an employee cannot be required to work additional hours unless it is ‘reasonable’ to do so.

The Fair Work Act 2009²⁰ identifies several issues that must be taken into account when determining whether or not additional hours are ‘reasonable’ for a particular employee, including: the employee’s personal circumstances; the needs of the workplace or enterprise; any health and safety risks arising from working additional hours; any compensation provided for working additional hours; the usual patterns of work in the relevant industry; and the importance of the employee’s role to the workplace or enterprise.

As can be seen, the impact on health and safety risks is only one of several dimensions that must be considered when determining whether or not hours of work are reasonable. The result is that the limit on ordinary hours of work does not necessarily provide protection against shift work related risks. In practice, the distinction between ordinary hours of work and additional hours of work is primarily related to the rate of pay that is applied. In particular, ordinary hours of work are paid at normal rates, whereas additional/overtime hours of work are paid at higher rates—sometimes referred to as penalty rates—which may include a premium for the associated social inconvenience (e.g. night work, weekend work, overtime work, etc).

The workplace health and safety system

Australia has an overarching system of workplace health and safety (WHS) laws, known prior to 2012 as occupational health and safety (OHS) laws. Like many areas of law in Australia, the WHS laws are not national laws, but instead are specific to each of the six states and two

territories. In practice, however, these are often considered a *de facto* national law since each state will pass model or template legislation based on an initial state's approach. In general, other states will adopt the model legislation relatively unchanged within their respective jurisdictions. The WHS laws describe non-specific approaches on how to identify, assess and mitigate workplace hazards that may impact on the health, safety and/or welfare of employees.

Each state and territory has an Act—which provides general principles regarding how to minimize workplace hazards, a Regulation—which describes the standards that must be met for specific types of workplace hazards, and various codes of practice—which give practical guidance on how to satisfy the provisions of the Acts and Regulations.

The Acts do not typically mention specific workplace hazards, but rather, the general risk management principles that they contain can be applied to reducing the risks associated with shift work. Nevertheless, fatigue related risk associated with hours of work is specifically mentioned in the Regulations of four of the six states (i.e., New South Wales, Victoria, South Australia, Western Australia) and one of the two territories (i.e., Northern Territory). The reasons for this are complicated but reflect an initial reluctance by regulators, organizations and unions to address fatigue systematically under general hazard requirements.

Agency-based jurisdiction

While the risks of shift work more broadly are regulated under industrial and WHS law, specific agencies can also have jurisdiction over specific industries. This is typical in the transport and mining arenas and refers primarily to the requirement to manage fatigue-related risk. In these cases we have a delegated responsibility whereby the National and state-based regulators cede authority to the industry regulator. In essence, if the working time arrangement conforms to the requirements of the industry-based regulator, the arrangement is 'deemed safe'.

Heavy truck drivers and commercial bus/coach drivers

In Australia, the control of fatigue-related risks associated with shift work for the drivers of heavy trucks and commercial buses is regulated by the National Heavy Vehicle Regulator (NHVR), through the Heavy Vehicle (Fatigue Management) National Regulation²², which is made under the Heavy Vehicle National Law Act 2012²³.

Under the Regulation, a truck is a motor vehicle, except a bus, with a gross vehicle mass >4.5 tons; a bus/coach is a motor vehicle that seats over 9 adults, including the driver;

two-up driving is when two persons share the driving of a heavy vehicle that has an approved sleeper berth; and solo driving is when a person drives a heavy vehicle alone.

The Regulation describes a three-tiered approach to managing the fatigue-related risks associated with shift work²². Depending on the presence and maturity of their risk management systems, employers and their drivers can either: (a) adhere to a simple prescriptive rule set (Standard Hours), (b) adhere to a slightly more flexible rule set with some standardized additional controls (Basic Fatigue Management), or (c) operate outside the prescriptive regulations using an approved firm-specific risk-based system (Advanced Fatigue Management). In some cases where a large number of operators require a similar approach under Advanced Fatigue Management, the regulator will work in conjunction with industry representatives to develop standardized templates under AFM²².

Standard hours scheme (SH)

Employers and drivers that do not have approval to employ a basic or advanced fatigue management scheme, and do not have a fatigue management exemption, must adhere to a prescriptive rule set. The rule set has four main types of hours of work rules for truck and bus/coach drivers:

- Maximum work limits. All drivers can work for a maximum of 5.25 h in any 5.5-h period, 7.5 h in any 8-h period, 10 h in any 11-h period, and 12 h in any 24-h period.
- Cumulative work limits. Solo truck drivers can work for a maximum of 72 h in any 7-d period and 144 h in any 14-d period. Solo bus/coach drivers can work for a maximum of 288 h in any 28-d period. Two-up drivers can work for a maximum of 60 h in any 7-d period and 120 h in any 14-d period.
- Minimum rest limits. All drivers must have a minimum of 15 continuous minutes of rest in any 5.5-h period, 30 continuous minutes of rest in any 8-h period, and 60 min of rest in blocks of 15 continuous minutes in any 11-h period. In any 24-h period, solo drivers must have a minimum of 7 continuous hours of stationary rest, and two-up drivers must have a minimum of 5 continuous hours of rest either stationary or in an approved sleeper berth in a moving vehicle.

- Cumulative rest limits. Solo truck drivers must have a minimum of 24 continuous hours of stationary rest in any 7-d period, and a minimum of 2 night rest breaks and 2 night rest breaks on consecutive days in any 14-d period. Solo bus/coach drivers must have a minimum of 6 night rest breaks in any 7-d period, and a minimum of 4 × 24

Table 4. Risk Classification System Tool

Principles	Baseline (Score=0)	Low fatigue likelihood/ safety risk (Score=1)	Medium fatigue likelihood/ safety risk (Score=2)	High fatigue likelihood/ safety risk (Score=3)
Work-related Rest breaks: breaks from driving within work opportunity (WO) to reduce performance impairment due to extended time-on-task				
1. Reduce the time spent continuously working in the WO	>20% of time in the WO	>15–20% time in the WO	>10–15% time in WO	6–10% time in WO
2. The more frequent breaks from driving the better	≥15 min in every 2 h	≥ 15 min in every 3 h	≥15 mins in every 4 h	≥15 mins in every 5 h
Recovery breaks: sleep opportunities between work opportunities (WO's) to ensure sufficient time to obtain sufficient sleep to prevent unsafe levels of fatigue				
3. Ensure an adequate sleep opportunity (SO) in order to obtain sufficient sleep	Recovery breaks ≥12 h	Recovery breaks >9 h	Recovery breaks >8–9 h	Recovery breaks 7–8 h
4. Maximise adequate night sleep	All Recovery breaks include 23:00 to 07:00 period	All Recovery breaks include 00:00 to 06:00 period	More than half of Recovery breaks include 00:00 to 06:00 period	Less than half of Recovery breaks include 00:00 to 06:00 period
5. Minimise shifts ending between 00:00 to 06:00 h	No WO's end in 23:00 to 07:00 period	No WO's end in 00:00 to 06:00 period	Less than half of WO's end in 00:00 to 06:00 period	More than half of WO's end in 00:00 to 06:00 period
6. Minimise extended shifts	<12 h WO between Recovery breaks	<13 h WO between Recovery breaks	13–14 h WO between Recovery breaks	>14–17 h WO between Recovery breaks
Reset breaks: breaks in sequences of WO to eliminate the build-up of unsafe levels of fatigue over an extended sequence of shifts				
7. Prevent accumulation of fatigue with Reset breaks at least 30 h and including two night periods, 00:00– 06:00) between work sequences	≤ 2 d (48 h) between Reset breaks	≤ 3 d (72 h) between Reset breaks	≤ 7 d (≤168 h) between Reset breaks	>7 d to 12 d (>168–288 h) between Reset breaks

continuous hours of stationary rest in any 28-d period. Two-up drivers must have a minimum of 10 continuous hours of stationary rest in any 52-h period, 24 continuous hours of stationary rest and 24 h of stationary rest in blocks of 7 continuous hours in any 7-d period, and a minimum of 2 night rest breaks and 2 night rest breaks on consecutive days in any 14-d period.

Basic fatigue management scheme (BFM)

Employers and drivers who are transitioning from using a purely prescriptive approach toward a risk management approach can participate in the basic fatigue management scheme (BFM). Drivers who are registered as participants in this scheme adhere to a prescriptive rule set that is similar to, but less stringent than, the rule set for drivers in the Standard Hours Scheme (described above). For example, the maximum work limit for a 24-h period is 14 h instead of 12 h.

Drivers participating in this scheme must undergo a medical examination and attend an approved fatigue management training course. Employers of drivers participating in this scheme must: (i) manage their drivers, including their driving, work, and rest times, so that they comply with the prescriptive rules, (ii) ensure that their drivers attend an approved fatigue management training course, and (iii) keep complete and accurate records regarding driving,

work, and rest times; the drivers' medical examinations; and the approved fatigue management training course attended by their drivers.

Advanced fatigue management scheme (AFM)

An employer or self-employed driver who wishes to use a risk management system to control the fatigue-related risks associated with hours of work, may apply for an exemption from any of the prescriptive rules related to driving time, work time, and rest time. An exemption may be granted if the employer or driver can show that: (i) the fatigue management practices that they plan to follow would be at least as effective as adhering to the prescriptive rule set in managing driver fatigue, and (ii) the fatigue management practices are likely to be followed effectively and consistently.

The unique aspect of this approach has been the introduction of a risk classification system that operates across 7 dimensions (Table 4)²⁴. This is a unique methodology that enables operators to restrict their operational practices across one or more dimensions in exchange for exceeding one or more dimensions. Approval requires the organization to demonstrate a no-net increase in risk compared to operating under the Standard Hours Scheme. For example, an operator could apply to exceed the maximum number of sequential shifts (e.g., from 6 up to 12) if they were pre-

pared to restrict driving to daylight hours only. The AFM program introduces the idea of ‘risk trading’ over a generic rule set. If one can demonstrate an appropriate suite of risk offsets equivalent or greater to the required risk increase (within a limited range), it is possible to obtain approval to operate using an alternate compliance methodology.

Freight and passenger train drivers

Historically, safety regulation in the rail industry has been delivered by separate regulators in each of Australia’s six states and two territories. However, in 2012, the Council of Australian Governments (COAG) created a national system of rail safety regulation, and established a single rail safety regulator—the Office of the National Rail Safety Regulator (ONRSR)—to administer the Rail Safety National Law. This law was first enacted in South Australia (i.e., Rail Safety National Law [South Australia] Act 2012)²⁵, and has since been replicated in most other states and territories.

The national law is supported by the Rail Safety National Law National Regulations 2012²⁶. These Regulations describe a risk management approach that must be applied in all states and territories to reduce the fatigue-related risks associated with train drivers’ hours of work. In two states—New South Wales and Queensland—in addition to utilizing a risk management approach, employers must also comply with prescriptive rule sets.

Risk management approach

Any organization that employs train drivers must have a fatigue risk management program that establishes, maintains, and documents the procedures that it will use to manage fatigue-related risks. These procedures must include: (i) scheduling practices that provide safe hours of work, safe periods of time off between shifts, and a sufficient number of drivers to meet reasonably foreseeable demands for relief arrangements, (ii) provisions for monitoring planned and actual hours of work, and (iii) the provision of appropriate education and training to enable employees to identify and manage fatigue-related risks.

Additional prescriptive rule sets

In addition to utilizing a risk management approach, employers and drivers in New South Wales and Queensland must also comply with an overarching prescriptive rule set that specifies ‘outer limits’ for particular dimensions of the working time arrangement.

New South Wales – freight train drivers.

- Maximum shift length: 9 h for one-driver operations,

with a break of ≥ 30 min between the third and fifth hour of a shift; 12 h for two-driver operations.

- Minimum break between consecutive shifts: 7 h if the break occurs away from a driver’s home depot; 11 h if the break occurs at a driver’s home depot.

- Cumulative work limits: In any 14-d period, a driver may work a maximum of 12 shifts, of which no more than 6 shifts may be 12-h shifts.

New South Wales – passenger train drivers.

- Maximum shift length: 9 h for suburban single-driver operations; 10 h for interurban or long-distance single-driver operations; 12 h for any two-driver operations.

- Minimum break between consecutive shifts: 7 h if the break occurs away from a driver’s home depot; 11 h if the break occurs at a driver’s home depot.

- Cumulative work limits: In any 14-d period, a driver may work a maximum of 12 shifts; and for two-driver operations, no more than 6 of these 12 shifts may be 12-h shifts.

Queensland – freight and passenger train drivers:

- Maximum shift length: 9 h for suburban passenger operations, with a maximum 8 h of driving time; 9 h for any other one-driver operations; 12 h for any other two-driver operations.

- Minimum break between consecutive shifts: 8 h if the break occurs away from a driver’s home depot; 12 h if the break occurs at a driver’s home depot.

- Cumulative work limits: In any 14-d period, a driver may work a maximum of 12 shifts and a maximum of 132 h in total.

Airline pilots

The control of fatigue-related risks associated with shift work for airline pilots is regulated by the Civil Aviation Safety Authority (CASA) through Civil Aviation Order 48.1 Instrument 2013²⁷. This instrument was created under the Civil Aviation Regulations 1988²⁸, the Civil Aviation Safety Regulations 1998²⁹, the Acts Interpretation Act 1901³⁰, and the Civil Aviation Act 1988³¹.

Historically, airlines have been required to control the fatigue-related risks associated with pilots’ hours of work by applying a prescriptive set of rules with maximum duty limits and minimum rest limits. Currently however, CASA is in the process of transitioning airlines to a new system under Civil Aviation Order 48.1 Instrument 2013²⁷. This new system, which should be fully operational in late-2018, provides airlines with the option to use either a prescriptive approach, or a risk management approach, to control fatigue-related risks (see Civil Aviation Order 48.1

Instrument 2013, Appendix 2 and Appendix 7, respectively²⁷⁾). The default position will be that an airline must use a prescriptive approach. However, if an airline trials a fatigue risk management system for at least 12 months, and satisfies CASA that it has acceptable safety outcomes during the trial, then it can be granted approval to operate a full fatigue risk management system.

Civil Aviation Order 48.1 Instrument 2013²⁷⁾ deals with pilots of various kinds of aircraft conducting various types of operations, but this sub-section is focused on pilots that operate passenger-carrying multi-pilot aircraft, i.e., airline pilots.

Prescriptive rule set

If an airline has not been granted permission to operate a fatigue risk management system, then it must apply a prescriptive rule set to its pilots' hours of work. The main rules are summarized below:

- Flight/duty limits for single duty periods with two pilots. The maximum limits are 7–10 h of flight and 8–14 h of duty, depending on: (i) whether a pilot's body clock is acclimatized to the time zone in which the duty period commences (limits are higher if a pilot is acclimatized), (ii) the time-of-day that the duty period occurs (limits are higher if the duty period occurs during the daytime), and (iii) the number of flight sectors to be flown in the duty period (limits increase as the number of sectors decrease).

- Flight/duty limits for single duty periods with more than two pilots. The maximum flight limits increase from 7–10 h to 9–16 h, and the maximum duty limits increase from 8–14 h to 11–18 h, depending on: (i) whether there is one or two extra pilots on a flight (limits increase as the number of pilots increase), (ii) the type of rest facilities available on a flight (limits increase as the quality of the rest facilities increase), (iii) whether or not a pilot's body clock is acclimatized to the time zone in which the duty period commences (limits are higher if a pilot is acclimatized), and (iv) the time-of-day that the duty period occurs (limits are higher if the duty period occurs during the daytime).

- Minimum off-duty limits after a duty period of ≤ 12 h.

A. If a pilot's body clock is acclimatized to the time zone in which the off-duty period occurs and the off-duty period occurs away from the pilot's home base, then the off-duty period must be at least the sum of 10 h plus the amount that the time zone difference between the duty period's start and end ports exceeds 3 h after westward travel or 2 h after eastward travel.

B. If a pilot's body clock is acclimatized to the time

zone in which the off-duty period occurs and the off-duty period occurs at the pilot's home base, then the off-duty period must be at least the sum of 12 h plus the amount that the time zone difference between the duty period's start and end ports exceeds 3 h after westward travel or 2 h after eastward travel.

C. If a pilot's body clock is not acclimatized to the time zone in which the off-duty period occurs, then the off-duty period must be at least the sum of 14 h plus the time zone difference between the duty period's start and end ports.

- Minimum off-duty limits after a flight duty period of >12 h.

A. If a pilot's body clock is acclimatized to the time zone in which the off-duty period occurs, then the off-duty period must be at least the sum of 12 h, plus 1.5 times the amount that the duty period exceeded 12 h, plus the amount that the time zone difference between the duty period's start and end ports exceeds 3 h after westward travel or 2 h after eastward travel.

B. If a pilot's body clock is not acclimatized to the time zone in which the off-duty period occurs, then the off-duty period must be at least the sum of 14 h, plus 1.5 times the amount that the duty period exceeded 12 h, plus the time zone difference between the duty period's start and end ports.

- Cumulative flight limits. A pilot must not accrue flight time in excess of 100 h in any 28-d period, or 1,000 h in any 365-d period.

- Cumulative duty limits. A pilot must not accrue duty time in excess of 60 h in any 168-h period, or 100 h in any 336-h period.

Fatigue risk management system

If an airline has been granted permission to operate a fatigue risk management system, then it does not have to conform to the prescriptive rule set described above to its pilots' hours of work. Rather, it must use principles of risk management to control the fatigue-related risks associated with its pilots' hours of work and demonstrate an equivalent or higher level of system safety.

An airline operating a fatigue risk management system must have practical operating procedures to: (i) identify fatigue-related safety hazards, (ii) implement remedial actions to mitigate the risks associated with the hazards, (iii) record and monitor the hazards and associated remedial actions, (iv) determine maximum flight limits, maximum duty limits, and minimum rest limits, and (v) amend the flight, duty and/or rest limits if safety data indicate that they are too high or too low.

An airline operating a fatigue risk management system

Table 5. Laws to protect night shift workers in Japan, China, and Korea

Country	Definition of night work	Legislation
Japan	Working from 10 PM to 5 AM	<p><u>Labor Standards Law</u> <i>Protection for pregnant women</i> Article 66-3. In the event that an expectant or nursing mother has requested, an employer shall not have her work at night.</p> <p><u>Industrial Safety and Health Law</u> <i>Health examination for night workers</i> Article 45. An employer shall have night workers take a health examination on each 6 month, in addition to changing the assignment of them.</p> <p>Article 66-2. Employees, who work at night 4 or more times per month in the past 6 month on average, can voluntarily take a health examination when they feel worried about their health. The employees can submit to the employer the results of the examination to care about their working condition.</p>
China	None (As far as we know, the definition is not found.)	<p><u>Labour Law of the People’s Republic of China</u> <i>Protection for pregnant women</i> Article 61. It is prohibited to arrange for women workers or staff members during their pregnancy to engage in work with Grade III physical labour intensity as stipulated by the State or other work forbidden to pregnant women. It is prohibited to arrange for women workers or staff members who have been pregnant for seven months or more to work in extended working hours or to work night shifts.</p> <p>Article 63. It is prohibited to arrange for female staff and workers during the period of breast-feeding their babies of less than one year old to engage in work with Grade III physical labour intensity as prescribed by the State or other labour forbidden to women during their breast-feeding period, or to work in extended working hours or to work night shifts.</p> <p><i>Health examination for night workers</i> None</p>
Korea	Working from 10 PM to 6 AM	<p><u>Labor Standards Law</u> <i>Protection for pregnant women</i> Article 70-2. An employer shall not have a pregnant female and one aged less than 18 work from 10 PM to 6 AM and on holiday.</p> <p><u>Industrial Safety and Health Law</u> <i>Health examination for night workers</i> Article 43. Special health examination was mandated 1 times per year among night workers in addition to regular health examination, given night shift work defined as an adverse work factor since 2014.</p>

must identify fatigue-related hazards using a combination of: (i) predictive processes, e.g., assessment of proposed rosters using biomathematical models of fatigue, (ii) proactive processes, e.g., fatigue surveys of pilots, and (iii) reactive processes, e.g., investigate events that negatively affect safety to determine the extent to which fatigue-related hazards were a contributing factor.

Asia (Japan, China, and Korea)

In terms of regulatory protection for night shift workers, we reviewed the information regarding the established laws in Japan, China, and Korea. Table 5 summarizes the

laws regarding the regulatory protection for night shift workers in the three countries. Interestingly, these jurisdictions have taken a fundamentally different approach. Rather than regulating the working time arrangement to protect all workers, these jurisdictions have opted to focus on protecting ‘at risk’ workers. At least two approaches are found in the level of governmental regulation. First is the protection for expectant and nursing mothers, which limits maternal working to protect from work-induced miscarriage. The approach is conducted in three countries. The second approach, adopted in Japan and Korea, requires special health examinations for night shift workers. As far as we know, the second approach is not conducted in

China. Then, we illustrate here the recent trends to protect the health and well-being of night shift workers in Japan.

Maternity protection

Pregnancy and maternity are vulnerable periods of time for working women³²⁾. Expectant and nursing mothers require special protection to prevent harm to their or their infants' health. According to Japanese labor standards law, an employer cannot request an expectant or nursing mother to work at night (22 to 5 h), to work overtime, or to work on their scheduled days off, during the nursing period and one year postpartum. In addition, the Korean federal government principally prohibits maternal working at night (22 to 6 h), but employers can allow pregnant employees to work at night if employees agree to do so. Namely, both countries allow pregnant employees work at night based on their "voluntary agreement" to work. However, there are no data available which examine whether pregnant women have a choice to refuse work at night without repercussions. Further studies would thus be needed to clarify the critical issues. It should also be noted that Korean nurses are often required to set an order of pregnancies within their hospital ward to prevent concurrent pregnancies. The system is so called "Pregnancy Turn System", which is a very crucial issue in Korea³³⁾.

Special health examination

Special health examinations are currently mandatory for workers in both Japan and Korea. The content is very similar between the two countries. Those who work at least 4 or more night shifts per month are required to take two health examinations per year. The system of special health examination was introduced in Korea in 2014 and in Japan in 1972.

As shown in Table 3, night shift workers in Japan can receive a health examination on a voluntary basis when they think it necessary. According to national statistics conducted at 2010, only 38.6% of the night shift workers are aware of this service and among those who are aware, 54.7% reported receiving the health examination³⁴⁾. In total, approximately 20% of the night-working individuals are estimated to use this sort of health service. It is difficult to determine how these values would be adequate, yet efforts may be needed to increase awareness of the current supporting system in the workplace. Furthermore, measures (e.g., medical history, subjective assessments, blood tests, electrocardiogram etc.) in the voluntary health examination are the same as those in regular health check-up for non-shift workers. A future task is to evaluate the

indicators measured critically and to propose more appropriate measures to catch health problems of the night shift workers at an early stage.

Examples of types of regulation

Notification on drivers

According to the Japan Ministry of Health, Labour and Welfare, the largest number of Karoshi (death, suicide, and health disorder due to overwork) cases are commercial drivers. In the 2017 fiscal year, a total of 840 claims for workers' compensation for cardiovascular disease were filed in Japan; 164 (19%) of those claims were made by drivers, and 89 (35%) of 253 compensation claims by drivers were awarded³⁵⁾. Drivers have been suffering from long working hours so far. Ironically, due to the development of information communication technology, online shopping has made it more convenient for the public to purchase goods. A side effect of this convenience is an increased volume of goods shipped with adverse effects on working hours and conditions for the drivers who deliver these goods. In order to reduce the risk of fatigue-related incidents associated with long working hours, the ministry provided a notification on drivers (Table 6), which is summarized as follows; 1) rest limits, 2) duty limits, 3) maximum consecutive driving time, 4) breaks, 5) naps during night shifts. This notification targets commercial drivers who are paid by employers regardless of shipping goods. And truck, bus, and taxi drivers are mainly regulated by this notification.

Guidelines on night shift-working nurses

The Karoshi problem is a serious occupational hazard for Japanese nurses. Long working hours are common among many Japanese hospitals where 16 h shifts have become commonplace. To improve the working conditions, the Japanese Nursing Association (JNA) proposed new guidelines in 2013 for nurses working night-shifts. These guidelines are based upon in recommendations, by Prof. Joseph Rutenfranz who served as Chair of ICOH Scientific Committee on Shiftwork from 1978 to 1989, for the design of shift work system³⁶⁾ since 2013³⁷⁾, as listed in Table 6.

New trends regarding the protection of mental health of Japanese workers

The Karoshi problem is highly prevalent in Japan, as mentioned before. In response to this circumstance, a new law to prevent the Karoshi has been introduced in 2014³⁸⁾. Much attention has been paid to prevention of excessive

Table 6. Regulatory approach for drivers and hospital nurses in Japan

Schedule component	Truck drivers (Notification on drivers by the Japan Ministry of Health, Labour and Welfare)	Hospital nurses (Guideline on night shift work for nurses by Japanese Nursing Association)
Rest limits	Provide 8 h or longer rest time between shifts	Provide 11 h or longer rest time between shifts.
Duty limits	Up to 13 h per day in principal. Truck: Up to 293 h per month Bus: Up to 65 h per 4 weeks on average Taxi: Up to 299 h per month	Total hours spent at work are up to 13 h per shift.
Maximum consecutive driving time	Bus & Truck: Max 4 h	N/A
Number of night shifts	N/A	Night shifts should basically be within 8 times a month in a system of 3 shifts per day. If using another shift systems, the number should adjust to the work hours.
Number of consecutive night shifts	N/A	Up to 2 consecutive night shifts
Number of consecutive working days	N/A	Up to 5 d
Breaks	Bus & Truck: Provide more than 30 min breaks after max 4 driving hours	Provide 1 hour or more in the middle of a night shift, and a period according to the length and load of the shift during a day shift.
Naps during night shifts	Taxi: Provide more than 4 h nap when drivers work the 48 h shift	Provide an uninterrupted nap time in the middle of the night shift.
Rest following a night shift (including days off)	N/A	Provide a rest period of 48 hours or more after 2 consecutive night shifts. A rest period of 24 h or more is desirable after 1 night shift.
Consecutive days off on weekends	N/A	Consecutive days off over Saturday and Sunday without preceding following night shift should be ensured at least once a month.
Direction of rotation	N/A	The roster to be forward rotating.
Start of the morning shift	N/A	Avoid starting the morning shift before 7 AM.

fatigue associated with work schedules at each layer of stakeholder engagement. Some progress in protecting the health and well-being of night shift workers have been made here.

To ensure mental well-being at work, the Stress Check Program, a new occupational health policy was introduced by the Japanese government in 2015³⁹). This program is enforced under the Industrial Safety and Health Law, and mandates employees in high psychological stress occupations in workplaces with more than 50 employees to undergo an annual psychological screening with a government appointed mental health care physician. Employers are required to provide employees with a physician interview upon request. However, the privacy of employees is of utmost importance, therefore, results of the Stress Check are not shared with employers without consent from participating employees. Given the fairly recent implementation of this program, the effectiveness has not yet been evaluated. As such, continued monitoring is critical.

In summary, this section provides the current status of

legislations for night shift workers in Japan, China, and Korea and recent, relevant conditions in Japan. We are able to address the three countries only, but should examine the circumstances in other Asian countries as well. Given the sociocultural differences among Asia, Europe, North America, or Oceania, countermeasures and policies towards night shift work need to be developed accordingly.

Acknowledgements

This section for Asia was supported partly by research funding of Industrial Disease Clinical Research Grants from the Ministry of Health, Labour and Welfare, Japan (150903-01). We thank Dr. Xinxin Liu and Dr. Rina So of the Research Center for Overwork-Related Disorders, National Institute of Occupational Safety and Health, Japan, for their providing us with essential information in China and Korea, respectively.

Disclaimer

The findings and conclusions in this paper are those of the authors and do not necessarily represent either the views of the National Institute for Occupational Health, U.S.A. or the National Institute of Occupational Safety and Health, Japan.

References

- 1) Wong IS, Dawson D, Van Dongen HPA (2019) International consensus statements on non-standard working time arrangements and occupational health and safety. *Ind Health* **57**, 135–8.
- 2) DIRECTIVE 2003/88/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 4 November 2003 concerning certain aspects of the organisation of working time.
- 3) AZG (Arbeitszeitgesetz Austria, 2014-11-14).
- 4) Collective Agreement KV_DenkmalFassadenGebäude, 2014.
- 5) 49 U.S. Code of Federal Regulations (CFR) Part 385 – Safety Fitness Procedures (U.S. Federal Motor Carrier Safety Administration).
- 6) 49 CFR Part 386 – Rules of Practice for Motor Carrier Safety and Hazardous Materials Proceedings.
- 7) CFR Part 390 – Federal Motor Carrier Safety Regulations; General.
- 8) CFR Part 395 – Hours of Service of Drivers (U.S. Federal Motor Carrier Safety Administration).
- 9) Canadian Statutory Orders and Regulations (SOR)/2005–313 – Commercial Vehicle Drivers Hours of Service Regulations.
- 10) 14 CFR Part 117 – Flight and Duty Limitations and Rest Requirements: Flightcrew Members.
- 11) 14 CFR Part 91.1062 – Duty periods and rest requirements: Flight attendants.
- 12) SOR/96–433 Part VII Subsection 700 – Canadian Aviation Regulations, Commercial Air Services.
- 13) 49 U.S. Code, Chapter 11 – National Transportation Safety Board.
- 14) 49 CFR 228 – Hours of Service of Railroad Employees; Recordkeeping and Reporting; Sleeping Quarters.
- 15) 49 CFR Part 228, Subpart F – Substantive Hours of Service Requirements for Train Employees Engaged in Commuter or Intercity Rail Passenger Transportation.
- 16) Transport Canada TC O 0–140 – Work/Rest Rules for Railway Operating Employees.
- 17) 46 CFR Part 15.1111 – Work hours and rest periods (U.S. Maritime Operations).
- 18) SOR/2007–115 – Marine Personnel Regulations.
- 19) 10 CFR Part 26.205 – Work Hours (U.S. Nuclear Regulatory Commission).
- 20) Gander P, Hartley L, Powell D, Cabon P, Hitchcock E, Mills A, Popkin S (2011) Fatigue risk management: Organizational factors at the regulatory and industry/company level. *Accid Anal Prev* **43**, 573–90. [[Medline](#)] [[CrossRef](#)]
- 21) Fair Work Act [Australia] 2009. <http://www.legislation.gov.au/Details/C2017C00144>. Accessed September 4, 2017.
- 22) Heavy Vehicle (Fatigue Management) National Regulation [Queensland]. <http://www.legislation.qld.gov.au/view/pdf/inforce/2016–02-06/sl-2013–0078>. Accessed November 2, 2017.
- 23) Heavy Vehicle National Law Act [Queensland] 2012. <http://www.legislation.qld.gov.au/view/pdf/inforce/current/act-2012–021>. Accessed November 2, 2017.
- 24) National Heavy Vehicle Regulator Risk Classification System Tool <http://www.nhvr.gov.au/files/201503–0152-risk-classification-system-tool.pdf>. Accessed November 2, 2017.
- 25) Rail Safety National Law [South Australia] Act 2012. <http://www.legislation.sa.gov.au/LZ/C/A/Rail%20Safety%20National%20Law%20%28South%20Australia%29%20Act%202012.aspx>. Accessed September 4, 2017.
- 26) Rail Safety National Law National Regulations [South Australia] 2012. <http://www.legislation.sa.gov.au/LZ/C/R/RAIL%20SAFETY%20NATIONAL%20LAW%20NATIONAL%20REGULATIONS%202012.aspx>. Accessed September 4, 2017.
- 27) Civil Aviation Order 48.1 Instrument [Australia] 2013. <http://www.legislation.gov.au/Details/F2016C00895>. Accessed September 4, 2017.
- 28) Civil Aviation Regulations [Australia] 1988. <http://www.legislation.gov.au/Details/F2017C00094>. Accessed September 4, 2017.
- 29) Civil Aviation Safety Regulations [Australia] 1998. <http://www.legislation.gov.au/Details/F2017C00470>. Accessed September 4, 2017.
- 30) Acts Interpretation Act [Australia] 1901. <http://www.legislation.gov.au/Details/C2016C00691>. Accessed September 4, 2017.
- 31) Civil Aviation Act [Australia] 1988. <http://www.legislation.gov.au/Details/C2016C01097>. Accessed September 4, 2017.
- 32) Burdorf A, Brand T, Jaddoe VW, Hofman A, Mackenbach JP, Steegers EA (2011) The effects of work-related maternal risk factors on time to pregnancy, preterm birth and birth weight: the Generation R Study. *Occup Environ Med* **68**, 197–204. [[Medline](#)] [[CrossRef](#)]
- 33) Korea Health and Medical Workers' Union. When it comes to pregnancy, women being told to 'wait their turn'. http://english.hani.co.kr/arti/english_edition/e_national/659317.html. 2014. Accessed February, 2017.
- 34) Ministry of Health, Labour and Welfare. Basic Survey on Industrial Safety and Health, 2010. http://www.e-stat.go.jp/SG1/estat/GL08020103.do?_xlsDownload_&fileId=000005091316&releaseCount=1, Accessed February, 2017.
- 35) Ministry of Health, Labour and Welfare. <https://www.mhlw>.

- go.jp/stf/newpage_00039.html. 6 July, 2018. Accessed August, 2018.
- 36) Japanese Nursing Association JNA News Release. <http://www.nurse.or.jp/jna/english/>. April 2013. Accessed February, 2017.
- 37) Knauth P, Rutenfranz J (1982) Development of criteria for the design of shiftwork systems. *J Hum Ergol (Tokyo)* **11** Suppl, 337–67. [[Medline](#)]
- 38) Yamauchi T, Yoshikawa T, Takamoto M, Sasaki T, Matsumoto S, Kayashima K, Takeshima T, Takahashi M (2017) Overwork-related disorders in Japan: recent trends and development of a national policy to promote preventive measures. *Ind Health* **55**, 293–302. [[Medline](#)] [[CrossRef](#)]
- 39) Kawakami N, Tsutsumi A (2016) The Stress Check Program: a new national policy for monitoring and screening psychosocial stress in the workplace in Japan. *J Occup Health* **58**, 1–6. [[Medline](#)] [[CrossRef](#)]