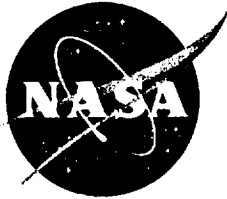


NASA/TM—1999–208799



Crew Factors in Flight Operations XI: A Survey of Fatigue Factors in Regional Airline Operations

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October 1999

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Acknowledgment

This research, conducted by NASA Ames Research Center, was requested and sponsored by the Federal Aviation Administration's Office of Aviation Research, Human Factors Division.

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1.0 Operational Overview

This report on fatigue factors in regional airline operations is the eleventh in a series on the physiological effects of flight operations on flight crews, and on the operational significance of these effects.

Regional airline operations, a growing segment of the commercial air transport industry, depend on the human operator to maintain high levels of flight safety. The specific operational requirements of regional operations create unique challenges regarding human fatigue. Regulatory differences, scheduling practices, and other factors have been suggested anecdotally as potential fatigue factors for regional operators. This survey study was conducted to identify operational factors that may contribute to fatigue in regional airline operations.

A retrospective survey of 119-questions was disseminated to pilots from 26 regional carriers. The survey addressed 7 main topics: general demographics, sleep at home, flying, duty, fatigue, and work environment, with a separate 3-question section for management pilots that focused on scheduling. Subjects were 1,424 regional flight crewmembers who voluntarily and anonymously completed the survey.

Overall, crewmembers identified fatigue as an important consideration in regional airline operations, with 89% rating it a moderate or serious concern. Further, 88% reported that fatigue was a common occurrence in regional operations, and 92% reported that when fatigue occurs, it represents a moderate or serious safety issue. However, 86% reported that they received no training from their companies that addressed fatigue issues. Fatigue factors identified by respondents included multiple flight segments, scheduling considerations, varying regulations, and others. The short-distance nature of regional operations results in multiple flight segments rather than the one or two long segments

common in long-haul operations. The two most commonly cited fatigue factors regarded flying multiple (more than four) segments. Scheduling factors identified by crews accounted for nine of the ten most common recommendations that crewmembers made to reduce fatigue in regional operations. The scheduling factors included: long duty days, continuous-duty overnights, reserve status, early duty report times, and the amount of time between flight legs. Many of these scheduling practices are unique to regional operations. Another specific challenge is that regional airlines operate under various parts of the Federal Aviation Regulations (FARs), including Part 135, which is the most common, Part 121, the Part under which major airlines operate, and Part 91 for General Aviation. Differing requirements among these regulations were cited as contributing to fatigue in regional operations. Other factors identified were: the flight deck environment, including high temperatures and noise; automation, including the lack of autopilot and other equipment; and diet, including dehydration and the availability of food.

The data from flight crewmembers suggested certain recommendations, including education of industry personnel about fatigue issues, and examination of scheduling practices. Education plays a critical role in any effort to address fatigue in operations. Physiological background information and practical strategies for fatigue management are two crucial topics. Educating individuals in every part of the system would maximize the benefit of this activity. Analyzing scheduling practices and identifying potential improvements may result in reduced fatigue as well as other benefits to operations.

2.0 Introduction

Modern commercial aviation requires 24-hour operations. While sophisticated technology is utilized in aircraft, air traffic control, maintenance, and other parts of the system, the human operator remains central to all of these activities. Therefore, human physiological

capabilities and limitations are critical factors in maintaining safety and productivity in the air transport industry.

Regional airlines play a specific and important role in commercial aviation. They provide service to many airports that major airlines do not serve, and connect these locations to main routes. In the current industry structure, major airlines concentrate operations at large "hub" airports, and regionals complete the system by linking smaller airports to the hubs. As the name implies, these airlines generally operate in one region of the country, increasing efficiency by limiting routes. This strategy results in a class of air transport operators that fly shorter distances, smaller aircraft, and more flight segments, carrying fewer passengers. In 1998, 102 regional airlines enplaned 66.1 million revenue passengers compared to the 577.3 million enplaned by 36 large commercial airlines, most by the 10 major airlines (ref. 1).

However, regional operations have shown dramatic growth in the last 20 years. Passenger enplanements, average seating capacity, and trip distance have increased steadily since the late 1970's, and industry projections forecast that they will continue to grow (ref. 2). As regional airlines carry more passengers and play an increasingly important role in commercial air transportation, the industry and the flying public may focus more attention on the safety of these operations.

While much information now exists concerning safety issues in other commercial flight environments (e.g., refs. 3-5), relatively few empirical data are available for regional operations, which may require unique consideration. In particular, data on fatigue in regional operations have been largely anecdotal. The objective of this investigation was to identify operationally significant factors that contribute to fatigue or impede alertness in regional operations.

2.1 Physiological Background

Fatigue, alertness, and performance are physiologically determined. A basic understanding of two physiological factors—sleep and the internal body clock (called the circadian clock)—are necessary background information. Together, sleep and circadian rhythms play a fundamental role in determining fatigue and alertness at a given time. Therefore, factors that affect sleep or the circadian system have the potential to affect fatigue, alertness, and performance as well.

Sleep is a vital physiological need. Most individuals require about 8 hours of sleep each day. When a person loses sleep, essentially all aspects of functioning suffer, including alertness, performance, and mood. Sleep loss can degrade cognitive processes, vigilance, physical coordination, judgment and decision making, communication, outlook, and countless other parameters (refs. 6-7). In fact, research has demonstrated that 1 hour of sleep loss can affect waking alertness, and that 2 hours of sleep loss can significantly affect both alertness and performance (ref. 8). Sleep loss, over time, accumulates into a sleep debt, which can exacerbate the effects of acute sleep loss.

Sleep is a complex process, influenced by many factors. The quantity and quality of sleep an individual obtains at a given time depend on prior sleep and wakefulness, time of day, age, environment, psychophysiological state, and the individual's innate and learned ability to sleep. Further complicating the matter, these factors interact with one another.

The basic concept behind the influence of prior sleep/wake patterns is a simple one: when individuals don't sleep, they become sleepy. That is, a homeostatic drive to sleep builds from the time of awakening until the next sleep, just as the drive to eat (hunger) builds between one meal and the next. The longer the period of time since sleep, the stronger the drive to sleep. Conversely, the homeostatic drive is weaker

shortly after sleep. A very long period of continuous wakefulness can create an intense sleep drive and associated sleepiness. When the drive for sleep becomes strong enough, it can send the brain and body into spontaneous sleep, regardless of whether sleep is appropriate or safe under the circumstances.

Almost every aspect of sleep changes with age. In general, the quantity and quality of sleep decrease with age. While older people do not necessarily need less sleep, they tend to obtain less sleep at night, have more nocturnal awakenings, truncate sleep in the morning, and nap more during the day. Therefore, the age of crewmembers may affect their experience of fatigue and alertness.

The sleep environment also plays a large role in the quantity and quality of sleep. Dark, quiet surroundings and a comfortable temperature and sleep surface are key elements for a sleep-conducive environment (ref. 9). Because individual preferences differ widely, the ability to adjust the environment for comfort is an important consideration. Even with an ideal sleep environment, sleep may be difficult due to stress, thoughts, or worries. Long-haul commercial pilots identified thoughts and worries as one of the top five items that interfered with their sleep in on-board crew rest facilities (ref. 10).

The ability to sleep also varies with the circadian rhythm of sleepiness. The term "circadian rhythm" (from Latin *circa* "about" and *dies* "day") refers to the cycle of a physiological function that repeats approximately every 24 hours. Virtually all functions of the body (e.g., sleep/wake, digestion, immune function) are controlled by circadian rhythms, which are regulated by the circadian clock in the brain. Generally, the body is programmed to sleep at night and to be awake during the day. Additionally, humans have two times of maximal sleepiness and two times of peak alertness each day. At approximately 3–5 a.m. and 3–5 p.m., sleepiness peaks, and sleep may come more easily.

These times correspond to lower levels of alertness and performance. Conversely, at about 9–11 a.m. and 9–11 p.m., alertness and performance peak, and it may be difficult to obtain sleep, even if sleep-deprived. Time-of-day fluctuations in performance have been observed in several unrelated operational settings (ref. 11).

The circadian system cannot adjust immediately to changes in the work/rest schedule or time zone. When such changes occur, the circadian system is desynchronized from the environment for a period of time, and individual rhythms are out of sync with one another. Circadian disruption caused by irregular schedules or time zone changes can lead to sleep loss, performance decrements, worsened mood, digestive upset, and other symptoms. It can take from days to weeks for the circadian clock to resynchronize completely.

Clearly, a range of physiological factors can influence fatigue, alertness, and performance. While an attempt was made to distinguish fatigue factors from one another in this study for the purpose of clarity, they are not completely independent. Further, beyond the intricacies of physiology, the complexity of flight operations precludes accounting for each difference in circumstance. However, while there is no simple solution to these issues, by managing fatigue and alertness in regional flight operations, the industry takes an important step in maintaining or improving the safety margin. Identifying the specific challenges that face regional pilots will inform any efforts to address fatigue in this particular flight environment.

2.2 Regional Airline Regulation: Parts 121 and 135

Different regional airline operations are subject to different sections of the Federal Aviation Regulations (FARs). The number of passenger seats in the aircraft flown determine which FAR Part applies: Part 135 regulates aircraft with 30 or fewer seats and Part 121 those with more than 30 seats. While a

majority of regional airlines operations are regulated by Part 135, many fall under Part 121, the set of rules that governs major airlines, which is more stringent in certain areas. An airline that flies aircraft with 30 seats (or fewer) as well as aircraft with more than 30 seats may conduct operations under both Parts. Prominent differences between the requirements of Parts 121 and 135 include airport certification, dispatch personnel, flight attendants, and flight time and rest requirements (ref. 12).

The National Transportation Safety Board has examined commuter¹ airline safety and has recommended that all scheduled passenger service in aircraft with 20 or more seats (those with 10 or more seats when possible), be conducted under the same regulations as major airlines (ref. 12). The Board based these recommendations on site-surveys of a representative sample of commuter air carriers and their pilots, and a public forum on commuter air safety. The Board cited two main reasons behind the recommendations:

- 1) regional/commuter airlines become increasingly like major airlines in the passengers they serve and in the size and sophistication of aircraft, and
- 2) to the public, what used to be a clear distinction between commuter airlines (under Part 135) and majors (under Part 121) has become unclear, if not transparent. When commuter airlines began operating in markets previously served by major airlines, many arranged to share flight codes (numbers that identify flights in airline reservation systems) with major airlines. While code-sharing can simplify reservations, passengers may infer that the major airline owns and operates the commuter, which may or may not be the case; thus the major may lend its reputation to an unrelated commuter airline. The Safety Board determined that, because passengers may not

distinguish between majors and commuters, both should meet the same requirements.

In its report, the NTSB identified several specific issues that arise from differences between Parts 121 and 135. One conspicuous example is that the two FAR Parts set different limits on flight duty time per week, month, and year, an issue that will be addressed in the following section within the context of scheduling practices. Another consideration is that airports serving Part 135 operators may meet less stringent standards than those serving Part 121 carriers, potentially resulting in lower levels of airport safety². Smaller airports that serve regional airlines may have less sophisticated navigational aids or air traffic control systems, which would further increase workload in the terminal area. Also addressed in the NTSB report was that requirements for support personnel, including licensed dispatchers and cabin crew, vary according to number of passenger seats. Operations under Part 135 do not require licensed dispatch service, and many companies do not provide it (ref. 12). Dispatchers aid pilots in flight planning, monitoring fuel loads and other performance parameters, and obtaining pertinent information in-flight. Such help can be especially important in decreasing pilot workload during fast turnarounds between flights. Some pilots in the NTSB Commuter Study (ref. 12) reported that they must rush to complete many important tasks (e.g., weight and balance, fuel load) within a short period of time, and reported that a licensed dispatcher checking calculations would increase their confidence. Flight attendants also can help decrease pilot workload in-flight, especially in case of emergency, by administering passenger safety. However, only aircraft with 20 or more seats are required to carry flight attendants. Many of these factors have the potential to play a role in fatigue.

¹While the terms "commuter" and "regional" are often used interchangeably, the report defined "commuter" as those operations conducted under Part 135.

²Airports that do not serve aircraft with more than 30 seats cannot participate in the FAR Part 139 Certification Program, and Part 135 carriers are not restricted to certified airports.

2.3 Scheduling Practices

In response to the unique demands of regional operations, certain distinctive scheduling practices have become common, including reduced rest, continuous-duty overnights, reserve status, and schedules based on different FAR Parts or combinations thereof (ref. 12).

Both Parts 121 and 135 allow for scheduling or assigning a reduced-rest period (as short as 8 h) before a flight, in exchange for a longer compensatory rest after the duty period. This provision was intended to acknowledge that flight operations are susceptible to unpredictable events (e.g., weather, air traffic) and to provide flexibility in case of delays. However, reduced rest has become a standard scheduling practice in regional airlines (ref. 12). The 8-hour rest period includes transportation to and from layover accommodations, meals, the opportunity to shower, change, and attend to other physiological needs, in addition to sleeping. Therefore, an 8-hour rest period may only allow 7 or 6 hours of sleep, while most individuals require approximately 8 hours. Additionally, the circadian timing of the rest period may influence how much sleep a crewmember physiologically can obtain. During the day, sleeping even 6 or 7 hours within an 8-hour period may prove difficult. Further, while the longer compensatory rest after the duty period may benefit pilot alertness and performance on the subsequent flight, it does not compensate for sleep loss on the flight that immediately follows reduced rest.

Continuous-duty overnights (CDOs), another regional scheduling practice, consist of flying one or more evening flights, spending the night on duty at a destination, then flying one or more flights the next morning. Several CDOs, also called "stand-up overnights", can be scheduled consecutively. Officially, pilots remain on duty through the night (i.e., the "stand-up" portion) because the ground time is not long enough for a rest period. However, while regulations do not require airlines to

provide rest accommodations for the "stand-up" portion, most companies that schedule CDOs do so (ref. 12). Because CDOs require wakefulness during much of the night and sleep during the day, they create potential for performance decrements, circadian disruption, and acute or cumulative sleep loss.

The complex and unpredictable nature of airline operations requires flexibility, and the industry often uses reserve status to respond to changing operational demands. A pilot on reserve status may remain awake and available for duty for almost 16 hours and then be called for a duty period of 14 hours or more. Therefore, a crewmember may experience a very long period of continuous wakefulness, which creates the potential for fatigue.

Finally, the FAR Part that regulates a given operation affects scheduling. Parts 121 and 135 differ in their flight time and rest requirements: Part 121 limits pilots to 30 flight hours per week, 100 per month, and 1,000 per year, while Part 135 sets limits at 34 h/wk, 120 h/mo, and 1,200 h/yr. Therefore, a pilot conducting operations under Part 135 can be scheduled for more flight hours than a coworker flying under Part 121. Additionally, certain non-revenue operations, such as ferrying empty aircraft, training exercises, and check rides, may be conducted under FAR Part 91, a practice that allows flight times to be extended past a full duty day of Part 135 or 121 operations.

2.4 Other Considerations

Regional operations engender other distinctive factors that may affect crewmember alertness and performance.

Because regional routes generally are shorter and flight segments more numerous, regional pilots may conduct more takeoffs and landings during each duty day compared to other airline pilots. These low-altitude flight phases are considered critical, demanding more concentration and higher levels of performance than cruise, for example. Accident statistics from 1994 illustrate the critical nature of

ground and terminal operations: 70% of serious accidents³ during scheduled Part 135 operations occurred during ground or terminal area operations, compared to 48% of Part 121 accidents (ref. 13). The fact that regional pilots spend more of their flight time in critical phases of flight suggests that they require at least the same level of alertness and performance as their counterparts in the major airlines.

Additionally, the level of automation in the aircraft may differ significantly among regional operations and from equipment used by major airlines. Engine type (e.g., jet vs. turboprop vs. piston), pressurization, navigational systems, and warning systems may affect flight deck environment, workload, and the level of vigilance required of pilots. Environmental conditions such as noise and vibration, which have been identified as fatigue factors by other commercial pilots (refs. 10, 14), vary among aircraft as well.

Clearly, some of these considerations stem from regulatory differences, others from operational requirements. Regardless of the source, regional operations present numerous challenges to flight crews attempting to maintain high levels of alertness and performance while performing their duties.

3.0 Methods

3.1 Survey

A retrospective survey designed to examine fatigue factors in regional flight operations comprised 119 questions divided into 7 sections (see Appendix A). The sections addressed general demographic information, sleeping at home, flying (including recent flying experiences), duty days (including scheduling practices), fatigue (including perceptions of fatigue in regional operations, fatigue factors, and fatigue effects), and work environment (including corporate attitudes, safety, and management quality). A separate

³Accidents resulting in serious injury, fatality, or substantial aircraft damage.

section for management pilots focused on scheduling. Data on demographics, home sleep, and flying experience provided context for an examination of current flight and duty patterns, work environment, and fatigue issues. For the three carriers from Alaska, two additional questions were included to reflect differences in their flight operations, and focused on duty time.

3.2 Subjects

Subjects were regional airline pilots from 26 regional carriers. A representative sample of regional pilots was targeted by identifying a representative sample of carriers. The regional carriers operating at the time of selection were categorized by the nine Federal Aviation Administration geographical regions and then stratified into three groups based on size⁴. Carriers that offered only cargo or mail service (i.e., no passenger service) were eliminated to control for operational differences. Three carriers, one from each stratum (large, medium, and small), were selected at random⁵ from each of the nine geographical regions, resulting in a list of 27 potential participant airlines.

Of these 27 carriers, 19 agreed to participate. Two of the 19 carriers were replaced due to a zero return rate. Therefore, 17 (63%) of the originally selected carriers provided data. Of the 10 remaining spaces, 9 carriers were replaced by carriers from corresponding FAA region and size stratum, but no large carrier from the Southwest region was available for participation. Therefore, 26 carriers participated, representing each geographical region and size except for large carriers from the Southwest.

⁴Assessed by number of enplanements as reported in the Regional Airline Association's 1994 annual report, or, when enplanement figures were unavailable, number of aircraft.

⁵When only one airline from a specific region and size stratum was available, it was selected.

3.3 Implementation

Once a carrier agreed to participate in the study, a company contact was identified to work with NASA investigators. To demonstrate their cooperative support for the study, a member of company management and a pilot representative each signed a cover letter that accompanied the survey. Survey packets (one for each pilot at the company) were sent in bulk to the company contact, who distributed them to the pilot population.

Each survey packet included a survey, a postage-paid envelope addressed to the investigators, and the cover letter signed by investigators as well as management and pilot representatives. To encourage accurate and forthright responses, the cover letter emphasized that participation was voluntary, anonymous, and confidential. Toward that end, pilots were instructed not to identify themselves and to return surveys directly to NASA investigators in the enclosed envelope.

3.4 Data

Data from completed surveys was entered into a Filemaker Pro (Claris Corp, Santa Clara, CA) database, and imported into S-Plus (Statistical Sciences Inc, Seattle, WA) for further data processing and analysis. Other analyses were produced with the BMDP (University of California, Los Angeles) and ANOVA (analysis of variance; University of California, San Diego) statistical packages.

4.0 Results

Regional crewmembers returned 1,424 completed surveys of the 4,583 sent to carriers, a 31% overall return rate. The number of pilots per carrier ranged from 6 to 855, and return rates for individual carriers ranged from 6% to 83%.

4.1 Demographics

Ninety-five percent of the respondents were male, and subjects averaged 36.4 yrs of age, 5 ft 11 in of height, and 179 lb. Over half (58%) reported an assigned domicile in the

Eastern time zone, 20% in the Pacific, and 17% in the Central. Likewise, a majority (54%) reported living in the Eastern time zone, 20% in the Pacific, and another 20% in the Central. Pilots reported a 1.6-h commute, on average, and 80% commuted by automobile. The 20% who reported holding other jobs described spending 43 h/mo at them.

4.2 Sleeping at Home

The pilots presented a normal home sleep profile, on average, sleeping 7.9 h per night, going to bed at 2248 h, and rising at 0736 h. They reported an average sleep latency of 21 min and 1.4 awakenings per night. Asked to identify one predominant cause of the awakenings, 48% cited the need to use the bathroom, 18% reported being awakened by their children or spouse, 12% by noise, 11% by "other" factors, and 10% because they were unable to sleep. After awakening, it took subjects an average of 13 min to return to sleep. They reported getting 2.6 nights of sleep at home between trips.

Subjects were asked to rate the frequency with which they nap based on a five-point scale from "never" to "very often: 5-7 times/wk", with a middle rating of "sometimes: 1-3 times/mo". Forty-five percent reported napping "rarely" or "never", 33% "sometimes", and 22% "often" or "very often". The average reported nap duration was 1.2 h. Rating the frequency with which they experience problems getting to sleep (on the same 5-point scale), over half of the group (58%) reported "rarely" or "never", 33% "sometimes", and 9% "often" or "very often". Most (95%) reported "never" or "rarely" taking medication to aid sleep. Similarly, 90% reported "never" or "rarely" using alcohol as a sleep aid, while 3% reported using it "often" or "very often". Overall, the pilots identified themselves as good sleepers, with 89% rating themselves as "good" or "very good" sleepers. Ninety percent reported having no sleep problem. Of those who reported problems, 6% (11 subjects) had been diagnosed by a physician, and 11%

(27 subjects) reported that the problem had prevented them from flying a scheduled trip at some time.

Subjects were asked to rate 18 factors on the extent to which each affects home sleep, using a 5-point scale from “1–interferes” through “3–no effect” to “5–promotes”. The responses for each factor were averaged. The top five promoting factors based on these averages were “pillows” (mean = 3.88), “readiness for sleep” (3.79), “quality of sleep surface” (3.75), “ventilation” (3.73), and “sheets” (3.70). The most interfering factors based on averages were “thoughts running through your head” (1.82), “random noise events” (2.11), “high humidity” (2.21), “heat” (2.23), and “background lighting” (2.34). Based on the highest proportion of “promotes” responses (i.e., “5–promotes”), the five most promoting factors were “readiness for sleep” (35%), “pillows” (34%), “quality of sleep surface” (33%), “privacy” (23%), and “ventilation” (22%). The highest proportions of “interferes” responses were “thoughts running through your head” (38%), “heat” (30%), “high humidity” (23%), “random noise events” (21%), and “background lighting” (17%).

Asked to rate 4 additional factors on the extent

to which they interfere with sleep, on a 5-point scale from “1–strongly interferes” to “5–no effect”, subjects rated “personal worries” as the most interfering (mean = 2.33, rated 1 by 26%), followed by “thirst” (2.85, 11.6%), “hunger” (3.23, 8.2%) and respiratory factors (3.84, 5%).

Two questions concerned sleep at home when on reserve status. Subjects reported that, when on reserve status at home and not called out, they usually get 7.7 h of sleep at home. They identified factors that most interfered with sleep at home while on reserve, and those that most promoted sleep on reserve. Their responses were categorized, and Figure 1 shows the five most commonly cited interfering factors (indicated by negative values) as well as the top five promoting factors (positive values). The five categories of most commonly identified interfering factors were: “work worry,” including concerns about being called for duty, what the trip would entail, what scheduling changes would be made; “thoughts,” including non-work oriented thoughts or anxiety; “noise”; “environment,” including temperature, humidity, and ventilation; and “not ready for sleep,” which refers to a physiological inability to fall asleep at the time. The five categories of most commonly identified promoting factors were:

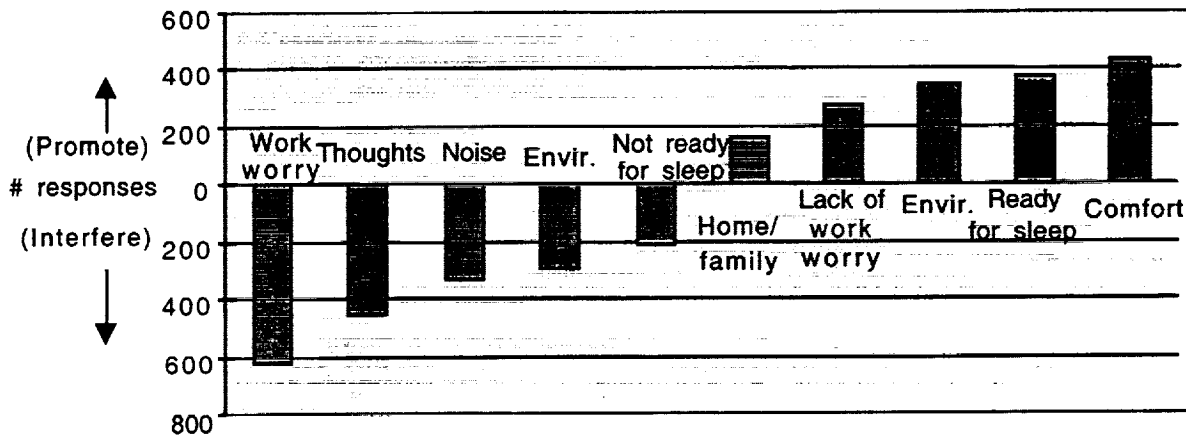


Figure 1. Factors that interfere and promote home sleep when on reserve.

“home/family,” including the familiarity of surroundings and having a bed partner present; “lack of work worry,” including knowledge of the schedule and details for a trip, and feeling secure that there would be a late call or no call; “environment”; “ready for sleep,” which refers to a physiological ability to fall and stay asleep; and “comfort,” including sleep surface, pillows, and blankets.

4.3 Flying Information

The pilots reported having an average of 3090 total flight hours when hired by their current airlines, and 7050 lifetime hours at the time of the survey. Most subjects (85%) reported holding an Air Transport Pilot Certificate. Subjects reported 4310 h of flight time with airlines, 1820 h in general aviation, 1630 h in other categories, and 674 h of military time. In a typical month, pilots reported flying 81 h with airlines, 1.1 h of general aviation, 0.35 military hours, and 0.12 h in other categories. They had held salaried flying positions with an average of 2.8 different companies, and had been employed at the present airlines for an average of 4.9 yrs at the time of the survey. Crewmembers reported flying the following types of aircraft: 1191 (96%) reported flying turboprop aircraft, 81 (6%) jets, and 11 (1%) reciprocating-engine aircraft. Almost three-quarters (68%) reported flying under Part 135 of the FARs only (i.e., not Part 121); 27% reported flying only under Part 121; and 63 (4%) reported operating under both Parts 121 and 135 (fig. 2). In addition to regular operations under Parts 121 and 135, 10% reported operations under Part 91. On average, pilots reported an hourly wage of \$33 and a monthly

income of \$2,590. A slightly higher percentage of captains (54%) than first officers (46%) responded to the survey.

Pilots answered a series of questions based on flying done for their regional airline jobs within the past year. For several questions, they were asked to report three values: a typical value, and high and low values. They reported flying 13.5 h of actual IFR (i.e., IMC, instrument meteorological conditions) in a typical month, flying 4.6 h at least and 27.1 at most. A typical flight delay lasted 24 min, while the shortest lasted 7 min and the longest 1 h 39 min. Air traffic control (ATC) delays occurred 3.6 times in a typical month, 0.6 times in the best case, and 9.5 times in the worst case. Delays due to weather occurred 2.3 times/wk typically, and ranged, on average, from 0.35 to 7.8 times/wk. Company-mandated delays 2.7 times in a typical week, ranging from 0.8 to 5.9 times/wk. In a typical week, 1.9 mechanical delays occurred, with 0.4 in the best case and 4.4 in the worst. Pilots reported flying in a high density operating area 3.9 times in a typical day, 2.0 times/day at least and 6.0 times at most. They flew in non-radar environments 3.4 times/wk typically, 1.4 times/wk at least and 6.6 times at most.

Thirty percent reported flying reserve lines at the time of the survey. Most of those (93%) identified the type of reserve as “on call at home”, while 5% reported airport reserve and 2% cited both. Subjects reported that 45% of their flight hours in a typical month was reserve flying, on average, 16% at least and 63% at most. Typically, pilots were notified an

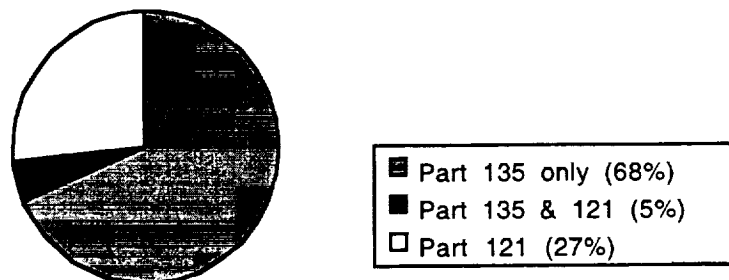


Figure 2. Subjects by FAR Part (135 vs. 121).

average of 4.9 h before they were expected to report for duty while on reserve, 1.0 h before duty at least and 19.9 h at most. They reported getting 5.6 h of sleep before reporting for duty when called out of reserve. Subjects were asked how often their 24-consecutive-hour required rest period was assigned after the fact, that is, assigned retroactively to be the 24 hours preceding the callout. Pilots reported that their required rest was assigned retroactively 1.0 times in a typical month, 0.3 times in the best case and 2.1 times in the worst case.

4.4 Duty

Pilots reported flying 18.3 duty days in a typical month, 15 days/mo at least and 20.9 days at most. Alaskan flight crew were asked how many consecutive duty days they worked in a month, and 24 crewmembers reported that they typically worked 6.8 days in a row on average (range: 4-30) and at most, they worked 13.6 days in a row on average (range: 6-45). They reported being scheduled for an average of 81.3 h in a typical month, with a range from 66.4 h to 92.1 h, and actually flying an average of 80.6 h typically, with a

range from 63.1 h to 96.0 h. A typical duty day included 5.6 flight segments, 2.3 at least and 7.4 at most. Subjects reported an average of less than half an hour (mean = 27 min) on the ground between flights, with a range from 7 min to 4 h 24 min.

In a typical month, 1.2 duty days exceeded 8 h of actual flight time, ranging from 0.2 days to 2.8 days. Asked to indicate on a four-point scale how often their companies readjusted schedules to account for actual block times, 19% reported "never", 38% "rarely", 34% "occasionally", and 9% "frequently".

Pilots reported ferrying aircraft under Part 91 FARs, after flying 8 h under another Part, 0.7 times in a six-month period. They cited undergoing check rides or training flights under Part 91, after flying 8 h under another Part, 0.2 times in a typical year. Subjects were asked how many times in the year preceding the survey they had exceeded the 7-consecutive-day flight time limit, which is 30 h under Part 121 and 34 h under Part 135. Pilots reported exceeding the limit 0.3 times while

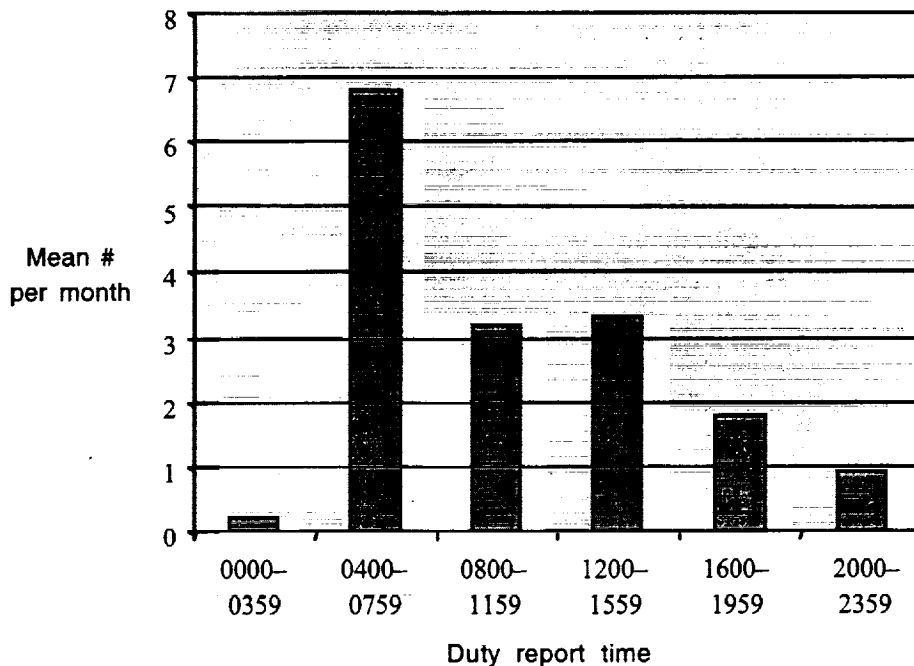


Figure 3. Distribution of means of duty report times in month preceding survey.

flying under Part 121 (43% reported 0 times) and 0.9 times under Part 135 (74% reported 0 times).

Subjects reported an average typical duty day of 11.2 h, a shortest day of 5.6 h and a longest of 15.0 h. The longest day of their airline careers was 16.8 h, on average. Pilots reported that, within a typical month, 0.8 duty days were extended to keep flight time within regulated limits, with a range from 0.2 to 1.8 times. In a typical month, pilots stayed in hotels 8.3 times, in trailers 0.04 times, and in other accommodations 0.8 times. Duty report times in the month preceding the survey were most commonly in the early morning, between 0400 and 0759 (mean = 6.8 times), while 3.3 duty days started between 1200 and 1559, and 3.2 days began between 0800 and 1159 (fig. 3).

Pilots were scheduled for reduced rest an average of 3.8 times in a typical month, 1.4 times at least and 6.4 times at most. They reported being asked to take unscheduled reduced rest 1.1 times in a typical month, at least 0.2 times and at most 2.5 times/mo. When asked to take unscheduled reduced rest, the rest periods were reduced to 8 h an average of 1.7 times and to 9 h an average of 0.8 times.

In a typical month, 3.3 duty days included CDOs, 1.1 days at least and 6.9 at most. During

a CDO, the typical scheduled ground portion was 6.4 h, ranging from 4.8 h to 7.7 h. Pilots reported that the time available for sleep during these periods was typically 4.8 h, and ranged from 3.2 h to 6.2 h. Indicating on a four-point scale how often they slept during the "stand-up" portion of a CDO, over three quarters (79%) cited "frequently", 16% "occasionally", and 5% "rarely" or "never". Over three quarters (79%) of the pilots reported that their companies provided accommodations for the "stand-up" portion of CDOs. Those who responded to a question regarding these accommodations reported that, in a typical month of flying, they stayed in hotels 3.7 times, 0.1 times in trailers, and 0.2 times in other accommodations. On a five-point scale from "very poor" to "very good", 67% rated the accommodations "good" or "very good", 28% rated them "fair", and 5% "poor" or "very poor". Pilots reported getting an average of 4.6 h of sleep during the "stand-up" portion of CDOs typically, 5.9 h in the best case and 2.6 h in the worst case. They reported that they ferried planes during the "stand-up" portions of CDOs an average of 0.49 times in a typical month. Over half (56%) acknowledged having flown the final segment of a CDO without having slept at all.

The rest period between consecutive CDOs lasted 11.5 h typically, and ranged from 8.9 h

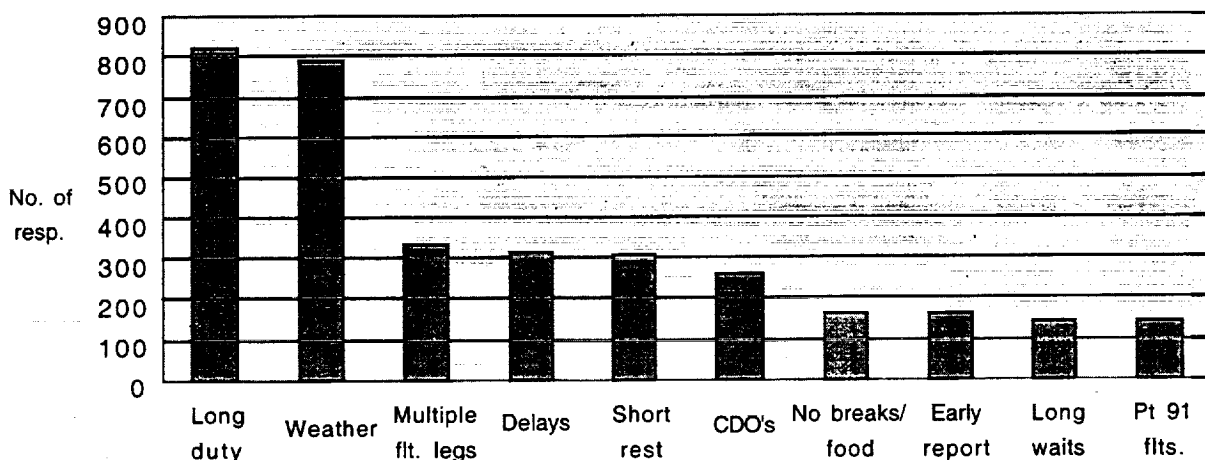


Figure 4. Factors contributing to worst work day.

to 14.9 h. Of those times, 8.3 h was typically available for sleep, 6.1 h minimum and 10.8 h maximum. Pilots reported getting 3.3 h of sleep between consecutive CDOs typically, 2.3 h in the worst case and 5.8 h in the best case.

4.5 Fatigue

Subjects were asked to describe the worst work day flying regional airlines, including the specific contributing factors. The reported factors were categorized, and the ten most commonly reported factors, shown in figure 4, were: long duty day; weather (including flying in instrument meteorological conditions and shooting instrument approaches to minimum descent altitudes, but not delays on the ground due to weather); multiple flight legs; delays (including mechanical, weather, and others); short rest (including reduced rest and inadequate rest or sleep); continuous-duty overnights (including single and consecutive CDOs); no breaks/food (including turn-around times between flight legs that were too short to allow for food or other physiological needs); early duty report times; long waits (including long periods of time between flight segments); "Part 91 flights" included ferrying of aircraft and other operations under FAR Part 91. Most subjects (89%) indicated that they considered

fatigue a "moderate" or "serious" concern in regional flight operations, while 11% considered it "minor" or not a concern. Similarly, 88% described crew fatigue as a common occurrence in regional operations. Further, most (92%) indicated that, when crew fatigue occurs, it is a "moderate" or "serious" safety issue. Subjects described specific ways in which fatigue affects their flight performance (fig. 5). Asked which flight phase is most affected when flight performance is affected by fatigue, 40% identified the enroute phase, 30% landing, 19% descent, and 7% takeoff, and 4% taxi. Descent and landing together, which includes the approach phase, accounted for almost half (49%) of responses. Pilots were asked to suggest changes to reduce fatigue in regional airline operations. Figure 6 shows the ten most commonly recommended changes along with the number of times each was cited. Table 1 provides examples of suggestions from each category.

Over three-quarters of the subjects (80%) acknowledged having nodded off during a flight at some time. Over half (56%) reported that they had been on a flight during which arrangements had been made for one pilot to sleep during the segment.

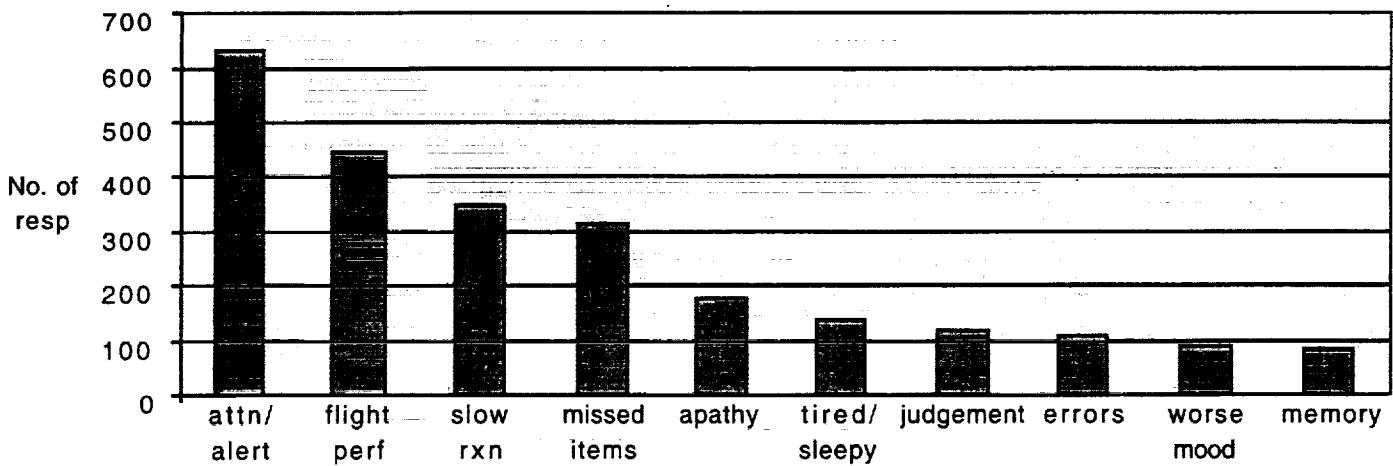


Figure 5. Specific effects of fatigue on crewmember performance.

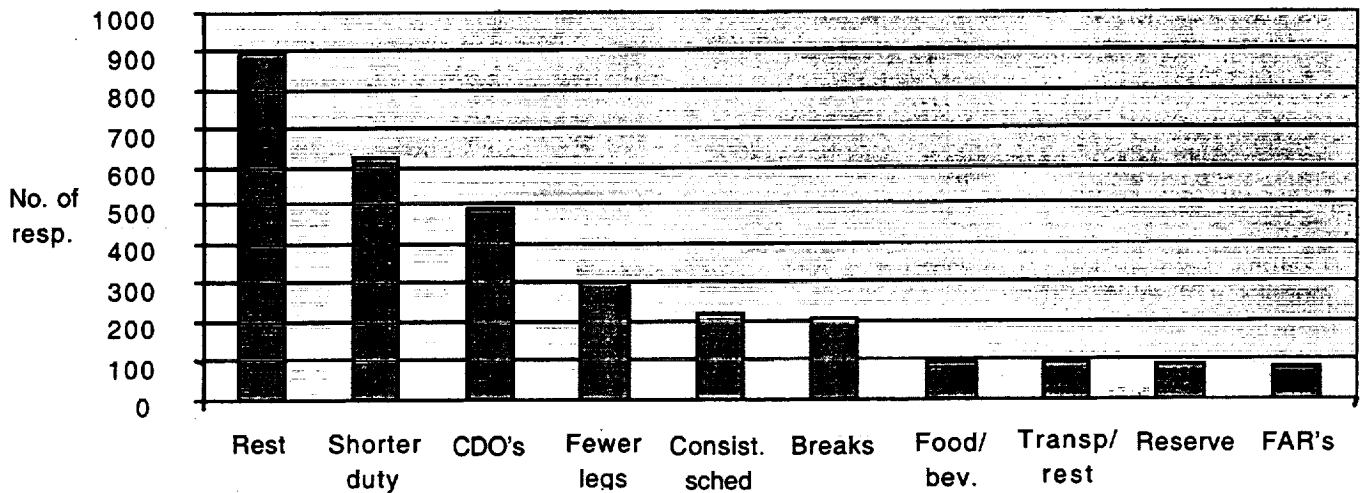


Figure 6. Crewmember recommended changes to reduce fatigue in regional airline operations.

Table 1. Categories of changes recommended by crews to reduce fatigue.

Category:	Includes:
Rest	Eliminate scheduled reduced rest Eliminate reduced rest Longer rest periods
Shorter duty	Shorter duty days Limit number of duty hours allowed
CDOs	Eliminate CDOs No consecutive CDOs
Fewer legs	Schedule fewer flight legs Limit number of flight legs
Consistent scheduling	Schedule for days or nights, not alternating Do not mix CDOs with early morning report times Minimize multiple scheduling changes
Breaks	Schedule turnaround times to allow for break/meal/bathroom Do not schedule long (several hour) breaks between flight segments
Food/bev	Provide food and beverage on flight Schedule enough time between flight legs for meals
Transport/rest	Start rest period upon arrival at hotel (do not count transportation as part of rest period)
Reserve	Consider time on reserve as duty time Shorter reserve periods (limit to either a.m. or p.m.)
FAR's	Change all airline operations to FAR Part 121 Place regulatory limits on duty time Stricter flight/duty/rest limitations

Subjects were asked to rate 21 factors on the extent to which each affects fatigue using a four-point scale from "not at all" to "seriously" (fig. 7, left axis), and to assess the

frequency each factor was experienced using a five-point scale from "0 = never" to "4 = very often (5-7/wk)" (fig. 7, right axis). The rating of each factor's effect on fatigue was

assigned a numerical value (e.g., not at all = 1, seriously = 4), and responses were averaged. The 10 factors with highest average ratings are shown in Figure 7, which shows/lists the mean fatigue rating as well as the mean frequency rating for each factor.

Examining the fatigue effect rating in conjunction with the frequency of occurrence, eight of the top ten factors received frequency ratings higher than “sometimes”: ratings indicated that flying 7 or more flight segments occurred almost halfway between “sometimes” and “often”; company scheduling practices and noise, slightly more than “often”; high ambient temperatures, lack of available nutritious food, and IFR flight, slightly less than “often”; flying without an autopilot slightly more than “sometimes”; and flying 4–6 flight segments occurred “often”. Severe turbulence, while rated as having a moderate effect on fatigue, was rated as occurring “very rarely”, and dehydration less than “sometimes”.

4.6 Work Environment

Crews were asked to give their perceptions of their companies’ priorities by ranking 6 factors, with an additional 7th option for “other”. Average rankings were as follows: “profit” 1.4; “public image” and “safety” 3.2; “customer satisfaction” and “growth” 3.6; and “employee satisfaction” 5.6. Over three-quarters (78%) of the crewmembers perceived “profit” as the companies’ first priority. “Safety” was ranked as the companies’ first priority by 12%. About three-quarters ranked “employee welfare” as their companies’ 6th or 7th priority.

Comparing the safety of their regional airlines to that of the majors using a five-point scale from “much less safe” to “much safer”, 41% rated their airlines “as safe”, 35% “somewhat less safe”, and 11% “somewhat safer”. A weighted average (mean = 2.7) indicated a perception that the regional airlines were between “somewhat less safe” and “as safe” compared to major airlines. Rating their job-security using a four-point scale from “very

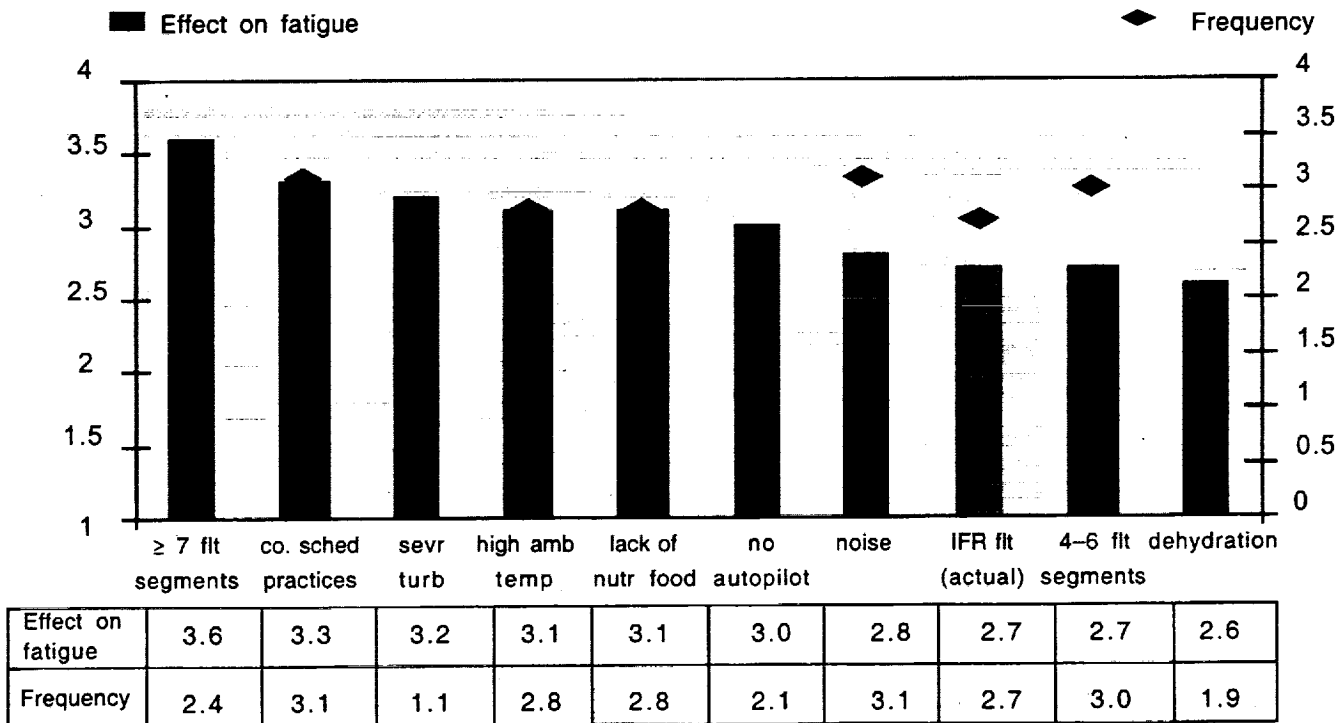


Figure 7. Highest rated fatigue factors and frequency of occurrence.

insecure" to "very secure", 49% felt "secure" and 28% "insecure".

Almost three-quarters (72%) reported that there was no pilot union on the property at the time of the survey. Of those who indicated that a pilot union was present, 92% reported being a member. Subjects rated how well the union and company management worked together, based on a five-point scale from "very poorly" to "very well": over a third (34%) indicated "very poorly", 29% "poorly", 26% "moderately", and 11% "well" or "very well". Pilots rated the quality of their unions on a five-point scale, and the average was 3.2, slightly better than "fair" (8% "very good", 36% "good", 34% "fair", 16% "poor", and 6% "very poor"). Pilots rated management on the same scale resulting in an average of 2.5, indicating a rating halfway between "poor" and "fair".) A majority (86%) reported that their companies did not offer any training that addressed fatigue issues.

4.7 Management

Pilots who also held management positions in the company were asked to answer three additional questions. They reported having logged 4500 flight hours in airlines, 4100 h in the military, 2040 h in general aviation, and 700 h in other types of flying, on average. Almost a fifth (19%) reported that they were involved in company scheduling decisions. This subset of the group (n = 10) was asked to rank factors with regard to the priority given to each factor in scheduling decisions. "Maximizing net income" received the highest average rating (2.1) and was ranked first by 7 of the 10 respondents; "availability of equipment" had the second highest rating (2.6) and was rated second by 6 respondents; "pilot's duty time for the work day" had an average ranking of 3.4, with rating that varied among respondents; "number of legs flown by pilot" had the fourth highest average ranking of 3.6, but 5 of 9 ranked it as their third highest priority; "takeoff time during night/early morning" received the lowest ranking (4.6) with 4 of 9

ranking it as their fourth priority. Additionally, the one response in the "other" category that was ranked first priority was "pilot experience."

5.0 Discussion

5.1 Caveats

As with any operational study, certain limitations apply to this investigation. Survey studies, in particular, are limited by the subjective nature of the data. Responses depend on subjects' perception, memory, and understanding of the questions. Additionally, research has demonstrated that individuals' subjective perception of their sleep often is discrepant from physiological measures (ref. 15). Self-assessed estimates of sleep latency times, sleep durations, awakenings, and other parameters are frequently inaccurate. Attempts were made to quantify response choices to minimize interpretation of descriptors (e.g., "often: 1-4 times/wk."). Also, because much of the information requested was retrospective, subjects were asked to reference their logbooks or paysheets for accuracy. Nevertheless, interpretation of the findings should allow for the limitations of subjective data. The survey format also has inherent sampling limitations due to the fact that voluntary respondents are a self-selected group.

5.2 Fatigue in Regional Operations

Overall, responses indicated that regional flight crewmembers consider fatigue a significant issue in regional flight operations. According to reports from the flight crews surveyed, fatigue is a moderate-to-serious concern that most agree is common in regional flight operations. Further, a great majority of crewmembers consider fatigue a moderate-to-serious safety issue when it does occur, and almost half identified descent or landing as the flight phases most affected by fatigue-induced performance decrements, which are critical operational phases.

Providing further evidence that fatigue affects regional operations, most crewmembers

reported that they have nodded off during a flight at some time, and over half reported that they have been on a flight during which arrangements were made for one pilot to nap in-flight. Nevertheless, few reported that they received training about fatigue from their flight departments.

5.3 Fatigue Factors Identified

Responses from regional flight crewmembers corroborated many of the fatigue issues that are typically identified anecdotally, as well as those described in the NTSB Commuter Study (ref. 12). These include long duty days, multiple flight segments, continuous-duty overnights (CDOs), flying reserve, issues around operations under different Parts of the FARs, and technology and equipment. Also identified as fatigue considerations were early duty report times, environmental factors, and personal physiological requirements, such as food.

5.3.1 Operational Requirements: Multiple Flight Segments

Regional operations require multiple take-offs and landings each duty day, which increases the amount of time spent in critical low-altitude operations. This fact is significant from two perspectives. From one perspective, flying multiple segments may contribute to fatigue. This potential is evidenced by the fact that flying multiple segments in the same duty day accounted for two of the top ten fatigue factors identified by crews, as well as the third most frequently identified factor contributing to the worst work day in regionals. From another perspective, fatigue that affects a regional pilot, who faces these high-workload, critical flight phases about five times as frequently as long-haul pilots, may create increased opportunity for fatigue-induced performance decrements to manifest themselves.

5.3.2 Scheduling Factors

Crewmembers rated company scheduling practices as the second most fatiguing factor, reporting that it occurred often. Several specific issues concerning regional airline

scheduling practices were identified through responses to questions on CDOs, flying reserve, and duty report times. Scheduling factors accounted for 8 of the 10 most frequently cited contributors to the worst regional flying day. Suggestions concerning scheduling factors represented nine of the ten most common recommendations to reduce fatigue in regional operations.

Regional crewmembers reported average workdays of 11.3 hrs. Long duty days were the most frequently cited factor in the worst regional workday. Crews recommendations to limit or reduce the length of duty days were the second most common suggestion to reduce fatigue in regional operations.

Continuous-duty overnights (CDOs) entail flying during much of the night and sleeping during the day, especially when CDOs are scheduled consecutively. Most companies provide accommodations, usually hotels, for their pilots flying CDOs. However, crewmembers reported that only 4.8 h were available for sleep during the "stand-up" portion, of which they slept 4.6 h, compared to their normal at-home average of 7.9 h. This suggests that crews may have started early morning flight segments with an average of 3.3 h of sleep loss, regardless of the sleep they may have had later in the day. Over half of the crewmembers reported having flown the final segment without any sleep at all. This sleep loss may exacerbate those performance decrements that normally would occur during the early morning circadian low. Further, crewmembers reported that despite the fact that an average of 8.3 h was available for sleep between consecutive CDOs (i.e., during the day), they obtained only 3.3 h of sleep on average, which translates to 4.6 h of sleep loss. This abbreviated sleep time is consistent with the fact that the circadian signal to be awake during the day often prevents people from getting their normal amount of sleep when they attempt to sleep during the day. These factors may affect any flight involving CDOs, which was almost one-fifth of flights according to crewmembers.

CDOs represented the sixth most frequently cited factor in the worst workday, and the elimination or reduction of CDOs was the third most frequent suggestion to reduce fatigue in regional operations.

The approximately one-third of crewmembers who fly reserves may face another set of challenges. The nature of flying on reserve means that crewmembers must respond when called for duty, thus creating unpredictability in their schedules. This unpredictability can lead to sleep loss, for example, when a call for duty occurs when a sleep period was planned. As evidence that sleep loss occurred, crewmembers reported getting 5.6 h of sleep before duty on average—2.3 h less than their normal average sleep. Sometimes (about once a month according to responses), the rest period that a crewmember must be given was assigned retroactively. That is, when called for duty, the crewmember was told that the previous hours constituted the required rest period. Clearly, this may add to the problem of planning a sleep schedule. These factors may result in flight crewmembers starting duty sleep-deprived. Modifying reserve scheduling practices was among the ten most commonly cited recommendations to reduce fatigue.

Another scheduling factor that may lead to sleep loss among crewmembers are early duty report times. The most common report times were between 4 a.m. and 7:59 a.m., according to responses. Early morning starts may truncate the normal sleep period, resulting in sleep loss. In order to accommodate an early report time, crewmembers may attempt to go to sleep earlier than normal to get their usual amount of sleep. However, because the natural tendency of the circadian clock is to lengthen rather than shorten the day, they may be physiologically unable to fall asleep earlier. A NASA study of pilots flying short-haul air transport operations concluded that early reports times contributed to the sleep loss the crews experienced (ref. 4). Further, the type of sleep lost may be REM sleep, which occurs more in the morning, and which is often

credited with the restoration of cognitive functions. Early report times were among the ten most frequently cited factors in the worst regional flying day.

Finally, the amount of time between flight legs accounted for two of the ten most frequently cited factors in the worst workday as well as the sixth most common suggestion to reduce fatigue in regional operations. Interestingly, two issues seem to be involved: first, short periods between flights that do not allow for meals or breaks; second, extended waits between flight segments that may contribute to long duty days with little flight time. Therefore, while very short breaks were among the commonly cited factors, very long periods between flights also were cited.

5.3.3 *Factors Concerning FARs*

The fact that many regional airlines operate under a different Part of the FARs from the majors (i.e., Part 135 vs. 121) and sometimes operate under more than one Part (i.e., Parts 135, 121, 91) raises several potential issues, including discrepant flight time limitations and differing requirements for support.

As a general overview question regarding the safety of regional airlines compared to that of major airlines, crewmembers rated their regional airlines as being between somewhat less safe than and as safe as major airlines. A NASA study of short-haul air transport pilots flying for major airlines used both physiological and subjective measures to assess fatigue factors, and the results suggested some similarities between those operations and regional airline operations (ref. 4). Like regional flight operations, short-haul flying required multiple flight segments (5.6 in regional vs. 5.1 in short-haul). Regional duty days (averaging 11.2 h) were somewhat longer than in short-haul (10.6 h), and the daily flight times were comparable, with regional pilots averaging 4.4 h of flight per duty day, while short-haul pilots averaged 4.5 h. Therefore, regional pilots flew slightly more flight segments, had slightly longer duty days, and flew

approximately the same number of hours. However, the regional operations under Part 135 differed in their requirements for flight and rest time, flight dispatch service, and airport certification, all of which are regulated more under Part 121. These discrepancies in themselves may constitute an additional challenge to alertness in regional operations.

In the NTSB Commuter Study, pilots reported that short turn-around times without the help of dispatchers made them uncomfortable about the possibility of making mistakes concerning important flight information (ref. 12). The regional pilots in this study corroborated short turn-around times, reporting an average turn-around time of 27 minutes and a shortest turn-around of under 7 minutes.

As described earlier, airlines may assign certain operations, such as ferrying aircraft or training flights, under Part 91 after a crewmember has met the 8-h flight time limit under Part 135 or 121. Pilots reported that they ferried planes 0.7 times in six months, and had check rides or training flights 0.2 times in a typical year. These responses suggest that operations under Part 91 after regular operations under another Part may not be frequent but that they do occur, about 1–2 times per year, on average. Part 91 operations in addition to standard Part 135 or 121 operations were among the ten most frequently cited factors in the worst regional flying day.

5.3.4 Other Fatigue Considerations in Regional Operations

The ten highest-rated fatigue factors identified by regional pilots included two environmental factors (high ambient temperature and noise), two factors that may be related to aircraft automation (flying without autopilot and flight in actual IFR conditions), and two dietary factors (lack of available nutritious food and dehydration).

Aircraft flown in regional operations may be older, less technologically advanced, and less well-equipped than aircraft flown by major

airlines. Depending on the specific aircraft and other equipment, this may result in less control over environmental factors such as flight deck temperature and noise. The technology and automation, also dependent on the specifications of the aircraft, may not include autopilot or the latest navigation equipment (which may affect operations in IFR conditions).

Finally, the lack of available nutritious food and dehydration may relate to various factors. For example, food may be provided, but it may not be of high nutritional value, or food may not be provided at all. The availability of both food and water in flight also may relate to whether or not the flight includes food and drink service for passengers, and whether flight attendants are on board.

Some of these challenges, such as regional schedules or the automation level in the aircraft, may be complex to address, while others, such as available food and water, may be more straightforward.

5.4 Recommendations

Regional flight crewmembers identified several fatigue factors in their responses. These factors may be categorized broadly as deriving from operational requirements, scheduling, FARs, technology and equipment, and individual physiological requirements.

Whether the fatigue factors concern regulation, flight/duty schedules, aircraft environment, or personal sleep habits, education plays an invaluable role in managing fatigue. If all industry members, including policy makers, flight department managers, schedulers, dispatchers, flight crews, cabin crew, and others, were equipped with basic information concerning sleep, circadian physiology, and the effects of these factors on flight operations, they would be better able to help improve alertness and performance in regional airlines. Additionally, flight crews and others may benefit greatly from learning fatigue countermeasures, including the use of planned naps, strategic caffeine, how to create an appropriate

sleep environment at home and on trips, and how to develop and practice good sleep habits.

Scheduling factors accounted for the two highest rated fatigue factors, eight of the ten most frequently cited factors in the worst regional flying day, as well as the five most common recommendations from pilots to reduce fatigue in regional operations. An overall review of scheduling practices may be an important part of any attempt to address fatigue. Duty duration, continuous-duty overnights, reduced rest, consistency of day vs. night duties, report times, and reserve practices might benefit from special attention. Identification of ways to improve schedules from a fatigue standpoint while meeting operational and economic needs of the airlines would be invaluable.

Environmental fatigue factors identified by regional flight crews, high ambient temperature and noise, might be addressed by maximizing control of those factors to the extent possible. Potential approaches range from providing individuals with certain equipment to making aircraft modifications.

The lack of available nutritious food may be addressed by both crewmembers and by airlines. For example, companies might provide fresh, nutritious in-flight meals when flights have food service. Crews, in turn, could plan ahead and bring healthy snacks. Likewise, while companies can provide beverages, crewmembers can be sure to have enough liquids by bringing some bottled water or other non-caffeinated beverage.

Additionally, education can help ensure that pilots are aware of the dehydrating effects of the aircraft and the importance of staying hydrated.

Finally, the responses suggest that operations under Part 135 may face unique challenges. This supports the NTSB recommendation that distinct regulatory standards for different segments of the airline industry be re-examined. As the NTSB noted in its Commuter Study, regional airlines are continuously growing in the number of passengers they carry as well as in the role they play in the air transport industry. Therefore, it becomes increasingly important for regulations that guide the airline industry to reflect available scientific information on fatigue, alertness, and performance.

Just as there is not a solitary cause for fatigue in regional flight operations, there will be no single solution. To maximize alertness and performance in flight crews, dispatchers, cabin crews, maintenance technicians, and others crucial to flight safety, the regional air transport industry will need to take a comprehensive, integrated approach by addressing to the fullest extent possible each contributing factor. By managing fatigue, the industry can contribute to a higher overall safety margin in regional flight operations.

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Appendix A: Regional Survey

Please answer all questions as accurately as possible. Watch for special instructions for a question or set of questions.

A. GENERAL

1. Gender? female male
2. Age? yr
3. Weight? lb
4. Height? ft in
5. In what time zone is your domicile? Eastern Central Mountain Pacific Hawaiian Alaskan
6. In what time zone do you live? Eastern Central Mountain Pacific Hawaiian Alaskan
7. How long does it usually take you to travel from your home to your assigned domicile? hr and min
8. What is the typical mode of transportation from your home to your assigned domicile? auto airplane other - specify _____
9. Do you currently hold another job(s) in addition to your airline job? yes no
10. If you answered yes to #9 above how many hours do you spend at your additional job(s) in a typical month? hr

B. SLEEPING AT HOME

Based on **an average night of sleep at home** (at least 2 days after your return home following a trip), please give one best answer to each of the following questions. Use your **local 24-hour clock**.

11. On average, how many nights of sleep do you get at home between trips? nights
12. On your days off duty, what time do you usually go to bed?
time, 24-hr clock
13. On your days off duty, how long after going to bed do you usually fall asleep? hr and min
14. When sleeping at home, how many times on average do you wake up? times
15. If you wake during the night, what most often awakens you?
(Check **ONLY** one answer.)
- | | |
|------------------------------------------|--------------------------------------|
| <input type="checkbox"/> bathroom | <input type="checkbox"/> can't sleep |
| <input type="checkbox"/> children/spouse | <input type="checkbox"/> noise |
| <input type="checkbox"/> other _____ | |
16. If you wake during the night, on average, how long does it take you to go back to sleep? hr and min
17. When sleeping at home, what is the amount of total sleep you get on average? hr and min
18. On your days off duty, what time do you usually get out of bed?
24-hr clock
19. How often do you take a nap at home?
- | | | | | |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| never | rarely | sometimes | often | very often |
| | 1-10 /yr | 1-3 /mo | 1-4 /wk | 5-7 /wk |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

20. On average, how long are your naps?

<input type="text"/>	and	<input type="text"/>
hr		min

21. When sleeping at home, how often do you have problems getting to sleep?

never	rarely	sometimes	often	very often
	1-10 /yr	1-3 /mo	1-4 /wk	5-7 /wk
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

22. How often do you take medication to help you sleep?

never	rarely	sometimes	often	very often
	1-10 /yr	1-3 /mo	1-4 /wk	5-7 /wk
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

23. If yes, please specify the medication.

24. How often do you use alcohol to help you sleep?

never	rarely	sometimes	often	very often
	1-10 /yr	1-3 /mo	1-4 /wk	5-7 /wk
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

25. Overall, what kind of sleeper are you?

very poor	poor	good	very good
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

26. Do you have a sleep problem?

yes	no
<input type="checkbox"/>	<input type="checkbox"/>

27. If yes, what is your sleep problem?

28. If yes, has it been diagnosed by a physician?

yes	no
<input type="checkbox"/>	<input type="checkbox"/>

29. Has it ever prevented you from flying a scheduled trip?

yes	no
<input type="checkbox"/>	<input type="checkbox"/>

REMEMBER: Give only one best answer (for each factor) based on an average night of sleep at home (at least 2 days after you return from a trip).

30. Please rate the following factors and indicate how much they affect your sleep.

	interferes		no effect		promotes
	1	2	3	4	5
a) quality of sleep surface	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) heat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) cold	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) thoughts running through your head	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) random noise events	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f) constant background noise	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g) background lighting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h) readiness for sleep	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i) comfort of clothing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j) low humidity/dry air	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k) high humidity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l) trips to bathroom	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
m) bed partner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
n) privacy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
o) ventilation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
p) sheets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
q) blankets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
r) pillows	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
s) other (specify) _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

31. Please rate the following on the extent to which they **interfere** with your sleep at home.

	strongly interferes				no effect
	1	2	3	4	5
a) hunger	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) thirst	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) personal worries	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) respiratory factors (i.e., asthma, allergies, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) other (specify) _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

32. From the list in #30, please list the top 1. _____

three factors that **promote** your sleep 2. _____

at home in rank order. 3. _____

33. When on reserve status and not called out, what is the total amount of sleep you usually get at home ?

hr
 and

 min

34. Considering only when on **reserve** status, please list in rank order, the top three factors that interfere with or promote your sleep.

INTERFERE

1. _____
2. _____
3. _____

PROMOTE

1. _____
2. _____
3. _____

C. FLYING INFORMATION

35. How many total flight hours did you have when you were hired by your current airline?

hr

36. How many total flight hours have you logged in your lifetime?

hr

37. What certificates/ratings do you currently hold? (check all that apply)

- | | | |
|---------------------------------------|------------------------------------------|--------------------------------------------------|
| <input type="checkbox"/> ATP | <input type="checkbox"/> commercial | <input type="checkbox"/> instrument |
| <input type="checkbox"/> private | <input type="checkbox"/> flight engineer | <input type="checkbox"/> flight engineer written |
| <input type="checkbox"/> CFI | <input type="checkbox"/> CFII | <input type="checkbox"/> MEI |
| <input type="checkbox"/> other: _____ | | |

38. How many hours do you have in the following categories? (all categories are separate and exclusive)

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
airline	military	general aviation	other - specify

39. How many hours do you fly in the following categories in a typical month? (all categories are separate and exclusive)

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
airline	military	general aviation	other - specify

40. List all non-military salaried flying jobs you have had in your aviation career.

41. With how many different companies have you held a salaried flying position?

companies

42. List all company aircraft (make and model) that you are currently flying.

43. How long have you been employed by your present airline?

yr and mo

44. Under which of the following FAR Parts do you currently fly in your job? (check all applicable)

Part 121
Part 135
Part 135 cargo only
Part 91

45. What is your hourly wage with your current airline?

hourly

46. What is your usual monthly income from your current airline position?

usual monthly

47. What is your flightdeck position?

Capt. F/O S/O or F/E

Answer according to the flying done ONLY for your regional airline job within the past year.

48. How many hours of actual IFR do you fly in a month (not just filed flight plans, but actual conditions)?

hr typical hr fewer hr more

49. What is the duration of a flight delay?

min typical min shortest min longest

50. How frequently do ATC delays occur?

per wk average per wk shortest per wk worst case

51. How frequently do delays occur due to weather? per wk typical per wk shortest per wk longest
52. How frequently do company-mandated flight delays occur? per wk typical per wk fewer per wk more
53. How frequently do mechanical delays occur? per wk typical per wk fewer per wk more
54. How frequently do you fly into a high density operating area? per day typical per day fewer per day more
55. How frequently do you fly into a non-radar environment? per wk typical per wk least per wk most
56. Do you currently fly reserve lines? yes no
57. Which type of reserve do you currently fly? on call at home airport reserve
58. What percentage of your flight hours for the company is reserve time in a month? % typical % lowest % highest
59. How many hours prior to report time are you notified while on reserve? hr typical hr shortest hr longest
60. When called out of reserve status, how much sleep do you usually get before reporting for duty? hr and min
61. How often is your 24-consecutive-hour required rest period assigned after the fact (i.e., you receive a call indicating that the previous 24-hour-duty-free period was your required rest period)? per mo typical per mo best case per mo worst case

62. What are your aspirations for advancement in your current airline?

63. What are your long-term aviation career goals?

D. DUTY

(Please answer the following questions using your logbook or paysheet.)

64. How many duty days do you fly in a month? typical days least days most days
65. What is your number of **scheduled** flight hours per month? hr typical hr least hr most
66. What is your number of **actual** flight hours per month? hr typical hr least hr most
67. How many flight segments do you fly in a duty day? typical least most
68. How much time do you have on the ground between flights (time between blocking in and out)? hr typical hr least hr most
69. On how many duty days in a month does your actual flying time exceed 8 hours? typical least most
70. How often does your company readjust schedules to account for actual block times? never rarely occasionally frequently

71. During a six month period, how many times do you ferry a plane under Part 91 after already flying 8 hours under Part 121 and/or Part 135? times
72. During a typical year, how many times do you have a check ride or training flight under Part 91 after already flying 8 hours under Part 121 and/or Part 135? times
73. During the past year, how many times have you exceeded the 7-consecutive-day flight time limit? times (Part 121-30 hr) times (Part 135-34 hr)
74. What is the duration of your duty day?
 typical: hr and min
 shortest: hr and min
 longest: hr and min
75. What is the longest duty day you have had in your airline career? hr and min
76. How many times a month is your duty day extended to keep your regulated flight time within limits? typical best case worst case
77. In a typical month of flying, how many times do you stay in the following accommodations during your layover rest periods?
 hotel trailer other: specify _____
78. During the past month, how many times have you reported for duty during each of the following time periods?
 0000 - 0359 hr 1200 - 1559 hr
 0400 - 0759 hr 1600 - 1959 hr
 0800 - 1159 hr 2000 - 2359 hr

79. How many times are you scheduled for reduced rest in a month? typical times least times most times
80. How many times are you asked to take unscheduled reduced rest in a month? typical times least times most times
81. When asked to take unscheduled reduced rest, how many times in a typical month is your rest period reduced to the following number of hours? 8 hr times 9 hr times
82. In a month of flying, how many duty days include continuous duty overnights (CDOs)? typical least most
83. During a continuous duty overnight, how long is the scheduled ground time ("stand-up" portion)?
 typical: hr and min
 best case: hr and min
 worst case: hr and min
84. How much time is available for sleep during the "stand-up" portion of the CDO?
 typical: hr and min
 best case: hr and min
 worst case: hr and min
85. How often do you sleep during the "stand-up" portion of a CDO?
 never rarely occasionally frequently
86. Which of the following accommodations does your company provide for CDOs (check as many as applicable)?
 hotel
 trailer
 other: specify _____
87. In a typical month of flying, how many times do you stay in the following accommodations during the "stand-up" portion of a CDO?
 hotel trailer other: specify _____
88. Please rate the accommodations.
 very poor poor fair good very good

89. What are the good qualities of the accommodations?

90. What are the bad qualities of the accommodations?

91. How much total sleep do you get during the "stand-up" portion of a CDO?

typical: hr and min
best case: hr and min
worst case: hr and min

92. During a typical month, how many times do you ferry a plane during the "stand-up" portion of a CDO?

times

93. Have you ever flown the final segment of a CDO without getting any sleep at the out-station?

yes no

94. How long is the scheduled rest period between consecutive CDOs?

typical: hr and min
best case: hr and min
worst case: hr and min

95. How much time is available for sleep between consecutive CDOs?

typical: hr and min
best case: hr and min
worst case: hr and min

96. How much total sleep do you get between consecutive CDOs?

typical: hr and min
best case: hr and min
worst case: hr and min

E. FATIGUE

97. Describe the worst work day you've had while flying regionals, including the specific factors that made it the worst.

98. In your opinion, to what extent is fatigue a concern in regional flight operations?

not at all minor moderate serious

99. Is crew fatigue a common occurrence in flight operations?

yes no

100. When crew fatigue occurs, how significant a safety issue is it?

not at all minor moderate serious

101. In what ways does fatigue affect your flight performance?

102. When your flight performance is affected by fatigue, which phase of flight performance is most affected (choose only **ONE** answer)?

taxi descent
takeoff landing
enroute

103. List three strategies that you use for coping with fatigue in rank order.

PRETRIP:

1. _____
2. _____
3. _____

INFLIGHT:

1. _____
2. _____
3. _____

104. What three changes would you make to reduce fatigue in regional airline operations? List the most important first.

1. _____
2. _____
3. _____

105. Have you ever "nodded off" during a flight?

yes

no

106. Have you ever been on a flight where arrangements were made for one of the pilots to sleep during the leg?

yes

no

107. For the following question:

1. Check the box which represents the extent to which each factor affects your fatigue level.
2. Then, in the far right column, write the number which corresponds to how frequently you experience each factor (based on the frequency scale below).

Frequency Scale:				
0=never	1=very rarely (1-10/yr)	2=sometimes (1-3/mo)	3=often (1-4/wk)	4=very often (5-7/wk)

	not at all	slightly	moderately	seriously	frequency
a) VFR flight	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
b) IFR flight (actual)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
c) Light turbulence	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
d) Moderate turbulence	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
e) Severe turbulence	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
f) High ambient temperatures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
g) Low ambient temperatures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
h) Icing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
i) ATC interactions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
j) Passenger interactions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
k) Flying multiple segments in the same duty day					
1-3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
4-6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
≥7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
l) Flying without an autopilot	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
m) Company scheduling practices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
n) FAR	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
o) Aircraft vibration when flying	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
p) Unpressurized cockpit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
q) Luggage handling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
r) Lack of available nutritious food	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
s) Dehydration	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
t) Interacting w/ other co. employees	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
u) Noise	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
v) Other (specify) _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____

F. WORK ENVIRONMENT

108. Indicate your perception of your company's priorities by marking each item in rank order (1 = highest).

<input type="checkbox"/>	customer satisfaction	<input type="checkbox"/>	profit
<input type="checkbox"/>	employee welfare	<input type="checkbox"/>	public image
<input type="checkbox"/>	growth	<input type="checkbox"/>	safety
<input type="checkbox"/>	other: _____		

109. What safety issues does your company emphasize?

1. _____
 2. _____
 3. _____

110. Through what mechanisms does your company emphasize or implement these safety issues on the job?

1. _____
 2. _____
 3. _____

111. In your opinion, how safe is your regional airline compared to the major airlines?

much less safe	somewhat less safe	as safe	somewhat safer	much safer
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

112. How do you feel about the long-term job security in your current position?

very insecure	insecure	secure	very secure
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

113. Is there a pilot union on the property?

yes	no
<input type="checkbox"/>	<input type="checkbox"/>

Please answer questions 114 thru 116 ONLY if you answered 'yes' to the question #113.

114. Are you a member of that union?

yes	no
<input type="checkbox"/>	<input type="checkbox"/>

115. Rate how well the union and your management work together.

very poorly	poorly	moderately	well	very well
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

116. Rate the quality of your union.

very poor	poor	fair	good	very good
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

117. Rate the quality of your management.

very poor	poor	fair	good	very good
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

118. Does your company offer any training that addresses fatigue issues?

yes

no

119. If you answered "yes" to the above question, please elaborate.

MANAGEMENT

Please answer the following questions **ONLY** if you hold a management position in your company.

1. For each of the applicable categories, check the box and write the number of flight hours you have logged.

- airline
- military
- general aviation
- other: specify _____
- not applicable

2. Are you involved in flight scheduling for your company?

- yes no

3. If yes, please rank the following categories with regard to their priority in your scheduling decisions (1=highest priority).

- ____ a) number of legs flown by pilot
- ____ b) pilot's duty time for the work day
- ____ c) takeoff times during the night/early morning
- ____ d) availability of equipment
- ____ e) maximizing net income
- ____ f) other: _____

Report Documentation Page		Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.			
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE October, 1999	3. REPORT TYPE AND DATES COVERED Technical Memorandum	
4. TITLE AND SUBTITLE Crew Factors in Flight Operations XI: A Survey of Fatigue Factors in Regional Airline Operations		5. FUNDING NUMBERS 548-30-32	
6. AUTHOR(S) Elizabeth L. Co, Kevin B. Gregory, Julie M. Johnson, and Mark R. Rosekind			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) NASA Ames Research Center Moffett Field, California 94035-1000		8. PERFORMING ORGANIZATION REPORT NUMBER IH-003	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) National Aeronautics and Space Administration		10. SPONSORING/MONITORING AGENCY REPORT NUMBER NASA/TM—1999—208799	
11. SUPPLEMENTARY NOTES Point of Contact: David Neri, Ames Research Center, M/S 262-4, Moffett Field, CA 94035 (650) 604-0658			
12A. DISTRIBUTION/AVAILABILITY STATEMENT Subject Category: 52-03 Availability: NASA CASI (301) 621-0390		12B. DISTRIBUTION CODE Distribution: Public	
13. ABSTRACT (Maximum 200 words) This report is the eleventh in a series on the physiological effects of flight operations on flight crews. A 119-question survey was completed by 1,424 flight crewmembers from 26 regional carriers to identify factors contributing to fatigue in regional airline operations. Eighty-nine percent of crewmembers identified fatigue as a moderate or serious concern with 88% reporting that it was a common occurrence and 92% reporting that, when it occurs, fatigue represents a moderate or serious safety issue. However, 86% reported they received no company training addressing fatigue issues. Identified fatigue factors included multiple flight segments, scheduling considerations, varying regulations, and others. The two most commonly cited fatigue factors regarded flying multiple (more than four) segments. Scheduling factors accounted for nine of the ten most common recommendations to reduce fatigue in regional operations. Differing requirements among regulations were cited as contributing to fatigue. Other identified factors were the flight deck environment, automation, and diet. The data suggested specific recommendations, including education of industry personnel about fatigue issues and examination of scheduling practices. Education plays a critical role in any effort to address fatigue. Analyzing scheduling practices and identifying potential improvements may result in reduced fatigue as well as other benefits to operations.			
14. SUBJECT TERMS Fatigue, Sleep, Duty and rest, Scheduling, Regional airlines		15. NUMBER OF PAGES 39	
		16. PRICE CODE A03	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT Unlimited