DOT/FAA/AM-16/6
Office of Aerospace Medicine
Washington, DC 20591

Evaluation of Fatigue and Responsibilities of Cargo Supervisors and Flight Mechanic Cargo Supervisors

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August 2016

Final Report

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT/FAA/AM-16/6		

4. Title and Subtitle
Evaluation of Fatigue and Responsibilities of Cargo Supervisors and Flight Mechanic Cargo Supervisors

5. Report Date
August 2016

6. Performing Organization Code

7. Author(s)
Bryant MR, Nesthus TE, Rowley C

8. Performing Organization Report No.

9. Performing Organization Name and Address
FAA Civil Aerospace Medical Institute
P.O. Box 25082
Oklahoma City, OK 73125

10. Work Unit No. (TRAIS)

11. Contract or Grant No.

12. Sponsoring Agency name and Address
Office of Aerospace Medicine
Federal Aviation Administration
800 Independence Ave., S.W.
Washington, DC 20591

13. Type of Report and Period Covered

14. Sponsoring Agency Code

15. Supplemental Notes

16. Abstract
In response to an open National Transportation Safety Board (NTSB) recommendation (2016; A-15-014) and at the request of the Federal Aviation Administration's (FAA's) Aircraft Maintenance Division (ASF-300), a study was conducted to document the current rest and fatigue status of cargo load supervisors as well as collect information regarding the perceived responsibilities of load supervisors while performing regular duties. A total of four organizations agreed to have researchers observe daily cargo operations and recruit participants for each of the three studies: (a) a general fatigue survey, (b) a 14-day field study, and (c) a two-hour interview. Findings supported previous research on fatigue risk in shift workers and indicated that load supervisors were at risk of fatigue on all seven primary and contributing factors of fatigue: Time of day, Time awake, Time on task, Time asleep, Adequate sleep, Work schedule factors, and Cumulative sleep debt. Night shift load supervisors exhibited a greater risk of fatigue than their day shift counterparts. Interviews revealed that load supervisors perceived a majority of their responsibilities to be shared with cargo personnel, as opposed to holding sole responsibility. Recommendations include fatigue awareness training, monitoring of load supervisor duty/rest times inclusive of overtime, the use of Safety Management Systems (SMS) and Fatigue Risk Management Systems (FRMS) to reduce risk, and having clearly defined roles and responsibilities for load supervisor duties.

17. Key Words	18. Distribution Statement
Fatigue, Cargo, Responsibilities, Risk Mitigation	Document is available to the public through the Internet: http://www.faa.gov/go/oamtechreports/

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	21	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

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INTRODUCTION

On April 29, 2013, a Boeing 747-400 cargo jet crashed just after takeoff. All crewmembers onboard died, and the airplane was destroyed. Improper cargo loading was the primary contributing factor to this event. As a result of the accident investigation, the National Transportation Safety Board (NTSB) recommended the FAA create a certification for personnel responsible for the loading, restraining, and documentation of special cargo loads (2016; A-15-014). Included in the NTSB report was a recommendation that the certificating process include information regarding procedures, training, and duty/rest hours consistent with other safety-sensitive, certificated positions. The FAA's Aircraft Maintenance Division (AFS-300) has assigned the Cargo Focus Team to support this effort. The team requested a preliminary study of the current duty/rest times and responsibilities associated with cargo load supervisors for cargo-only operations. A small sample was recruited to explore possible patterns and trends of cargo load supervisors that may mirror patterns and trends found in similar studies of shift workers in the aviation industry. This report documents: (a) the current rest and fatigue status of cargo load supervisors, and (b) load supervisor's perceived job responsibilities.

Roles and Responsibilities of Load Supervisors

Cargo loading is managed and/or supervised by load supervisors. The load supervisor must be present to oversee the sequencing, loading, securing, and distributing of weight of the cargo; calculate the cargo restraint requirements; calculate the weight and balance of the aircraft given the cargo, passenger, and fuels weights; and prepare the load manifest prior to flight. The cargo can range from standard unit load devices to unique items called "special cargo," which may require restraining the cargo directly to the aircraft structure. Examples of this type of special cargo include munitions, aircraft engines, and large equipment such as tractors, oil rigging equipment, or heavy military vehicles.

In some instances, the load supervisor and/or maintenance personnel (e.g., flight mechanics) accompany the aircraft on long extended missions. The requirements to have personnel on board the aircraft are driven by the uncertainty of destinations, ground support, and mission requirements. The load supervisor is responsible for the duties previously mentioned and other flight and cargo safety issues often specific to a particular aircraft. The flight mechanics are present to ensure servicing, maintenance, and inspection applicable to the aircraft. In some operations, the flight mechanic may also perform the duties of the load supervisor. The availability of the load supervisor and flight mechanic are particularly critical when qualified personnel are simply not available at remote locations.

One of the challenges associated with 24/7 operations, such as cargo loading and maintenance, is fatigue. The load supervisors often work in shifts and work long hours. The load supervisor and flight mechanics who accompany the aircraft often arrive at remote locations and proceed immediately to work, while flight crews are headed to quarters for appropriate sleep/rest.

Research Questions

In response to the research request, a study was conducted to gather information concerning work schedules and fatigue in load supervisors and flight mechanics. The purpose of this study was to determine:

1. What are the current rest/duty schedules of load supervisors and flight mechanics?

2. What are the current fatigue risks present for load supervisors and flight mechanics?

3. What are the current duties and responsibilities of load supervisors in the field?

A total of six cargo-only certificate holding organizations were contacted to request participation. Four organizations agreed to allow researchers to observe daily cargo operations and to recruit participants for each of the three studies included in this report: (a) a general fatigue survey, (b) a 14-day field study, and (c) a two-hour interview. Those personnel who were identified as a load supervisor or flight mechanic had the opportunity to participate in all three studies.

METHOD

One principal investigator (researcher) and one research technician (assistant) travelled to two U.S. locations for a one-week period at each location. Throughout these visits, the researchers briefed management on the goals and outcomes of the study and recruited, observed, trained, and collected data from participants.

Table 1
Sample Questions from the General Fatigue Survey

Question categories	Example questions
Shiftwork History	• Are you currently working shift work? • How many years have you worked shifts?
Duty/Rest Time	• How many hours of overtime do you typically work? • How often do you work overtime? • What is your average one-way commute time to your cargo loading job?
Sleep and Fatigue	• Do you often have difficulty falling asleep? • Do you frequently awaken in the night? • Do you drink beverages with caffeine within 5 hours of trying to sleep?
Health and Wellbeing	• Do you exercise on a regular basis? • Please describe your typical diet/eating pattern. • Have you suffered from (diagnosed by your doctor) any of the following medical conditions?
Coping	• To what extent does working shifts cause you problems with sleep, social life, domestic life, or work performance? • To what extent do you use the following strategies when you have problems caused by working shifts?
Work Environment	• To what extent do you feel your cargo organization facility adjusted scheduling to minimize fatigue? • What type of training or information has your airline provided you regarding fatigue? • What operational changes would you recommend to reduce your risk of fatigue?
Circadian Type	• Do you tend to need more sleep than other people? • If you had to do a certain job in the middle of the night, do you think you could do it almost as easily as you could at a more normal time of day? • If you have a lot to do, can you stay up late to finish it off without feeling too tired?
Demographics	• Please indicate your primary role/position. • What is your age? • How long have you worked in your current position?

General Fatigue Survey

A general fatigue survey was compiled and modified from three previously administered studies regarding fatigue and shift workers in the aviation industry (Barton, et al., 1995; Hall, Johnson, & Watson, 2001; Nesthus, Schroeder, Connors, Rentmeister-Bryant, & De Roshia, 2007). The survey questions focused on general information regarding shiftwork history, duty/rest times, health and wellbeing, coping, work environment, circadian type, and demographic data. Table 1 lists each category and example questions from each. The items listed in this table are not exhaustive of all questions asked.

14-Day Field Study

Daily log. In the 14-day field study, participants were asked to log their daily activities twice a day for each of 14 days using a mini iPad®. This log was similar to those used in previous fatigue research (Cruz & Della Rocco, 1995; Cruz, Detwiler, Nesthus, & Boquet, 2003). Participants were instructed to fill out their log within 40 minutes of waking and the second log was to be entered at least 30 minutes prior to lying down for sleep. Daily activities such as type of day, sleep and wake times, mood, food and beverages ingested, symptoms, medication taken, as well as any additional comments the participant had were all included. Table 2 provides the categories of questions as well as sample items for each. The items listed in this table are not exhaustive of all questions asked.

Psychomotor vigilance test. In addition to the daily log, participants were asked to complete a 5-minute Psychomotor Vigilance Test (PVT) using the mini iPad® twice a day: once upon waking, and once just before bed. This measure has been used in previous research (e.g., Roma, Hursh, Mead, & Nesthus, 2010), is considered the "gold standard" of alertness measurement in fatigue studies (Basner & Dinges, 2011), and has been used as a measurement of alertness in a myriad of studies including aviation, space, and other industries that include 24/7 operations such as the trucking, rail road, and coal mining industries. Sleep loss and fatigue studies have shown PVT data to accurately reflect alertness associated with sleep loss and circadian

Table 2
Sample Questions from the 14-day Daily Field Log

Question categories	Example questions
Day Details	• Is today a workday, day off, office work, inspection day, etc.?
Sleep/Wake	• What time did you awaken? • What time did you arise? • What time did you go to bed? • What time did you fall asleep? • Please indicate how deeply you slept last night. • Please indicate how rested you feel right now.
Mood	• How interested do you feel right now? • How alert do you feel right now? • How attentive do you feel right now?
Food	• List the meals/snacks you had today, please indicate what time and quantity as well.
Symptoms	• Did you experience any of the following symptoms today, headache, backache, nasal congestion, light-headedness, etc.?
Medication	• Did you take any prescription or over-the-counter medications today? If so, please indicate the name, time, and dosage.
Miscellaneous	• Is there anything about today which sets it apart from any other day?

rhythm. Vigilant attention is an important factor in safe performance. Thus, measurement of reaction time upon waking and prior to sleeping provided an indicator of performance at different points in a participant's circadian rhythm and represented an indicator of effects of sleep differences on performance.

There are three primary measures when PVT data are collected. First, simple reaction time to the stimulus is measured and response speed is calculated. Reaction time is the time it takes for the participant to react when the stimulus is presented. Therefore, a lower time measured indicates faster reaction time and thus, better performance. Reaction time is used to calculate response speed where the reciprocal of the reaction time (1/RT) is examined and represents how quickly the participant responded to the stimuli. Response speed is a standard measure used to interpret PVT data. Thus, the higher a participant's speed, the better their performance (the inverse of reaction time). Second, the number of times participants miss the stimulus entirely is represented by lapses. This measure is the ultimate measure of alertness wherein missing the stimulus or responding slower than 500 m/s (lapsing) is equivalent to not attending to the task (Basner, Mollicone, & Dinges, 2011). Third, to determine those who are at risk of lapsing, the slowest 10% of responses are reported. This measure represents those who may be at risk of fatigue simply due to how slowly they responded to the stimulus.

Actigraphy device. An actigraphy device was worn by all participants to measure daily activity with an accurate accelerometer designed for long-term monitoring of motor activity. This measure has been used in previous research as an objective measure of sleep/wake activity (Signal, Gale, & Gander, 2005). Participants wore the watch-like device on their non-dominant hand for the duration of the 14 days of study. Participants were instructed to remove the device for water/liquid-related activities (e.g., showering, washing dishes, the need to submerge their hand/arm in liquids for work-related activities). Once the water/liquid activity was complete, participants were instructed to put the device back on. The actigraphy device was used to determine each participant's hours of sleep, sleep latency, and overall sleep quality. For the purposes of this report, only the number of hours of actual sleep is reported.

Training procedure. All participants were provided an informed consent form in which the study purpose, duties, and duration were all explained. Once participants acknowledged and consented to participating, they were issued a hand-held electronic device (mini iPad®) and the actigraphy watch. The researcher then trained participants on the daily procedure of logging their information. In addition, participants were trained to complete the PVT application on the mini iPad®. The PVT was to be completed at the same time participants filled in their log each day. Upon completion of training, participants were provided multiple avenues (e.g., email, phone) to contact the researcher for the duration of the study. At the end of the study, participants returned all equipment in a pre-paid envelope via overnight mail. Data were confirmed and uploaded. Upon final review of hours (i.e., verification that logs were entered and PVT tests were completed at the specified times), participants were compensated for their time.

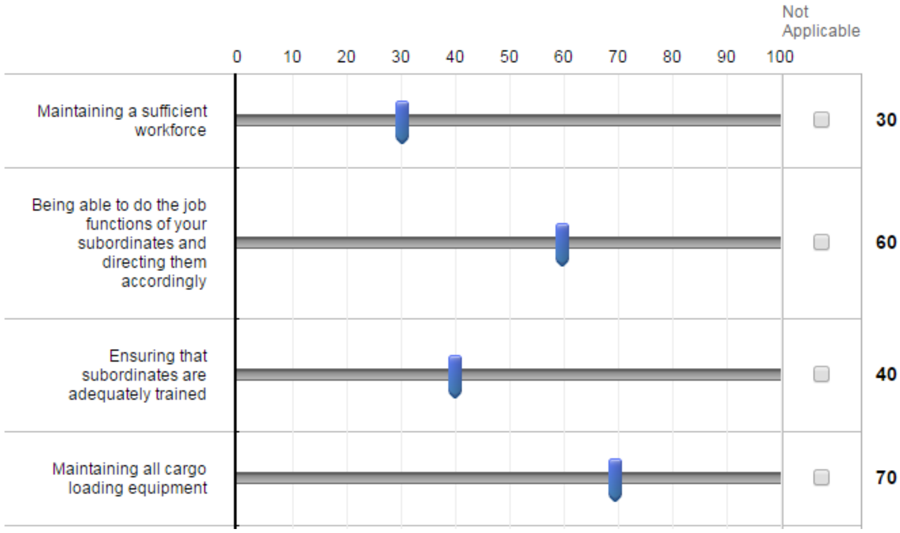

Figure 1. A sample of responsibilities identified and the percent to which load supervisors may perceive that responsibility as their own. For example, "What percentage of the time are you responsible for the job functions of your subordinates and direct them accordingly?"

Interviews

Data were gathered to support the perceived responsibilities of load supervisors while on duty. These data were collected via 2-hour, one-on-one, structured interviews. Interviewees were asked a list of 43 questions based on a database search of the most common responsibilities for load supervisors (see Table 6 for the full list). Participants were asked to estimate the percentage of responsibility the load supervisor has for each task listed (Figure 1). For example, participants were asked, "About how much of the time are you responsible for maintaining a sufficient workforce while on duty?" A participant may answer, "About 30% of the time."

Additionally, interview participants were asked to answer questions regarding their past work experience, cargo type experience (e.g., special cargo, live animals, etc.), how a cargo loading team divides responsibility, and the load supervisor's duty/rest time. Participants were also asked to rate their subjective workload and stress experienced on the job using a continuous analog scale anchored from 0 to 100. Finally, participants were asked about the use of rest facilities while flying with cargo. Each section of the interview was intended to understand the daily descriptions of the duties and responsibilities of load supervisors, while also placing those descriptions within the context of their workday.

Interview procedure. All participants were provided an informed consent form in which the study purpose, duration, and conclusion were explained. Once participants acknowledged and consented to participating, their permission was requested to audio record the session. All participants agreed to be recorded at which time the interview began. The items outlined above were asked in a semi-structured interview format. This means that while most questions were pre-planned, there were instances where the researcher asked for elaboration or further clarification of the answers. All interviews lasted between 60 and 90 minutes.

Participant Overview

Participants across each of the three studies were all male. The age distribution of participants is displayed in Figure 2. A majority of respondents reported between 1 and 5 years of experience in their current position, with between 1 and 30 years in the industry overall.

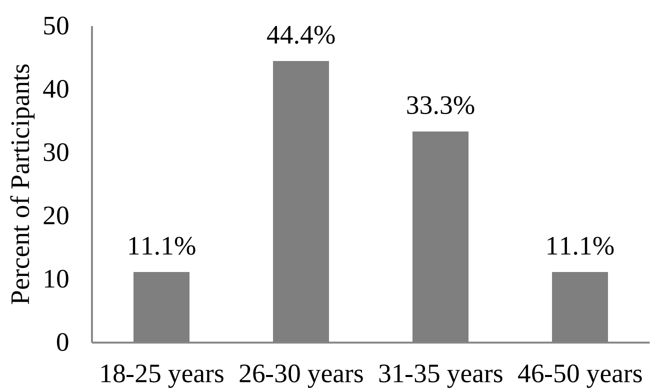

Figure 2. Percent of participants across age groups for all three studies.

General fatigue survey participants. A total of 15 participants were recruited to participate in a General Fatigue Survey (Table 3). Three participants returned study equipment without completing the General Survey. Two participants' data were incomplete, in that they did not fill out the entire survey (i.e., less than half). Of the four participating cargo organizations (carriers), one (Carrier C) did not employ load supervisors for their operations. Rather the ground operations supervisor performed the duties associated with load supervisor responsibilities. This participant did not choose to participate in the general fatigue survey.

Table 3
Demographic Characteristics of General Survey Participants

General Survey	Carrier	*N*	Day Shift	Night Shift	LS	FM
	A	4	2	2	3	1
	B	3	1	2	3	0
	C	0	0	0	0	0
	D	3	2	1	3	0
Total	4	10	5	5	9	1

*Note: Load Supervisor (LS), Flight Mechanic (FM)

Day shift and night shift *N*s were computed by the observed sleep and wake times reported daily. Participants were then assigned the shift that they typically worked while participating in the field study.

Field study participants. A total of 15 participants were recruited to participate in the 14-day log study. Three participants returned study equipment without completing the full 14 days. One participant's data was incomplete in that the data provided were not consistent enough to warrant inclusion. Therefore, a total of 11 participants were included in the final data analysis (Table 4). Of the four carriers, one (Carrier C) did not employ load supervisors for their operations. Rather, the Ground Operations Supervisor performed the duties that would be associated with load supervisor responsibilities. This participant was included in the interviews but did not participate in the 14-day field study.

Table 4
Demographic Characteristics of Field Study Participants

Field Study	Carrier	*N*	Day Shift	Night Shift	LS	FM
	A	6	4	2	5	1
	B	2	1	1	2	0
	C	0	0	0	0	0
	D	3	0	3	3	0
Total	4	11	5	6	10	1

*Note: Load Supervisor (LS), Flight Mechanic (FM)

Interview participants. The same cargo carriers allowed their load supervisor personnel to participate in a two-hour interview regarding the responsibilities of a load supervisor. A total of nine participants were interviewed (formally or informally) as to the responsibilities and duties associated with the load supervisor position (Table 5). Two participants were informally interviewed while the researcher observed normal duty time operations. Therefore, the information collected pertained to specific scenarios and operations and was constrained to the timing and events occurring in real time. In these instances, it was not possible to ask these individuals all of the formal interview questions.

Table 5
Demographic Characteristics of Interview Participants

Interview	Carrier	*N*	Day Shift	Night Shift
	A	4	3	1
	B	1	1	0
	C	1	1	0
	D	3	2	1
Total	4	9	7	2

RESULTS

Sleep Data

Night shift load supervisors in this study were found to be at risk of fatigue on each of three primary contributing factors: Time of day, Time awake, and Time asleep. That is, night shift load supervisors' behaviors appear to follow similar patterns and trends of larger fatigue studies on each of the primary contributing factors (See, Della Rocco & Nesthus, 2005 for review).

Time of day. Alertness and fatigue fluctuate as a function of time of day, i.e., in response to changes in the circadian rhythm. Fatigue is, when present, most severe between 2:00 a.m. and 6:00 a.m. (Folkard, 1996). Observations conducted by the principal investigator while collecting data found that the average start time for the night shift was 10:00 p.m. while day shift workers average start time was 8:00 a.m. Previous research has shown that start time prior to 9:00 a.m. resulted in decreased overall sleep time and quality, alertness reduction, and vigilance performance decrements in pilots (Simons & Valk, 1999, from Della Rocco & Nesthus, 2005). Based on the field log data, night shift load supervisors primarily worked a "4-on-4-off" schedule (i.e., working 4 days at 10 hours each, then having 4 days off) while day shift load supervisors averaged working 5 days a week for a duration of 8 hours. Though night shift workers may be accustomed to the "4-on-4-off" schedule, research shows that these disruptions in schedule result in disruptions to the circadian rhythms can result in more than just decreased alertness (Monk, Folkard, & Wedderburn, 1996, from Della Rocco & Nesthus, 2005) but can also have negative long-term health effects as well (Costa, 1999, from Della Rocco & Nesthus, 2005).

Time awake. When people have been continually awake for a long period of time, they are more likely to be fatigued. Figure 3 shows what the average day and night shift workers' "day" looked like when the reported work hours (from Field Study), overtime hours (General Fatigue Survey), recorded sleep times (actigraphy device), and commute times (General Fatigue Survey) were included.

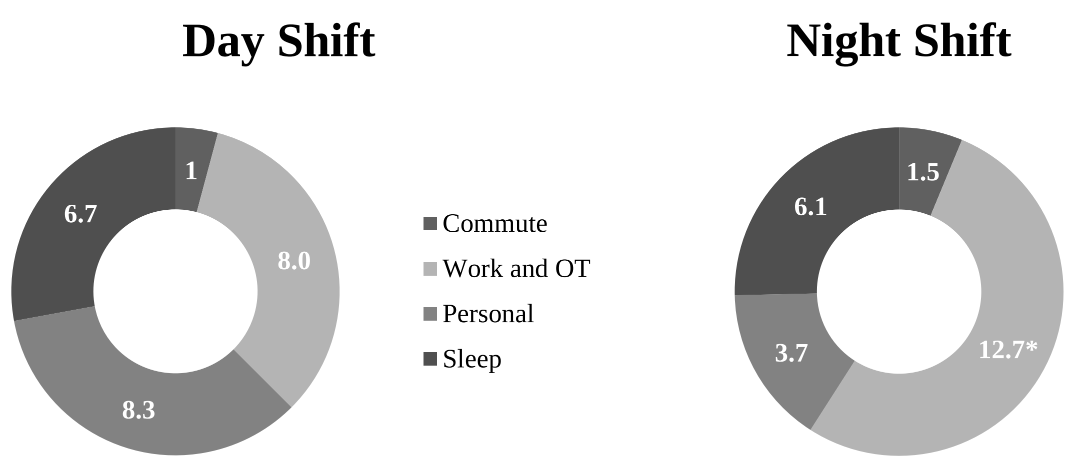

Figure 3. The average day of load supervisors and flight mechanic by shift. Data were combined across studies. Personal time was calculated by summing commute, work and overtime, and sleep times, then subtracting that total from 24 (hours in a day).
**Note:* Given the "4-on-4–off" schedule of the night load supervisor included in this study, 4 workdays would be at least 40 hours, with the remaining overtime allotted to a day off. This would increase the night load supervisor's work week by one full day as opposed to their day shift counterparts.

Time asleep. Getting less than 8 hours of sleep in the past 24 hours means one is more likely to be fatigued (Carskadon & Roth, 1991). A majority of load supervisors in this study reported sleeping less than 6 hours the night prior to the study date (Figure 4; General Fatigue Survey). This was also found to be the case in previous research conducted by Johnson Hall, & Watson (2001) where maintenance personnel reported an average of 5 hours per night. Compared to the Bureau of Labor Statistics (2014), these personnel reported sleeping roughly two hours less than their working counterparts.

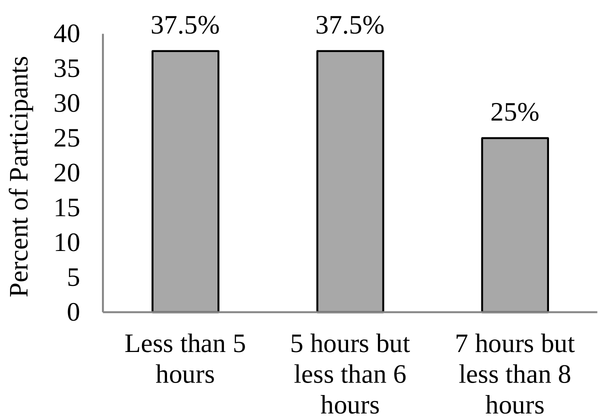

Figure 4. Percent of participants and their reported sleep for the night prior to taking survey as reported in the General Fatigue Survey. No participant responded they had 6 hours but less than 7 hours of sleep the previous night.

Adequate sleep. Research has consistently demonstrated that adequate sleep of around 8 hours sustains performance (Dinges, Graeber, Rosekind, Samel, & Wegmann, 1996). Sleep during the nighttime is preferable because it provides the most recuperative value due to the fact that sleep is occurring during the normal circadian low. Sleep should not be fragmented with interruptions (reducing sleep quality). In addition, environmental conditions, such as temperature, noise, and light, impact how beneficial sleep is and how performance is restored (Della Rocco & Nesthus, 2005). Sleeping during the daytime has also been found to be shorter in duration, more disrupted, and less restorative (Knauth & Rutenfranz, 1982).

Actigraphy data collected from[1] load supervisors in this study found that night shift workers both slept less and awoke consistently more frequently during their daytime sleep period than their day shift counterparts who sleep during the nighttime (Figure 5 and Figure 6, respectively).

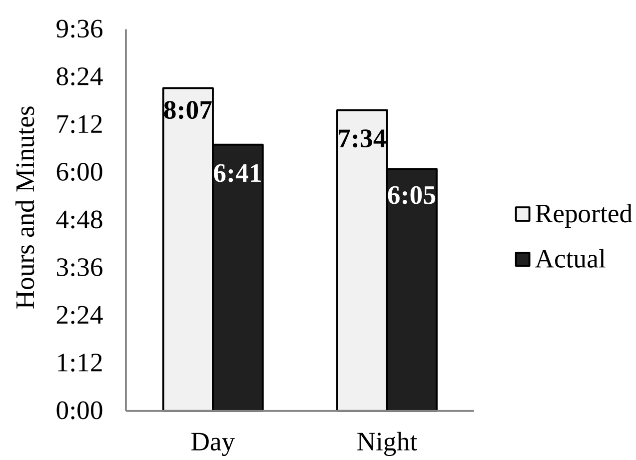

Figure 5. Mean hours of sleep duration by shift (Daily Log) for reported sleep hours and actigraphy sleep hours (actual).

[1] Given the small sample, descriptive and frequency counts were used to observe possible differences between day and night shift load supervisors for all actigraphy data.

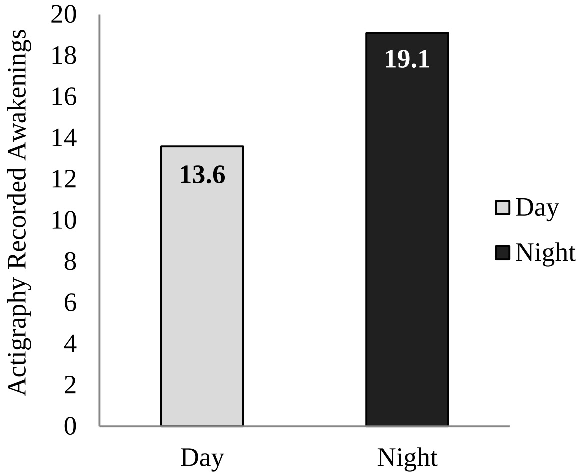

Figure 6. Actigraphy results of mean number of awakenings during sleep by shift.

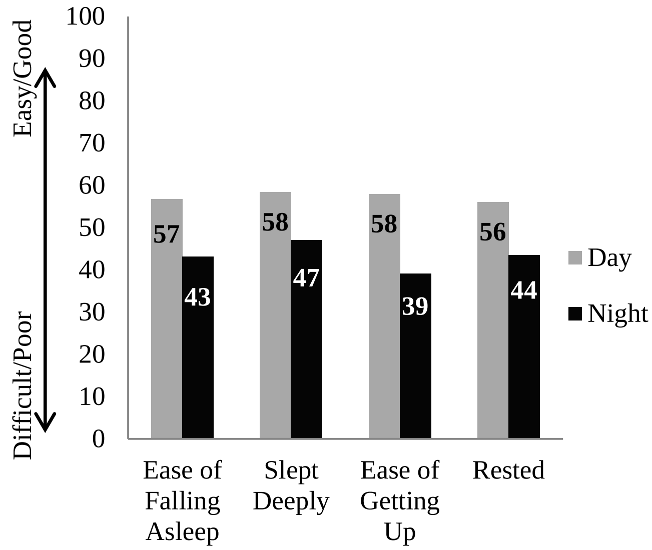

Figure 7. Mean ratings of sleep quality by shift as reported in Daily Logs. Participants were asked to rate on an anchored, continuous scale from 0 to 100 for each item.

Differences between data shown in Figure 4 and Figure 5 may be related to several factors. First, data collected regarding the previous night's sleep (Figure 4) was asked at the outset of the study. Therefore, participants may have given a more representative answer of their actual sleep length. Second, data collected regarding the average reported sleep (Figure 5) was asked as the study progressed through the 14 days. It is possible that participants became more aware of their sleep habits and over-estimated their sleep schedules based on knowledge gained about the risks of getting too little sleep. This bias is not uncommon in research studies (see Fisher, 1993 for examples) and is a primary reason why collecting objective data (via actigraphy and PVT data) are required elements of sleep research.

According to field log data, when asked on a continuous scale from 1 to 100, night shift load supervisors also reported consistently lower quality of sleep when compared to day shift load supervisors (Figure 7). These awakenings include times in which the participant may not have been aware of the awakened state, but that according to the accelerometer readings, the individual was moving at a frequency consistent with wakefulness. It is also important to note that these values were not skewed by one or two individuals but are representative of the participants overall.

Work schedule and alertness. The work schedule of an individual can also affect sleep and subsequent alertness (Knauth, 1993 as cited in Della Rocco & Nesthus, 2005). These include early morning start times, extended work periods (over 8 hours), insufficient time off between work periods (e.g., 8-hour quick turns), insufficient recovery time off between consecutive work periods, amount of work time within a shift or duty period (e.g., without breaks), number of consecutive work periods, night work through one's window of circadian low, daytime sleep periods, and day-to-night or night-to-day transitions (as cited in Della Rocco & Nesthus, 2005). The load supervisors in this study reflected what would be expected of typical shift workers with regard to alertness.

Response speed. A post-hoc multivariate analysis showed a significant effect of shift on response speed ($F(1)= 34.08$, $p<.001$) where night shift personnel responded faster than day shift overall even when day shift reported sleeping longer. Additionally, the post-hoc analysis revealed a significant Time by Shift interaction for response speed ($F(1)=8.25$, $p=.005$; Figure 8). That is, day shift response speeds were faster upon waking, than before bed, while night shift response speeds were faster before bed than upon waking. This finding supports the previous statements regarding the effects of the circadian rhythm. For example, it appears that day shift workers' alertness predictably declined over the time of their shift, whereas night shift workers' alertness did not. Given that the average time their night shifts ended was 8 a.m. (as recorded through researcher observations), participants were outside of the "window" for fatigue risk (between 2 a.m. and 6 a.m.) and were likely experiencing the normal rise in alertness associated with their body clock (i.e., circadian rhythm). Additionally, there may be more factors such as environmental cues (i.e., shift changes where an increase in interactions between people occurred, etc.), which may have contributed to this result.

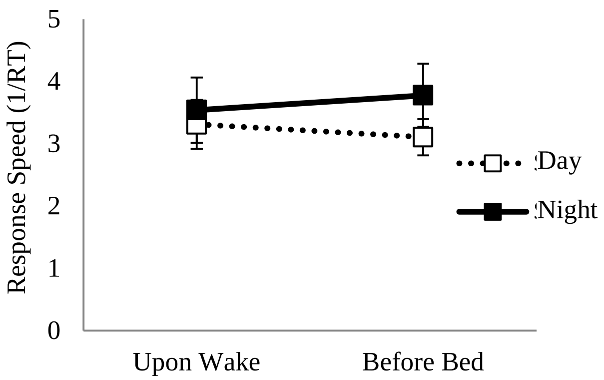

Figure 8. Response speed (1/RT) by shift at waking and at bedtime. Higher reaction speed (faster) indicated better performance.

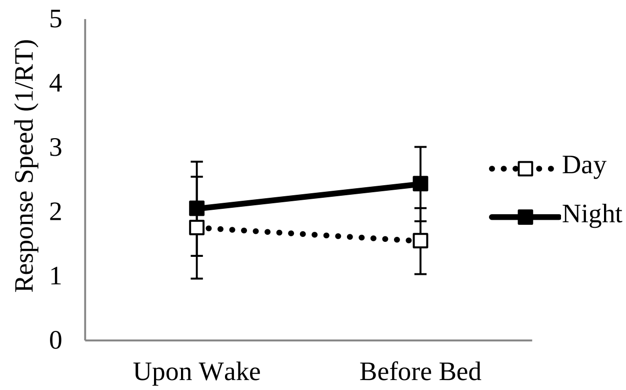

Figure 10. Lowest 10% response speed (1/RT) by shift at waking and at bedtime. Lower response speed (slower) indicated poorer performance.

Lapses. A lapse is defined as a response longer than 500 m/s. In post-hoc testing, there was a significant effect of shift in reaction time lapses ($F(1)=31.35$, $p < .001$) where day shift lapsed significantly more than night shift overall. Additionally, a significant Shift by Time interaction for lapses was shown ($F(1) = 6.174$, $p < .05$; Figure 9). That is, day shift lapsed less upon waking, than before bed, while night shift lapsed more upon waking than before bed. This indicated that day shift was more alert upon waking, than before bed, while night shift appeared more alert at bedtime. This finding supports that the performance of each shift was not simply due to one group having a faster time than another, but that each group lapsed predictably when compared to their response speed. It also supports sleep research (Folkard & Tucker, 2003), which suggests that night shift alertness does not decline in a predictable pattern when compared to day shift alertness.

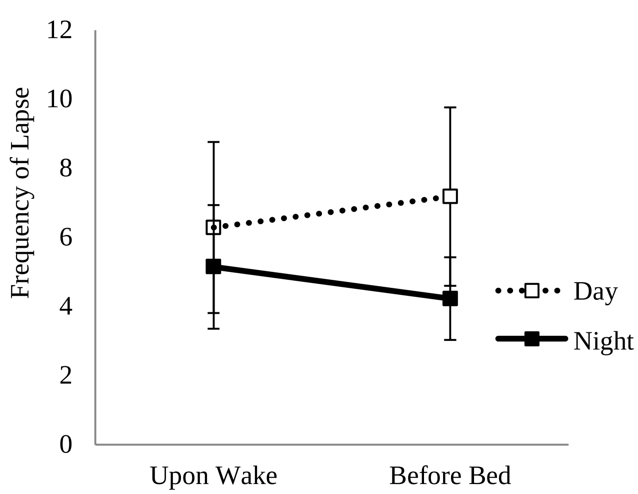

Figure 9. Number of lapses by shift at waking and at bedtime. More lapses (slower than 500 m/s) indicated decreased alertness.

Slowest response speeds. Finally, post-hoc tests revealed a significant shift effect for the slowest 10% of responses ($F(1)= 27.30$, $p < .001$) where day shift responses were slower than night shift overall. Additionally, a significant Shift by Time interaction was revealed for the slowest 10% of responses ($F(1) = 6.174$, $p < .05$; Figure 10). That is, of the slowest 10% of responses, the day shift responded faster upon waking than before bed. In contrast, the night shift's slowest responses were worse upon waking than before bed. This supports the previous two PVT findings reported, which indicate that day shift alertness and fatigue risk followed a predictable pattern, whereas night shift did not.

Cumulative sleep debt. Essentially, cumulative sleep debt is the difference between the amount of sleep a person received over the past several days and the amount of sleep one would have received if they had 8 hours of sleep per night (Van Dongen, Rogers, & Dinges, 2003). At the end of a work-week with an accruing sleep debt, you are more likely to be fatigued. This is especially true for those personnel who work overtime, double shifts, or with inconsistent schedules. When a person has accumulated a sleep debt over the work-week, recovery sleep is necessary to fully restore the person's "sleep reservoir." Recovery sleep should occur during at least one nighttime, that is, one sleep period during nighttime hours in the time zone in which the individual is acclimated. The average person's recovery sleep (dependent on the amount of cumulated sleep debt; Pejovic et al., 2013) should be 9 hours or more to recover from a sleep debt (as cited in Della Rocco & Nesthus, 2005). The numbers reported in this study are well below these minimums.

The load supervisors in this study reported both their work days and days off were different depending on which shift they worked. For example, day shift workers typically worked overtime by adding time to the beginning or end of their shifts. However, night shift workers (in this study, a majority worked "4-on-4-off") often worked on their days off in addition to extending their workdays. This pattern of reported work times indicated that the work days represented in Figure 3 for night shift load supervisors, adds one extra 12-hour day to their condensed schedule and may not allow for enough restorative sleep to make up for the cumulative sleep debt accruing during their work week. In fact, these data highlight the heightened risk of those load supervisors who work night shifts and consecutive, regular overtime as being at the greatest risk of fatigue-related mishaps than their day shift counterparts.

Summary of Sleep Data

There are seven primary risk factors associated with fatigue: Time of day, Time awake, Time asleep, Amount of recent sleep, Adequate sleep, Work schedule factors, and Cumulative sleep debt (see Folkard, 1996; Monk, 1990 for reviews). On all seven factors, load supervisors were found to be at risk of fatigue. The pattern of alertness found for nightshift load supervisors is supported in the scientific literature, however was contrary to how load supervisors *reported* their alertness. That is, in this study when load supervisors were asked to report their alertness levels at the start and end of their day, both day and night shift reported being more alert upon waking. However, PVT measures showed that night shift load supervisors were actually less alert at waking. It is important to note that people respond to fatigue factors a little differently and may become more fatigued at different times and to different levels of severity under the same circumstances (Della Rocco & Nesthus, 2005). However, the data collected and reported in this report indicate that while load supervisors reported feeling fatigued at times while on duty, they reported that it was not an issue they felt contributed to their performance. This means that based on the data collected, they did not know when they were most susceptible to fatigue, nor were they taking appropriate steps to reduce their risk of experiencing fatigue. By comparison, a study conducted by Belenky et. al, (2003) found that long-haul truck drivers who got less than 7 hours of sleep a night, also experienced decreased performance. In addition, they found that those who obtained 6 to 7 hours of sleep over consecutive nights cannot recover as quickly as someone who has been deprived of sleep for just one night. Further, research supports that those who are sleeping in the day time are experiencing less quality of sleep than those sleeping during traditional night hours (Akerstedt, 2003). In a follow up study, Akerstedt and Wright (2009) found that night shift workers were experiencing shorter sleep times and higher risk of crashes with lower productivity when compared to day and swing shifts. These comparisons show that though the sample for this particular study of cargo supervisors was small, the reported results point toward a high risk segment of the aviation industry that commands attention.

Interview Data

Perception of responsibility. Participants were asked to report about how much of the time they were responsible for a list of commonly listed load supervisor duties. Their responses could range from 0 (e.g., "I am never responsible for that task,") to 100 percent (e.g., "I am always responsible for that task,") and any percentage in between. Table 6 shows the collective responses for each of the 45 prompts asked of participants and presented by percentage of responsibility.

Load supervisors who were interviewed agreed that, with the exception of one task, all of the tasks were the responsibility of the load supervisor to some degree. The extent to which they were solely responsible for the task varied. For example, one participant responded that checking each pallet for illegal cargo is primarily the responsibility of the organization's front desk, where the cargo was initially taken from a customer. Another load supervisor responded that it would be "really hard" to know if there was illegal cargo in a unit load device because of the way it is palletized and responded that it is difficult to assign a percentage to that responsibility for the load supervisor alone. In another example, a load supervisor indicated that it was the responsibility of all cargo crew members to ensure locks are in the up and locked position for each flight, which led him to assign a smaller percentage of responsibility to the load supervisor for that task. For all of these items, the idea of "<u>shared responsibility</u>" permeated most if not all interviews. Therefore, percentages where load supervisors reported less than 100 percent responsibility were often caveated with a statement of this idea that it is the shared responsibility of all cargo team members to ensure these responsibilities were completed. In another example, in response to the prompt, "Positioning each pallet/container correctly in the appropriate position and then installing it there by properly locking the pallet in place," cargo supervisors responded that they are responsible for that action about 75% of the time. They would go on to explain that the other 25% of the time, this action is performed by their loading crew, leaving the cargo supervisor to later observe that this action had been done. This was the case for all of the responsibilities presented during the interviews where the percentage not accounted for by a supervisors responsibility was considered to be the responsibility of a cargo team member. Indeed, the degree to which they shared a perception (indicated by a lower standard deviation) was most often influenced by the amount a participant indicated they relied on their team. Therefore, cargo supervisors who *did not* rely on their teams to a great degree would report a higher percentage of sole responsibility where supervisors who *did* rely on their teams would report a lower percentage of sole responsibility.

Table 6

Perception of Responsibility Load Supervisors Report for Specific Tasks

Legend	Code
Duty/Responsibility that had **high agreement**. Lower variance represents more similar ratings across load supervisors for a duty/responsibility.	**Low Variance** **Color: Green; B&W: $\vee\sigma^2$**
Duty/Responsibility that had **moderate agreement**.	**Moderate Variance** **Color: Green; B&W: $\sim\sigma^2$**
Duty/Responsibility that had **low agreement**. High variance represents more differences across load supervisors for a duty/responsibility.	**High Variance** **Color: Green; B&W: $\wedge\sigma^2$**
Duty/Responsibility that had **high agreement** and relatively **low percentage of responsibility** perceived.	**Not a Responsibility** **Color: Brown; B&W ***
The **percent responsible** column represents the amount of time the load supervisor felt the duty/responsibility was their sole responsibility.	**% Responsible (Mean)**
The **variance in answers** column represents the degree to which answers across load supervisors were similar.	**Variance in Answers (Standard Deviation)**

Position	Duties/Responsibilities	Mean	Std. Deviation	Code
1	Calculate load weights for different aircraft compartments.	100.0	0.0	$\vee\sigma^2$
2	Certifying that dangerous goods shipments have been loaded correctly.	100.0	0.0	$\vee\sigma^2$
3	Certifying that pallet locks are in the up and locked position for each cargo laden flight that departs.	100.0	0.0	$\vee\sigma^2$
4	Distribute cargo in such a way that space use is maximized.	100.0	0.0	$\vee\sigma^2$
5	Sequencing cargo for a particular flight based on the load plan.	100.0	0.0	$\vee\sigma^2$
6	Signing the loading certification form certifying that the aircraft has been properly loaded.	100.0	0.0	$\vee\sigma^2$
7	Supervise the sequencing, loading, unloading, and securing of cargo.	100.0	0.0	$\vee\sigma^2$
8	Affixing the pallet position on the pallet/containers tag as depicted on the load plan form (as directed).	96.7	8.2	$\vee\sigma^2$
9	Calculate the weight and balance of the aircraft.	96.7	8.2	$\vee\sigma^2$
10	Directing the installation of pallets in the aircraft according to proper methods and practices.	96.7	8.2	$\vee\sigma^2$
11	Ensuring that the loaders safely and correctly install pallets/containers in the aircraft in the assigned locations.	94.0	13.4	$\vee\sigma^2$
12	Ensuring that all pallet/container locks are in the up and locked position for all cargo (loaded).	93.3	11.5	$\vee\sigma^2$
13	Certifying aircraft have been loaded properly.	91.7	20.4	$\sim\sigma^2$
14	Reporting any cargo restraint fittings that are missing or not functioning properly.	91.7	20.4	$\sim\sigma^2$
15	Bring any irregularity to the attention of the immediate supervisor.	90.0	20.0	$\sim\sigma^2$
16	Checking all pallets containing dangerous goods for leakage prior to loading into the aircraft.	90.0	22.4	$\sim\sigma^2$
17	Positioning each pallet/container correctly in the appropriate position and then installing it there by properly locking the pallet in place.	90.0	22.4	$\sim\sigma^2$

18	Preparing cargo load plans and assigning specific positions to the pallets for a particular flight.	90.0	20.0	$\sim\sigma^2$
19	Checking aircraft cargo areas for signs of cargo leakage and debris.	88.3	20.4	$\sim\sigma^2$
20	Contacting airline management, dispatch or FAA for suspected dangerous good spills or leaks and initiating the emergency response by directing personnel away from the aircraft and area until relieved by superiors.	86.0	31.3	$\sim\sigma^2$
21	Checking the aircraft and ramp area for debris and potential hazards.	84.0	35.8	$\sim\sigma^2$
22	Brief the aircraft commander or designated representative on the aircraft load, hazardous cargo and weight distribution.	83.3	40.8	$\wedge\sigma^2$
23	Maintaining all cargo loading equipment.	82.5	23.6	$\sim\sigma^2$
24	Checking the cargo loading equipment to ensure proper function and operation.	80.0	27.4	$\sim\sigma^2$
25	Compute aircraft center of gravity.	80.0	44.7	$\wedge\sigma^2$
26	Determining the quantity and orientation of cargo.	80.0	44.7	$\wedge\sigma^2$
27	Preparing the weight and balance documents (i.e., load manifest) prior to flight.	80.0	27.4	$\sim\sigma^2$
28	Staging aircraft cargo or baggage.	80.0	27.4	$\sim\sigma^2$
29	Inspecting aircraft cargo compartment areas prior to loading (e.g., checking for proper number, condition and operation of pallet locks, cargo loading system, cargo restraint equipment, and side rails.	78.3	24.8	$\sim\sigma^2$
30	Positioning each pallet on the aircraft according to instructions received, and pointing out to the immediate supervisor pallets that appear to be going into wrong position (such as a very heavy pallet/container going toward the tail section instead of over the wing).	75.0	41.8	$\wedge\sigma^2$
31	Securing cargo to the aircraft (e.g., Installing cargo restraint or pallet locks ("bear traps")).	75.0	41.8	$\wedge\sigma^2$
32	Supervising ACMI flights when applicable.	75.0	41.8	$\wedge\sigma^2$
33	Reporting any unsafe practices to airline management.	70.0	46.9	$\wedge\sigma^2$
34	Being able to do the job functions of your subordinates and directing them accordingly.	63.3	31.4	$\sim\sigma^2$
35	Accompany aircraft to perform duties related to cargo or maintenance.	62.0	52.2	$\wedge\sigma^2$
36	Planning, selecting, sequencing, manifesting, and monitoring each aircraft cargo/mail load.	60.0	40.5	$\wedge\sigma^2$
37	Coordinating the removal of trash from within the aircraft prior to the installation of cargo.	58.3	34.3	$\sim\sigma^2$
38	Checking each pallet/container for illegal cargo such as batteries, chemicals, etc.	55.0	52.6	$\wedge\sigma^2$
39	Maintaining a sufficient workforce.	55.0	32.7	$\sim\sigma^2$
40	Reporting potential hazards to the appropriate authorities, flight operations, or captain.	55.0	42.0	$\wedge\sigma^2$
41	Ensuring that subordinates are adequately trained.	44.0	34.4	$\sim\sigma^2$
42	Assigning loading crews to each flight.	37.5	47.9	$\wedge\sigma^2$
43	Assist in briefing passengers or couriers on safety and emergency procedures.	10.0	14.1	$\vee\sigma^2$
44	Performing record maintenance (e.g., hiring, training, posting revisions).	0.0	0.0	$\vee\sigma^2$

**Note:* Interviewees were asked, "Performing record maintenance is your responsibility *blank percent* of the time," to which interviewees responded with a percentage. Lower variance represents more similar ratings across load supervisors for a duty/responsibility.

Crew treatment. The Cargo Focus Team requested that participants be asked, "When you fly with cargo, what role do you play and are you treated as one of the crew?" For those participants who flew with cargo, there were two different experiences reflected. First, when load supervisors travels with cargo, they experienced being treated as a "jumpseater."[2] That is, being allowed to ride in an available jumpseat and available if help was needed, but not considered a part of the crew. The second experience was being treated as one of the crew. However, all participants agreed that even when they were treated as one of the crew, they were not comfortable using available on-board rest facilities as it was *well-known* that those areas were "reserved" for pilots.

Flying versus non-flying load supervisors. The topic of scheduling based on the number and duration of flights in which a load supervisor accompanied cargo yielded unanticipated results. In interviews with load supervisors who flew with cargo, it was pointed out to the researcher that although their organizations considered the full duration of the flights as duty time, it was also expected that any rest that would be needed would be done while flying between destinations. Although participants indicated that they were not comfortable using the on-board rest facilities, they were expected to sleep when on long-duration flights. In the interviews, it was clear that there was a distinction to be drawn not only between flying versus non-flying load supervisors, but also between short-duration and long-duration cargo hauls.

Short- haul. In a short-haul operation, participants indicated they would typically work a normal shift where if on day shift, they would arrive around 8:00 a.m. and assist with the end of loading a cargo flight for about one to two hours (given that this plane has typically been loaded by the night shift and will only need one or two additional pallets/ULDs added just before departure). Then the load supervisor departs with the plane, arriving at a destination within one to two hours of the departure time. At this point, the cargo supervisor would assist with unloading (and re-loading if necessary) for about one to two hours, and then return to the origination airport. This shift would last approximately 8.5 hours, with approximately 2 to 4 of those hours comprised of flight time. These short-haul flights can be delayed by maintenance or related issues in which case the cargo supervisor would get overtime. In situations where more than 3 to 4 hours of overtime would occur, the oncoming cargo supervisor would take over the shift. An example of a load supervisor short-haul schedule is located in Appendix A. This short- haul flight is characterized by two conditions, (a) the cargo supervisors begin and end their duty time in the same location, and (b) the cargo supervisors begin and end their duty cycle in no more than 12 hours including flight time.

Long-haul. In a long- haul flight operation, participants indicated they would typically work around the shift schedule of the cargo. That is, the load supervisor's shift beginning was directed by the departure time of the cargo flight the supervisor will accompany. In addition, the shift is not determined by duty hours, rather the amount of cargo loaded/unloaded, the length of the flight, and the duration of the time at destination locations, the aircraft capabilities (e.g., fuel, specialized landing abilities, weight and balance requirements), and flight crew availability. Currently, this so-called long-haul operation has no length of time limitation from origin start to origin return, geographic locations, or cargo type. Examples of two different load supervisor long–haul schedules are located in Appendix B and Appendix C. This long- haul flight operation is characterized by two items, (a) cargo supervisors do not begin and end their duty time in the same location (see Appendix B and C for examples) while in Quito, Ecuador and in Atlanta, Georgia, the load supervisor would stay in lodging over night before continuing the flight) and (b) the cargo supervisors duty cycle is more than 24 hours including flight time, but typically in excess of 48 hours including flight time, from origin beginning to origin return.

DISCUSSION

In response to the research request, a study was conducted to gather information concerning work schedules and fatigue in load supervisors and flight mechanics. The research questions were:

1. What are the current rest/duty schedules of load supervisors and flight mechanics?
2. What are the current fatigue risks present for load supervisors and flight mechanics?
3. What are the current duties and responsibilities of load supervisors in the field?

Current Rest/Duty Schedules

Shifts. An examination of the reported hours at work, actual time asleep, and other activities (such as personal time or commute time; Figure 3) revealed that night shift load supervisors are working schedules that are very different from their day shift counterparts. For example, in a "4-on-4-off" schedule, a shift worker would need to get 40 hours of work in four days rather than five. In addition, overtime was reported more often for night shift load supervisors than day shift. This indi-

[2] A jumpseat, in aviation refers to an auxiliary seat for individuals other than normal passengers, who are not operating the aircraft. In a cargo-only aircraft, it is typically located just rear of the cockpit.

cates that while a majority of night shifts are scheduled with 4 days off each week, many of them are working overtime on at least one of those days, reducing their overall rest time.

Flying with cargo. In addition to the typical shift patterns reported above, in some cases load supervisors are required to fly with the cargo in order to assist with unloading/reloading in a location where a load supervisor is not stationed. Reports from interviews in this study highlighted distinctions between those who fly long-distances (i.e., long-haul), short-distances (i.e., short-haul), and those who do not fly with cargo at all. Findings from these data highlight that the practicality of flying a long-haul cargo flight is likely to increase the risk of fatigue for load supervisors (See Appendices B and C for examples). Short-haul load supervisors seem at less risk. However, a larger study specifically targeted toward differences between long and short-haul cargo flights is necessary before attempting to include data specific to these variables and their possible risk of fatigue.

Current Fatigue Risks

Fatigue is classified as more than simply sleepiness. There are physical, mental, and emotional symptoms that are indicators one may be suffering from fatigue. Indeed, when asked about such symptoms, cargo loaders reported experiencing between 8 and 25 of them including difficulty falling asleep due to worry, difficulty sleeping due to shiftwork, awakening while trying to sleep, tiredness upon waking, and moodiness.

Previous research shows that there are three primary contributors to fatigue: time spent asleep, time spent awake, and circadian rhythm disruption (Folkard, 1996). The human body needs between 7 and 9 hours of sleep to get high-quality sleep. In this study, load supervisors reported getting consistently less than this recommended amount. Previous studies have also shown that performance declines by hours awake in a similar manner to those who have been drinking alcohol. Specifically, after approximately 17 hours of continuous wakefulness, one performs the same as an individual with a blood alcohol concentration of .05% (Dawson & Reid, 1997).

Results from the present study showed that the amount of hours an average load supervisor spent awake totaled almost 17.5 hours. Day shift cargo loaders reported that 10.5 of those hours were spent at work and commuting to work daily while night shift reported 14.25 of those hours as commute time and work time. Only one night shift load supervisor reported napping intentionally suggesting that these hours of wakefulness are, indeed, continuous. Finally, the internal body clock or circadian rhythm plays a role in one's level of alertness. One element of influence on circadian rhythm is environmental cues such as light and darkness (Monk, 1990). These cues influence when the body is signaled to wake up and when to go to sleep. Shift workers are especially susceptible to fluctuations such as these if they find themselves working variable schedules. Load supervisors in this study reported working a variable work schedule including "4-on-4-off" (indicating 4 days of work with 4 days off), rotating schedules where after working several day shifts in a row they rotate to working several night shifts in a row, and frequently picking up shifts for coworkers, as well as working night shift into a day shift overtime or vice versa. Alertness data in the present study also showed that load supervisors who were working night shifts were at risk of reduced alertness when they started their shift. While the contributing factors alone do not make the case that fatigue is a risk for load supervisors, the evidence taken together, did suggest that fatigue was a risk for load supervisors. Table 7 summarizes risk factors indicated by load supervisors.

Table 7
Load Supervisor and Flight Mechanic Fatigue Risk Characteristics

Risk Factors	LS/FM Characteristics
1. Time Asleep	6.4 Hours
2. Time Awake	17.6 Hours
3. Circadian Rhythm	Frequently Changing Schedules

Load supervisors reported working overtime between once and twice a week, adding more time to an already condensed schedule. Night shift load supervisors also slept less, reported lower quality of sleep, and awoke more often while attempting to sleep than did day shift. Alertness data collected revealed that night shift alertness levels may be lower when they begin their shift, than at shift end. This finding underscores differences between day shift and night shift load supervisors in that day shift workers performed predictably, while night shift load supervisors did not. When participants were asked to report what operational changes they would recommend to reduce load supervisor's risk of fatigue, they chose seven from a list of typical fatigue risk reduction actions (Table 8). It is important to note that only one respondent reported that there was no change needed.

Table 8
Self-reported Actions to Reduce Load Supervisor's Risk of Fatigue

1. Limit the number of duty times allowed.
2. Shorten duty days.
3. Limit the number of flight segments/legs.
4. Do not mix continuous duty overnights with early morning report times.
5. Maintain consistent scheduling.
6. Consider flight time as duty time.
7. Lengthen rest periods.

Current Duty Responsibilities

There are currently no defined standards for the duty responsibilities of a load supervisor across cargo operations. A list of 45 duties (see Table 6) were mutually agreed upon to be included in this study between the cargo focus team and the researchers. Seven of the 45 duties and responsibilities presented to load supervisors were agreed to be 100% the duty of a load supervisor. These were: sequencing cargo, signing to certify the aircraft was loaded properly, and calculating the load weights for different aircraft compartments. Those responsibilities listed in positions 1 to 12 represented the highest agreement that the duties were the primary responsibility of the load supervisor a majority of the time. However, at position 13, the variability in agreement increased indicating that the load supervisors in this study agreed less than in the previous 12 tasks. The increase in variability of agreement suggests that the responsibilities listed from position 13 through 42 are not the sole responsibility of the load supervisor while on duty. In fact, in many cases, interviews indicated that these responsibilities were shared among the load crew to some degree or another. Finally, in position 43, all load supervisors agreed that it was never their responsibility to perform record maintenance while on duty.

The findings from this study suggest that there are differences between cargo organizations with regard to what is expected of load supervisors. These differences seem to be based on cargo type, whether cargo supervisors fly with the cargo or not, and on the degree of shared responsibility cargo teams have over the roles and responsibilities of a single cargo supervisor. More to the point, there are differences of understanding between load supervisors, even within those organizations, as to what the primary responsibilities of a load supervisor are while on duty. This finding underscores a need for industry-wide standards for defining load supervisors' responsibilities, as well as conveying those standards uniformly within cargo organizations as a whole.

Study Limitations

The preliminary nature of this study resulted in a limited recruitment phase and subsequently a small sample size. Therefore, the results and discussion are limited to the patterns and trends observed in comparison to findings reported in the literature for comparable shift work. Though the sample was small, the demographic characteristics of participants are in line with cargo supervisors across the industry. For example, every effort was made to adequately represent personnel from each shift, overtime hours, frequency and duration of loading responsibilities while on shift, and demographic characteristics such as age and experience. In addition to this sample representativeness of the industry over all, given the expansiveness of sleep and fatigue research for shift workers, our findings show that cargo supervisors are susceptible to the same risks found in fatigue shift work studies.

SUMMARY

Load supervisors view their role in their organizations to be both important as well as interactive. In fact, when asked to choose three terms that best describe the load supervisor job duties, the three most highly chosen terms were *challenging*, *interesting*, and *very complex*. In reported data as well as observed behaviors, the participants in this study deemed their responsibilities to be important to the safety and well-being of everyone involved in their operations. They expressed a desire to do their job well and to be treated as the integral team member they view themselves to be. The knowledge gained from this study highlighted that there are steps that need to be taken within the cargo industry to ensure load supervisors are receiving such treatment. Those recommended steps are:

1. Institute a Human Factors Awareness Training program for all cargo loading personnel to include a segment focused on Fatigue Awareness and Countermeasures (available at MxFatigue.com).

2. Organizations should have a tracking system in place that monitors the number of duty times and rest times afforded to their load supervisors inclusive of overtime.

3. Organizations should institute a Fatigue Risk Management System appropriate to the roles and responsibilities associated with load supervisors and cargo personnel.

4. Organizations should use available information sources (from current SMS programs and those outlined in these recommendations) to take measurable actions that limit the risk of fatigue and fatigue related mishaps/accidents in their operations.

5. Organizations currently emphasize the team aspects of responsibility. However, organizations should further emphasize the absolute responsibility of the load supervisor in duties where appropriate.

Each of these recommendations has a source by which cargo organizations may use to begin moving toward voluntarily mitigating fatigue risk in their operations today. Further information is available at MxFatigue.com, and through the FAA's CAMI Human Factors Research Division (AAM-500) in Oklahoma City, OK.

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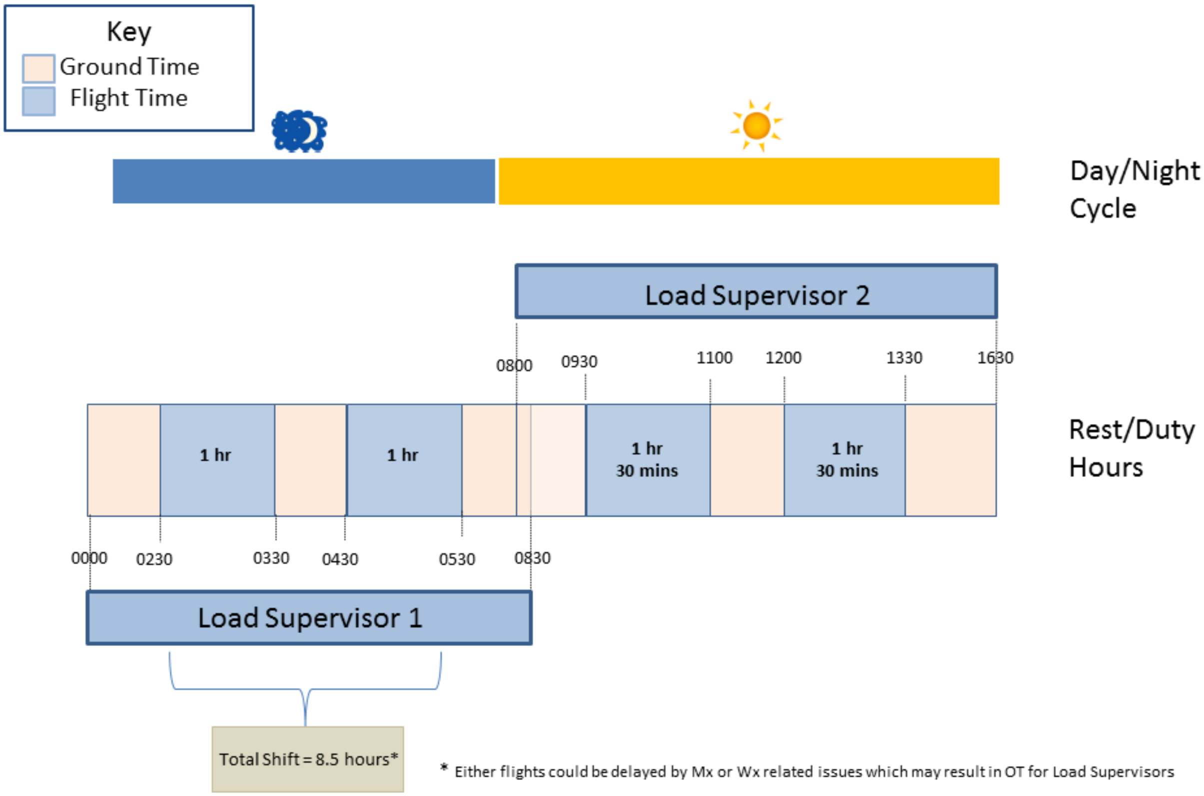
APPENDIX A

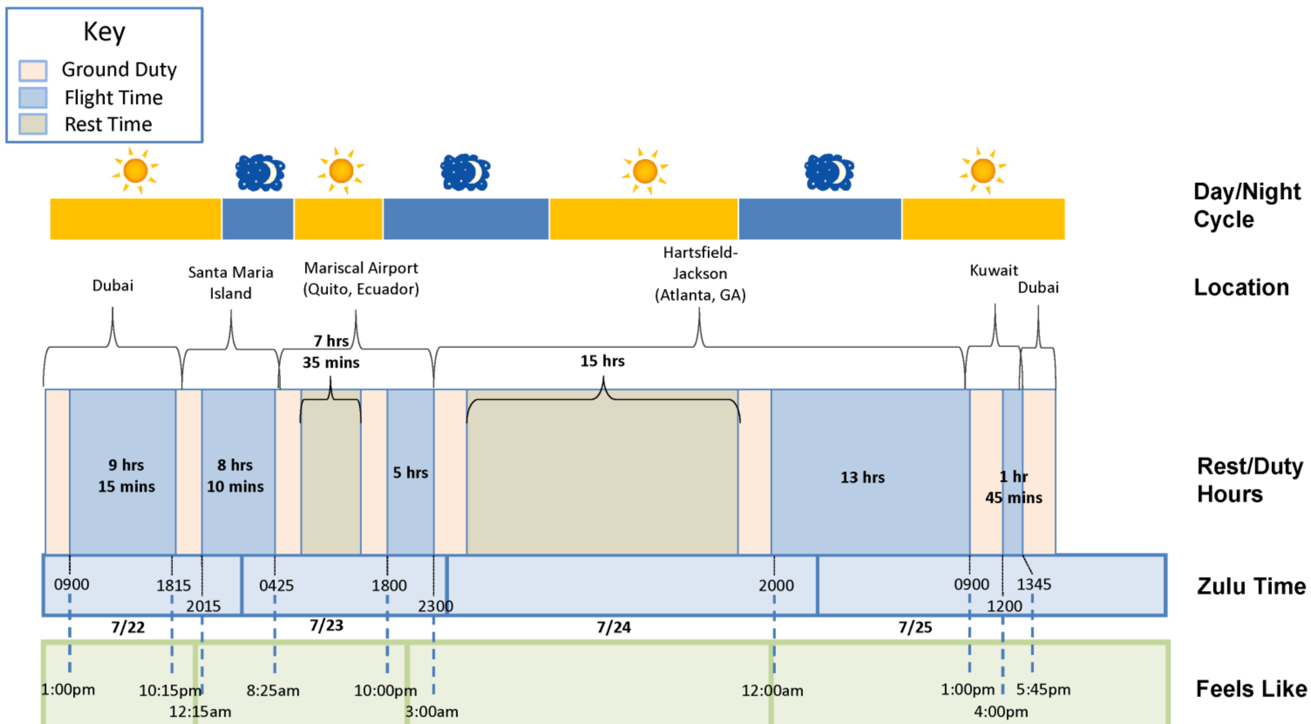
Short-haul Flying Load Supervisor Schedule Example



- The day begins at 0000 at the origin location. The load supervisor spends 2 to 2.5 hours preparing the outbound flight.
- At 0230 the flight departs for a one hour flight. The flight arrives at what feels like 0330.
- The load supervisor spends about an hour offloading and reloading (if necessary) the flight. The departure time is at 0430.
- The flight lands approximately an hour later at 0530 where the load supervisor spends time offloading and completing ground duties until shift end at 0830. The load supervisor's shift is approximately 8 and a half hours.
- The Day shift load supervisor would follow a similar flight schedule for approximate shift duration of 8 and a half hours.
- Either flight could be delayed for maintenance (Mx) or weather (Wx) related issues, which would result in overtime for the load supervisor.
- In cases where Mx or Wx delays were extensive (exceeding 3 to 4 hours), the next load supervisor to come on shift would take over the flight, releasing the initial load supervisor from duty.

APPENDIX B

Long-haul Flying Load Supervisor Schedule Example 1

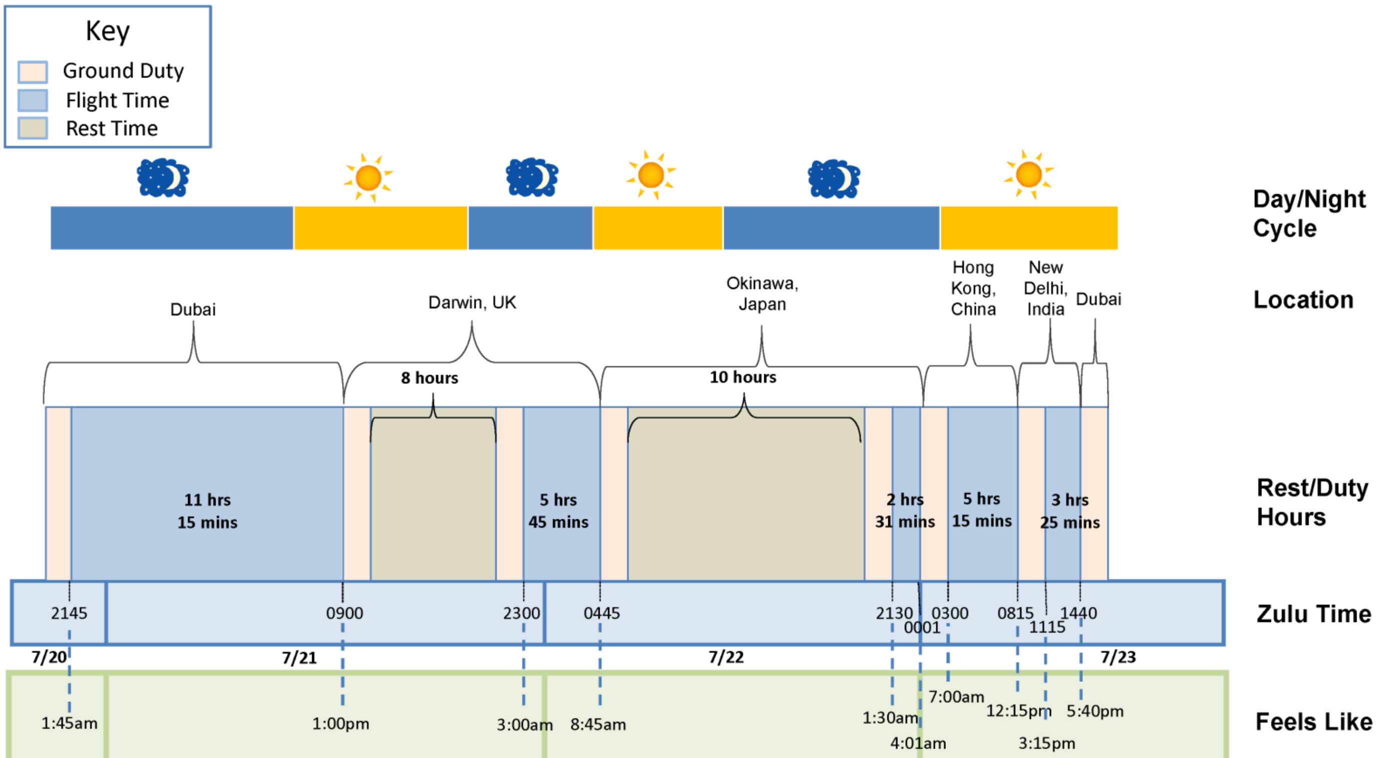


In this example, note that the load supervisor starts and ends the shift in Dubai, United Arab Emirates.

- The day begins at what feels like 10:00 a.m. with the sun shining in Dubai. Approximately 3 hours is spent preparing the outbound flight.
- At what feels like 1:00 p.m., the flight departs for a duration of 9 hours and 15 minutes. The flight lands while daylight still shines at what feels like 10:15 p.m. for this load supervisor. The load supervisor spends approximately 3 hours on the ground offloading and re-loading the flight as the sun is still shining.
- At what feels like 12:15 a.m., with the sun still up, the flight departs for a duration of 8 hours and 10 minutes. At what feels like 8:25 a.m., the flight lands in Quito, Ecuador where the sun is beginning to rise. The load supervisor then assists with preparing the load for approximately 3 hours and then has about 7 hours and 35 minutes in daylight to rest without ground duties.
- At what feels like 7:00 p.m. the load supervisor arrives back to the departing flight to finish preparations for departure. At this time the sun is slowly setting. The flight departs at what feels like 10:00 p.m. to the load supervisor on a 5 hour night flight to Atlanta, Georgia.
- Landing at what feels like 3:00 a.m. in Georgia, in the dark, the load supervisor assists with offloading and/or loading cargo before leaving at what feels like 6:00 a.m. for a 15 hour rest period with no ground duties. The rest time is comprised of partial darkness but at what would feel like approximately noon to the load supervisor, the sun would begin to rise in Georgia. From this time until approximately 9:00 p.m. the load supervisor would spend rest time exposed to sunlight before arriving back to the cargo ramp to prepare the next flight where the sun would again be setting.
- At what feels like 12:00 a.m. the flight departs for a partially dark and partially sunlit 13 hour trip to Kuwait. At what feels like 1:00 p.m., the flight lands in Kuwait in sunlight where the load supervisor would spend approximately 3 hours preparing for the last flight.
- At what feels like 4:00 p.m., the flight departs for a 1 hour and 45 minute trip back to Dubai. The load supervisor would spend roughly 3 hours on the ground finalizing trip reports before completing this leg of duty time at what feels like 8:45 p.m.

APPENDIX C

Long-haul Flying Load Supervisor Schedule Example 2



In this example, note that the load supervisor starts and ends the shift in Dubai, United Arab Emirates.

- The day begins in darkness at what feels like 10:45 p.m. in Dubai. Approximately 3 hours is spent preparing the outbound flight.
- At what feels like 1:45 a.m., the flight departs for a duration of 11 hours and 15 minutes. The flight lands in daylight at what feels like 1:00 p.m. for this load supervisor. The load supervisor spends approximately 3 hours performing ground duties and then has about 8 hours of rest. This 8 hours is comprised primarily of daylight exposure.
- At what feels like 1:00 a.m., in the dark, the load supervisor arrives to load and finalize the flight for departure at what feels like 3:00 a.m. The flight departs for a duration of 5 hours and 45 minutes primarily in darkness.
- At what feels like 8:45 a.m. the load supervisor arrives in sunny Okinawa, Japan and assists with unloading/loading ground duties for approximately 3 hours. At what feels like 11:45 a.m. the load supervisor now has approximately 10 hours of rest time comprised of about 4 hours of light and 6 hours of darkness.
- At what feels like 10:30 p.m. the load supervisor arrives back to the cargo ramp in Okinawa, in darkness, to finish preparations for departure to Hong Kong, China. The flight departs at what feels like 1:30 a.m. to the load supervisor for a 2 hour and 31 minute night flight.
- Landing at what feels like 4:01 a.m. in Hong Kong, in the dark, the load supervisor assists with offloading and/or loading cargo before leaving at what feels like 7:00 a.m. for a 5 hour and 15 minute daylight flight to New Delhi, India.
- At what feels like 12:15 p.m. the flight arrives in New Delhi, India where the load supervisor performs loading/offloading duties for approximately 3 hours. At what feels like 3:15 p.m., the flight departs for a 3 hour and 25 minute flight to Dubai.
- At what feels like 5:40 p.m., the flight arrives in Dubai. The load supervisor assists with finalizing ground duties before completing this leg of duty time at what feels like 8:40 p.m.