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PILOT FATIGUE: UNRESPONSIVE FEDERAL AVIATION REGULATIONS AND INCREASING COCKPIT TECHNOLOGY THREATEN TO ROCK THE NATION’S PILOTS TO SLEEP AND COMPROMISE CONSUMER SAFETY

Temesha Evans-Davis*

As cockpit technology and automation advance and crews endure longer flights over more time zones, the problem of pilot fatigue is growing ever more serious. According to a NASA study, more airline pilots are falling asleep at the wheel due to this improved technology and an increased demand for flights. The resulting paradox is becoming dangerously clear. While the technology allows pilots to fly long distances for great durations, their bodies remain programmed to be awake during the day and asleep at night. To reconcile modern aviation capability and pilots’ very human and biological need for sleep, the FAA began a campaign under the Reagan Administration to bring old regulations in line with current usage and technology. The results have been unsatisfactory to pilots, and representatives of pilots’ unions have exhorted the FAA to take immediate action to deal with the problem of pilot fatigue. The aviation industry has voluntarily abolished Warsaw Convention liability limitations while NASA has released its fatigue countermeasures studies that encourage controlled napping. But, the proposed 1995 regulations remain unenacted. Furthermore, regulatory agencies for both trucking and railway industries have begun to directly address fatigue and possible regulatory changes. The time has come for the aviation industry to follow suit.

I. INTRODUCTION

When a plane rolls down the runway, the pilot at the controls is “most likely well trained, wide awake, and alert. But

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what happens once the plane reaches cruising altitude? An ongoing NASA study confirms a long held cockpit secret—on perhaps one in seven flights, [the] pilot falls asleep."1 Just as passengers on long airline flights get comfortable, lean back, and doze off to sleep, pilots, responding to their bodies' pressure for sleep, could be doing the same thing.2

"Sleep is . . . simply a symptom of fatigue."3 According to NASA research, improved technology and increased demand for flights are causing the fatigue that is driving pilots to fall asleep at the wheel.4 Pilots are currently banned from napping or taking mid-flight walks, except to use the restroom, and they "must endure more transcontinental flights with little to do at cruising altitudes."5 John McCulloch, a retired airline pilot with thirty years of service to Eastern Airlines, summed up the phenomenon as follows: "You're just sitting up there . . . . It could get a little boring. The autopilot's doing all the work. You could just sort of doze."6

The problem of pilot fatigue is growing ever more serious because continued cockpit technology and automation advances facilitate longer flights over more time zones.7 A greater number of frequent fliers than ever and an insufficient supply of pilots to meet these growing flight demands only exacerbate the problem.8 At a certain point, the body takes over and forces the pilot to fall asleep. It is an involuntary response.9

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2 See CNN Science and Technology Week (CNN television broadcast, June 27, 1998).
3 Id.
4 See Overseas Travel News in Brief, AAP NEWSFEED, June 25, 1998.
5 Id.
6 Martin Merzer, 1 in 7 Pilots Falling Asleep on Job, Studies Suggest, SUNDAY GAZETTE MAIL, June 21, 1998, at P1A.
8 See Eric Brazil, Study: OK for Pilots to Nap; Blames Airlines, FAA for Not Changing Regulations, SAN FRANCISCO EXAMINER, June 23, 1998, at A6 (quoting the head of NASA's pilot fatigue program: "Pilots are just as susceptible to jet lag as passengers.").
9 See Merzer, supra note 7, at A2. Jim Bishop, a veteran pilot, acknowledged that he nods off on rare occasions. According to Mark Rosekine, a psychologist who conducted several pilot fatigue studies for NASA and the FAA, Bishop's response simply illustrates that fatigue plays a significant role in aviation. Although the public doesn't understand it, pilot fatigue is an issue every single time they fly. See id.
The most significant concern this involuntary sleep response raises is its effect on safety. Since NASA instituted the Aviation Safety Reporting System (ASRS) in 1976, the United States government has documented hundreds of fatigue-related incidents, including many cases where pilots fell asleep at the controls. Unfortunately, the FAA has suppressed or ignored this data under pressure from cost-conscious airlines. Before making an analysis of the possible fatigue related safety ramifications, this section will explore fatigue and the regulations that the FAA enacted to address pilot fatigue.

A. Fatigue

Sleep is a “period of diminished responsiveness to external stimuli [that] alternates with wakefulness on a daily basis.” It is a “basic human need.” Like hunger and thirst, sleepiness is considered a visceral drive that reflects the need or pressure for sleep.

Several factors affect people’s ability to accurately judge their degree of sleepiness: an internal point of reference, environmental demands, and time of day. “[I]n boring, nonstimulating situations in which environmental demands to stay alert or to pay attention are reduced,” people often judge their level of sleepiness to be higher. “People with a high degree of sleepiness . . . fall asleep rapidly when given the opportunity to sleep.”

Problems arise when sleepy people are not given adequate opportunities to sleep. The dramatic effects of sleep deprivation, loss of initiative, loss of energy, lapses of attention, distractibility, and the overwhelming agony of wanting to go to sleep no matter what is being done, reveal the importance of adequate sleep. Although these symptoms are undeniable monikers of sleep deprivation, science remains uncertain about what the real func-
tion of sleep is. Intuitively, however, people know that “sleeping, like drinking and eating, returns [them] to a physiological even keel when [they] feel out of sorts.”

Though science is uncertain about what sleep does, it is certain how sleep occurs. Biological rhythms control sleep. Everyone has a personal circadian rhythm that controls sleep. Therefore, each individual has regular sleep and wake patterns that affect fatigue.

Although the body’s circadian rhythm influences sleep deprivation, it is not the only factor that contributes to fatigue. Living and working conditions can cause fatigue. In addition, stress, workload, and insufficient time off may fatigue people.

Sleep deprivation can inflict damage beyond mere fatigue. It causes mental acuity to decline, darkens moods, and impairs concentration, memory, and decision making ability. Finally, in extreme instances, sleep deprivation can be fatal.

B. TECHNOLOGY AND AUTOMATION

The traditional analog instrumentation board currently in cockpits is being steadily replaced. “Modern airline transports [now] equipped with electronic flight and engine system instrumentation” are referred to as “glass cockpits.” As automation

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18 See Anna Maria Gillis, Why Sleep? A New Hypothesis Suggests That We Sleep to Refuel Energy Stores in the Brain, 46 BIOSCIENCE 391 (1996) (“[M]odern researchers are, at the most fundamental level, as confounded by the purpose and ultimate control of sleep as were Hippocrates and Aristotle more than 2500 years ago.”).

19 Id.

20 See Daniel Goleman, Too Little, Too Late; Sleep, 11 AM. HEALTH 43 (1992).

21 See Gofen, supra note 17, at 4.


23 See id. (“[E]xcessive mental workload, such as where a crew member has too many things to attend to at once, can cause mental overload. Monotonous tasks, on the other hand, can produce boredom, inattention, and fatigue. It should be noted that excessive time spent on any task, whether high activity or monotonous, produces inattention and fatigue.”).

24 See Gillis, supra note 18, at 391.

25 See Goleman, supra note 20, at 43.

26 See Gillis, supra note 18, at 391. Allan Rechtschaffen and colleagues of the University of Chicago showed that rats, deprived of sleep, experienced a doubling of their metabolic rates. Although the sleep deprived rats ate more than rats allowed to sleep normally, the sleep-deprived animals lost weight. They could not maintain their body temperatures, and they developed unusual skin disorders. After two and a half weeks, the rats died. See id.

efforts and technology continue, the seemingly futuristic directive from a pilot to his plane: “Follow the highway down onto final approach and land, taxi to the indicated spot, and shut down,” is getting closer to becoming an aviation reality.28 “ Virtually all the technology is already developed, or can be in a very short time . . . .”29

“Computer-driven instruments, flight management systems, complex digital data buses [sic] and microprocessor-controlled components possess superior technologies to [their predecessor] analog systems.”30 Now those technologies are being upgraded and extended as the civil aircraft industry stands “on the brink of a huge step into the next generation of automation”—autonomous aircraft operations.31 Faced with a doubling of air traffic over the next ten to fifteen years, the aviation industry simply has no other means to manage such growth.32

Automation has been a tremendous boom and without it, meeting the passenger capacity demands of the future would be impossible.33 However, concern is growing among the airline industry that the application of present flight deck automated systems still has some major flaws. Detailed evaluations of the long-term impact of automation in the cockpit are only now becoming clear, and because the new generation of digital datalinks could take the pilot “even further out of the decision making loop, it is critical that the problem solving is done sooner rather than later.”34 Solving the problems of cockpit automation is a definite priority because pilots are distrustful of advanced technology aircrafts.35

Airbus Industries has taken the position that training is pivotal in helping pilots remain comfortable while making the transition from conventional-technology aircrafts to automated cockpits.36 Airbus believes that a pragmatic approach to auto-

29 Id.
30 Phillips, supra note 27, at 56.
32 See id.
33 See id.
34 Id.
35 See id. (referring to the U.K. RAF Institute of Aviation Medicine study on pilot comfort with automated cockpit technology).
mation is essential to its training. Rather than insist on the full use of automation, it prefers that trainees select the most appropriate level of information and automation.  

"Lack of understanding or excessive confidence in automation" contributes to incidents and accidents. Pilots frequently lose a "situational awareness" or fail to shift their "mental map" when dealing with automated cockpits. Developing a training program to address this mental map deficiency is more difficult than devising a solution for technical errors. One captain of a Boeing glass cockpit aircraft captured the automation dichotomy when he lauded the airplane’s modern computerized technology, but also said that pilots must guard against overdependence and automation complacency. "Ninety-nine percent of the technology makes flying safer, but you have to be aware of the one percent that can kill you."

In addition to gaining a mental map of automation, pilots flying in glass cockpits need to improve their flying skills. This need is a "crucial but often overlooked factor in reducing accidents." Threats of aircraft accidents are not prevented simply by investing in technology, but by investing in people as well.

Although other airlines have developed training programs to address automation, American Airlines' Advanced Aircraft Maneuvering Program (AAMP) is the most comprehensive. It was developed in early 1995 and focuses primarily on "raising a pilot's level of knowledge and awareness of aerodynamics, unusual altitude recoveries, phenomena that can cause aircraft upsets and automation dependency in the cockpit." "AAMP 'is built on the philosophy that the pilot must always fly the airplane first,' and that cockpit technology 'should be designed around

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37 See id.
38 Id.
39 See id.
40 Airbus Challenges "Negative Assessment" of Glass Cockpits, AIR SAFETY WK., Nov. 1997 (quoting the captain of a glass cockpit Boeing aircraft).
42 See id. According to Robert W. Baker, American’s executive vice president of operations, an airline program "seeks to reassign the appropriate role of aircraft automation within the cockpit, recognizing that ultimately, it will be the human being who is held responsible for the safety of our passengers and aircraft." Id.
43 Id.
the pilot: not the technical pilot, not the test pilot, but the line pilot.'"\(^{44}\)

This idiom encompasses two safety concerns applicable to automation and piloting. First, pilots must decide when and how much automation to use. After all, "[w]hat do the airlines want—a proficient pilot, or a pilot proficient in orchestrating automated systems?"\(^{45}\) Second, airlines must redirect crew ressource management to address pilots' "interface with automation and what the appropriate level of automation should be for specific cockpit tasks."\(^{46}\)

Operators espoused this conservative attitude towards cockpit automation loud and clear when Boeing decided to update the 737 platform.\(^{47}\) While improved operating characteristics are necessary, the idea is that technology must earn its way onto the airplane.\(^{48}\)

Airbus obviously believes technology has earned its way on board because it designed the A320 during the second wave of the revolution in cockpit technology.\(^{49}\) The first glass cockpit aircrafts were revised analogs of the conventional cockpit and had only enough automation to reduce the size and complexity of the switch panels.\(^{50}\) But "[t]he A320 exploited the computer revolution and used a higher level of automation . . . to reduce workload during both routine and emergency procedures."\(^{51}\)

Apart from the Concorde, the A320 was the first commercial aircraft to use "fly-by-wire controls" and thereby eliminate the need for two-handed mechanical leverage.\(^{52}\) Airbus replaced the conventional control yoke with force-sensitive sidesticks that move only when a pilot moves them. Did Airbus make the A320 too automated?\(^{53}\)

\(^{44}\) Id. (quoting Cecil Ewell, vice president of flight operations for American Airlines).

\(^{45}\) Id.

\(^{46}\) Id.

\(^{47}\) See generally, Perry Flint, A Dynasty of Success: The 737 Is Still Near the Top of Its Form, AIR TRANSP. WORLD, Feb. 1994, at 58 ("Yes, by all means update the 737 platform, but don't build an all-new airplane. Don't fiddle with the cockpit any more than is necessary.").

\(^{48}\) See id.

\(^{49}\) See Bill Sweetman, Rough Takeoff, Smooth Cruise; Accidents Inspire New Training Techniques for A320 Aircraft, AIR TRANSP. WORLD, Mar. 1994, at 54.

\(^{50}\) See id.

\(^{51}\) Id.

\(^{52}\) See id.

\(^{53}\) See id.
Boeing, not surprisingly, has no formal comment. Its 777 has yokes, not sidesticks. Automation on the 777 cockpit is driven by three basic principles: (1) long-term monitoring is automated because humans are bad monitors; (2) some actions are automated because the crew would have a Hobson’s choice; and (3) the pilot needs to control what appears on the displays.54

Some agree with Airbus’s more expansive and liberal view of automation. A 1994 industry task force report stated: “[w]ithout innovation enabled by technological advancement, general aviation within the U.S. will fail to respond to opportunity for expanded use.”55 Using people who had never flown before, NASA ran a pilot simulator program to test “EZ Fly/Highway in the Sky” single power levers. Researchers found that ninety percent of the participants were able to take off, fly a pattern, and land the very first time at the control.56 From a practical standpoint, the single power lever technology could be used to facilitate lesser-experienced pilots by removing “[m]uch of the grind and sweat of instrument flight rules.”57

The more accurate view of cockpit automation lies somewhere between the extreme absolute conservative and liberal perspectives. Prompted by the reality of accidents and incidents involving transport aircraft with advanced or highly automated systems, the FAA launched a study of human factors to determine how breakdowns in the pilot/aircraft interface affect safety.58 The FAA proposed an airworthiness directive against several Airbus series aircraft to modify certain flight control computers. These modifications would allow the autopilot to disengage when the aircraft is attempting a “go-around” maneuver.59

According to surveys and research on the influence of human factors on glass cockpit safety, many experienced pilots of auto-

54 See id. Hobson’s choice is an apparently free choice when there is no real alternative. See MERRIAM WEBSTER’S COLLEGIATE DICTIONARY 551 (10th ed. 1994). Hobson’s choice example: “if one pressurization controller fails, the only action is to switch to the second controller.” Id.

55 Ethell, supra note 28, at 38.

56 See id.

57 Id. This system would safely place 1,000 hour capability in the hands of a pilot with only 200 hours experience. The pilot would not need the judgment of a 1,000 hour pilot because, through expert systems in the cockpit, certain aspects of experience could be built in. See id.


59 See id.
mated aircraft are occasionally surprised by what the automatic systems are doing."\textsuperscript{60} Earl L. Wiener, a human factors researcher, says pilots in automated cockpits often ask: "What is it (the auto-flight system) doing? Why did it do that? What is it going to do next?"\textsuperscript{61} Human factors researchers David D. Woods and Nadine B. Sarter believe these inquiries show that pilots simply do not always "have a good 'mental model' of what computerized flight systems are up to in all circumstances."\textsuperscript{62}

These findings suggest that glass-cockpit designs have not always improved on previous-generation systems.\textsuperscript{63} In fact, designers and researchers should have used pilots to test new glass-cockpit engine displays in imparting information to the crew. Since this testing was not done, breakdowns in communication between the pilots and automated systems is occurring as computers are becoming more complex and usurping more authority in the cockpit.\textsuperscript{64} These problems must be addressed because the potential harm is tremendous.\textsuperscript{65}

\textbf{C. Regulation}

Automation and technology cannot, and arguably should not, be eliminated. But when modern day aviation innovation collides with man's circadian clock, progress meets a substantially limiting factor. Through regulation, the FAA has been trying to balance these two competing interests for decades. Not all the parties concerned, however, have met those regulations with open arms.

In 1982, the FAA made a push under the Reagan Administration's regulatory policy to bring outdated regulations in line with current usage and technology.\textsuperscript{66} The proposed rules were an attempt to revise the then thirty-year-old hour limitations to safely regulate the growing air transportation industry. Sug-

\textsuperscript{60} See David Hughes & Michael A. Dornheim, Accidents Direct Focus on Cockpit Automation, AVIATION WK. & SPACE TECH., Jan. 1995, at 52.

\textsuperscript{61} Id.

\textsuperscript{62} Id. ("[N]ew engine displays did not necessarily represent an improvement over the round-dial displays used in older 737s.").

\textsuperscript{63} See id. ("Woods and Sarter note that 'strong, silent, difficult-to-direct automation is not a team player [with the flight crew].' Wiener says some glass cockpits have clumsy automation that creates bottlenecks when pilots are least able to deal with them—during high-workload periods.").

\textsuperscript{64} See id.

\textsuperscript{65} See id. ("Woods and Sarter note that 'strong, silent, difficult-to-direct automation is not a team player [with the flight crew].' Wiener says some glass cockpits have clumsy automation that creates bottlenecks when pilots are least able to deal with them—during high-workload periods.").

\textsuperscript{66} See David M. North, FAA Moves to Simplify, Update Aviation Regulations, AVIATION WK. & SPACE TECH., Mar. 1982, at 40.
gested flight time regulations included the following: a 100 hour limitation on commercial flight time in any thirty consecutive days; a mandate that within any twenty-four consecutive hours, the required rest period must be at least eight consecutive hours for scheduled flight times of eight hours or less, and ten consecutive hours for scheduled flight times of more than eight hours; and a requirement that a certificate holder provide each flight crew member with a rest period of at least twenty-four consecutive hours once during any seven consecutive days.\textsuperscript{67}

Pilots and some commuter airlines opposed implementation of these proposed regulations.\textsuperscript{68} They particularly disagreed with the 100-hour monthly flight time maximum. For them, the FAA proposal just went far beyond what was necessary to solve a basic airline problem.\textsuperscript{69}

The FAA rebutted that the changes were needed since the current rules were drafted three decades earlier when piston aircraft predominated. "'Modern aircraft with turbine engines and other technological advances provide a more comfortable work environment to the flight-deck crew and more flexibility in selecting operating altitudes and speeds . . . . Yet the regulations governing flight time limits have remained unchanged. The present regulations are enormously complicated and detailed.'"\textsuperscript{70} Opponents then discussed how the operating environment had changed and become more tiring.\textsuperscript{71}

To address this issue of fatigue, the Air Line Pilots Association (ALPA) emphasized hours on duty as opposed to only flight hours. Since modern aircraft, with their high speeds and sophisticated monitoring systems, can demand that pilots give more complete attention, regulating flight hours is an understandable instinct.\textsuperscript{72} Pilots, however, want the FAA to recognize that, "'[i]f

\textsuperscript{67} See id. (noting that the rest time was to be assigned based on scheduled rather than actual time flown, and it was not to include "deadhead" transportation).


\textsuperscript{69} See id.

\textsuperscript{70} Id. (quoting the FAA).

\textsuperscript{71} Id. Despite modern aircraft, pilots must deal with more traffic today, operating speeds are higher, and airlines often contend with weather that would have grounded planes in the 1950's. See id.

\textsuperscript{72} See id.
a person is on duty for [twelve hours] he will get tired whether
he is doing much flying or not.'73

Although the 1982 proposed rules did not pass, in 1985 the
FAA did manage to establish flight time limitations and rest re-
quirements for domestic air carrier and regional airline pilots.74
ALPA called the new rules "a major improvement" over the old
rules dating back to the 1930's. Pilots liked the guaranteed min-
imum nine hour rest between trips, the tightened pilot flying
limits for commuter carriers, and the preservation of the cur-
rent daily, weekly, monthly and annual flight time limitations.75
Unfortunately, the 1930's rules still govern international opera-
tions because these regulations do not cover them.76

Although the 1985 amended rules addressed a number of sig-
nificant issues, they did not completely solve flight time and rest
requirement problems.77 In particular, the complexity of the
rules and inconsistencies between the various operations under
parts 121 and 135 continued to make application and interpre-
tation burdensome.78 This led ALPA to petition the FAA to
amend domestic flight time limits and rest requirements for
cockpit crews in 1990.79 The proposed amendments would have
increased the minimum rest period for flight crews scheduled to
fly less than eight hours in a twenty-four hour period to ten
hours, eight of which would be required to be in a rest facility.
For crew members scheduled to fly eight hours or more, or who
make eight landings in a twenty-four hour period, the rest time
would increase to twelve hours, ten of which would be mandated
to be in a rest facility.80

The union additionally requested a fourteen-hour duty limit
in any consecutive twenty-four hour period and one calendar

73 Id. (quoting Bruce Woodruff, chairman of the ALPA's flight-duty time
committee).
74 See generally, David M. North, FAA's New Flight-Time Limitations Fail to Satisfy
Transport Operators, AVIATION Wk. & SPACE TECH., July 1985, at 32.
75 See id. (stating the newly established limits for pilots flying in part 135 com-
muter operations are 1,200 hours in any calendar year, 120 hours per month and
34 hours for any seven consecutive days).
76 See id.
77 See Flight Crew member Duty Period Limitations, Flight Time Limitations
78 See id. at 65,952-53.
79 See ALPA Wants Changes in Flight/Rest Requirement, AVIATION DAILY, July 1990,
at 169 [hereinafter ALPA Wants].
80 See id.
day free of duty every seven calendar days. It also told the FAA that airlines should be prohibited from interrupting that day or any other rest period.\textsuperscript{81} As authority for these demands, ALPA cited a NASA study of short-haul air transport operations and "other scientific information" demonstrating that current rest requirements are not adequate to prevent flight crew member fatigue, an FAA long-recognized fundamental factor of flight safety.\textsuperscript{82}

Since the 1985 flight limitation rules, "many air carriers have been scheduling reduced rest every other day, which is causing both short- and long-term fatigue among air carrier pilots."\textsuperscript{83} Although air carriers claim that delays and late arrivals precipitate the need for operational flexibility and forces them to use the reduced rest provisions, the scheduling, though technically legal, is inapposite the purpose of the rules.\textsuperscript{84} Such normal scheduling use of the reduced rest provisions leaves pilots with significantly less time to rest than they need to avoid fatigue.\textsuperscript{85}

The results of this reduced rest scheduling are staggering. According to a union survey, eighty-six percent of pilots were provided less than eight hours rest from one to nine times per month. In addition, eighty-seven percent report actually flying more than eight hours between rest periods anywhere from one to nine times per month. Finally, eighty-one percent of these pilots exceeded sixteen hours of duty time during a twenty-four hour period from one to nine times a month.\textsuperscript{86}

In December of 1995, the Department of Transportation (DOT) and FAA responded to ALPA requests for new regulations. The FAA proposed amendments to establish one set of regulations for flight crew members engaged in air transporta-

\textsuperscript{81} See \textit{id}.

\textsuperscript{82} See \textit{id}.

\textsuperscript{83} Id. (quoting ALPA).

\textsuperscript{84} See \textit{id}. ("[I]t is contrary to the spirit of the regulations to use the reduced rest provision as a normal scheduling goal") (quoting ALPA).

\textsuperscript{85} See \textit{ALPA Wants}, supra note 79, at 169 ("ALPA, citing a NASA study of the effects on sleep of commercial short-haul flight operations, said that pilots need to relax prior to going to sleep after a day of flying, 'and when they do go to sleep, it takes them, on average, half an hour longer to actually fall asleep. When pilots are subjected to a minimum rest period of eight hours, considering their travel time to and from a rest facility, time required to eat and attend to other physiological needs, and time required to actually fall asleep, they will be lucky to actually have six hours of sleep.").

\textsuperscript{86} See \textit{id}. 
The objective of this proposal was to contribute to improved safety by providing guidelines that ensured flight crew members adequate opportunity to obtain the rest required to perform their routine and emergency duties.  

These regulations were inspired by the nature of the aviation industry and recent scientific findings relating fatigue to performance. Specifically, the aviation industry must operate twenty-four hours a day, every day of the year to meet global long haul, regional, overnight cargo, and short-haul domestic demands. Thus, both domestic and international aviation require crossing multiple time zones that necessitates irregular work schedules for flight crew members.

Over the last several decades, scientific knowledge about circadian physiology, fatigue, and performance decrements has confirmed that flight and duty practices have caused aviators to experience performance-impairing fatigue from sleep loss or deprivation. "Safely flying large groups of people six miles above the earth at nearly the speed of sound leaves little margin for error," and crew fatigue is arguably "the single most critical safety issue in today's . . . airline environment." Therefore, the FAA's belief that incorporating scientific information on fatigue and human sleep physiology into regulations on flight crew scheduling is critical to help maintain safety and facilitate optimum crew performance during flights is completely understandable.

NASA generated some of the scientific data and information the FAA used to form appropriate duty and rest regulations. In 1980 NASA created a Fatigue/Jet Lag Program to examine whether transmeridian flying and fatigue, in association with

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88 See id.
89 See id.
90 See id.
91 See id.
92 Byron Acohido, Boeing's 737 Is at the Center of a Debate Over Safety, SEATTLE TIMES, Oct. 30, 1996, at Al.
various factors found in air transport, caused safety problems. The program has pursued three goals: "(1) to determine the extent of fatigue, sleep loss, and circadian disruption in both domestic and international flight operations; (2) to determine the impact of these factors on flight crew performance; and (3) to develop and evaluate countermeasures to reduce the adverse effects of these factors and improve flight crew performance and alertness."

In addition to NASA's research efforts, which helped define the scope of the proposed flight, duty, and rest regulations, the National Transportation Safety Board (NTSB), prompted by the August 18, 1993, Douglas DC-8-61 freighter crash, made its own recommendations concerning issues of fatigue. NTSB concluded that the accident occurred because the extended flight was allowed by combining applicable part 121 and 135 flight and duty rules. Although this is the only accident specifically attributed to pilot error or fatigue, NTSB candidly recounted the circumstances of the incident and quickly responded with the following safety recommendations for flight and duty time limits:

(1) Revise part 121 to require that flight time accumulated in noncommercial "tail end" ferry flights conducted under part 91, as a result of 14 CFR, part 121, revenue flights, be included in the flight crew member's total flight and duty time accrued during those revenue operations. (A-94-105)

(2) Expedite the review and upgrade of flight/duty time limitations of the Federal Aviation Regulations to ensure that they in-

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95 See id. at 65,953.
96 Id.
97 See id. at 65,954
98 See id. ("The NTSB concluded that 'the accident trip was under the provisions of a combination of separate regulations that allowed extended flight and duty times to be scheduled, contrary to safe operating practices.'").
100 See Pilot Groups Close Ranks to Examine Proposed Duty/Rest Limits, AVIATION DAILY, Jan. 25, 1996, at 122. ("The pilots had been on duty for 18 hours and had been flying for nine hours prior to the crash. The crew was operating on what is referred to as the back side of the clock - flights that start or continue through normal sleeping hours."); see also, Flight Crew member Duty Period Limitations, Flight Time Limitations and Rest Requirements, 60 Fed. Reg. 65,951, 65,954 (1995) (to be codified at 14 C.F.R. pts. 121 and 135) (proposed Dec. 20, 1995) ("NTSB determined that among the probable causes of this accident were impaired judgment, impaired decision-making, and impaired flying abilities of the captain and flightcrew due to the effects of fatigue.").
corporate the results of the latest research on fatigue and sleep issues. (A-94-106).101

The NTSB recommendations were among many that the FAA considered before making its proposed amendments.102 In essence, the proposal was drafted to eliminate the differences between part 121 and part 135 flight time limitations and rest requirements for domestic, flag, supplemental, commuter, and on-demand operations.103 The proposal was a preventative measure, not specifically in response to any particular incident, to address the potential safety problems associated with fatigue-based performance decrements.

To remove ambiguity and unify the terms used in both part 121 and part 135 regulations, the proposal clarified several definitions. The FAA defined four kinds of time: assigned time, duty involving flight time ("duty period"), reserve time, and rest ("rest period").104 Since the United States was one of only two countries in the world to base regulation of aviation hours of service regulations on flight time rather than duty time or a combination of the two,105 the proposal painstakingly detailed "duty period is not solely a function of whether the aircraft is airborne."106 Finally, based on NASA Recommendation 2.3.6,

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102 See id. at 65,954-55. The Air Transport Association of America (ATA) petitioned the FAA to amend part 121, Subpart R, which governs flight time limitations for flag operations. ALPA petitioned to delete the reduced rest provisions and to increase the required minimum rest for flight crew members. Thomas T. Gasta, a turbo-jet aircraft captain, petitioned for a definition of "rest" that would protect crew members from being contacted to work by ensuring the period is free from restraint and responsibility for work. His particular concern was to specify that "reserve time" not be considered "rest." See id.
103 See id. at 65,955.
104 See id. at 65,956. "Assigned time" is time the flight crew member is assigned to activities other than flight duties and may be performed as part of a "duty period." "Duty period" is the period of elapsed time between reporting for an assignment involving flight time and release from that assignment. "Reserved time" is any period of time when a flight crew member must be available to report upon notice for a duty period. "Rest period" is any time period free from all restraint or duty and free of all responsibility for work or duty should the occasion arise. See id.
105 See id. at 65,954 (noting that France is the only other country in the world to use aviation hours as opposed to duty time).
106 Flight Crew member Duty Period Limitations, 60 Fed. Reg. at 65,656. The proposal explained that a typical duty period would consist of pre-flight duties and post-flight duties. Although aircraft carriers vary in how early they require flight crew members to check in to begin duty, typically 30 minutes to one hour before scheduled departure is required. In addition, flight crew members are
the proposal recognized that the use of additional flight crew members justifies longer duty periods if flight crew members have on-duty sleep opportunities.\textsuperscript{107} Table 1 summarizes the proposed limitations on duty time and flight time and proposed pilot rest requirements.

Although the 1985 regulations covered duty time, they did not specifically address reserve time. Two types of reserve assignments developed in the aviation industry: “standby reserve” and “reserve time.” Essentially, standby reserve is equivalent to duty period and would be treated accordingly for purposes of limitation and rest requirements. Reserve time is considered neither rest period nor duty period nor assigned time and therefore was dealt with separately under the proposal.\textsuperscript{108}

The proposal acknowledged the difficulty of trying to predict when an individual flight crew member is asleep and awake, so it did not base notice requirements on such individualized factors. Instead, the FAA placed emphasis on flight crew members receiving adequate notice to provide an opportunity for rest before the assigned duty period.\textsuperscript{109} Two approaches to reserve time assignment developed with adequate notice as their focus. Though the approaches share notice as a primary theme, they do not provide for an equal number of rest hours.\textsuperscript{110} NASA recommended providing a “predictable” protected eight-hour sleep opportunity, but the FAA was satisfied that the provisions would provide at least an opportunity for crew members to get eight hours of rest.\textsuperscript{111}

In addition to adequate notice provisions, the FAA was concerned with duty period extension. The 1985 flight time rules stated:

[\textit{A} flight crew member is not considered to be scheduled for flight time in excess of the flight time limitations if the flights to which he or she is assigned normally terminate within the limita-

\begin{footnotes}
\item[107] See id. at 65,957.
\item[108] See id. at 65,959.
\item[109] See id. at 65,959–60.
\item[110] See Flight Crew member Duty Period Limitations, 60 Fed. Reg. at 65,960. For a 14-hour duty period, a crew member must receive 10 hours of notification and if the requisite 10 hour notice is not given, the duty period length must be reduced. The second approach provides a minimum 6-hour period of protected time for each 24 hours of reserve time during which the flight crew member could not be assigned or contacted for duty. See id.
\item[111] See id.
\end{footnotes}
tions, but due to circumstances beyond the control of the certificate holder (such as adverse weather conditions) are not at block out time expected to reach their destination within the scheduled time. These requirements do not specify a limit to the flight time extensions under these circumstances.\textsuperscript{112}

According to this language, airlines could theoretically extend duty periods for unlimited periods of time so long as operational causes beyond the control of the air carrier like weather, mechanical problems, and Air Traffic Control situations were the culprits. NASA found this unacceptable, because unlimited extended duty time was “one of the major fatigue related problems with . . . flight crew member assignments.”\textsuperscript{113} The FAA, therefore, proposed to limit the amount of time that a duty period may be extended irrespective of the type of delay.

Regarding rest periods, the FAA retained some of the rules in existing regulations. Specifically, no aircraft carrier may assign any flight crew member and “no flight crew member may accept any duty period or flight time with the certificate holder unless the flight crew member has had at least the minimum rest period required.”\textsuperscript{114} The proposal went even further by suggesting that aircraft carriers could not make any duty assignments during required rest periods. Further illustrating the importance of rest periods, the proposal stated that a flight crew member not serving in assigned time, reserve time, standby duty or a duty period, was in a rest period.\textsuperscript{115}

\section*{II. LIABILITY LIMITS}

As the FAA and the aviation industry continued their commitment to optimizing safety by minimizing the effects of pilot fatigue, the industry made a bold leap that may potentially upset this delicate balance. Airline officials from some of the nation’s largest air carriers were concerned that they had been unfairly blamed for resisting regulations since they say safety has always been first, having adopted a “[d]o it yourself” approach to aviation safety.\textsuperscript{116} Although this “shift in the culture” could be “a

\textsuperscript{112} Id. at 65,961.

\textsuperscript{113} Id.

\textsuperscript{114} Flight Crew member Duty Period Limitations, 60 Fed. Reg. at 65,962.

\textsuperscript{115} See id.

\textsuperscript{116} J. Lynn Lunsford, \textit{Airlines Take Initiative for Safer Flying Carriers Make Improvements Without Prodding from FAA}, DALLAS MORNING NEWS, Apr. 5, 1998, at 1A.
very positive trend," the FAA must remember that it is "the government's responsibility to ensure public safety."117

This cautious optimism or, perhaps, thinly veiled skepticism may be attributed to the history of "airline-influenced" regulations. The regulatory language often served a less than altruistic purpose for the aviation industry.118 Critics assert that the aviation industry is merely acting on self-serving motivations to decrease possible civil liability for future accidents or even attempting to avoid potentially stricter regulations.119

Whatever the airlines' reasons for self-imposed safety standards and procedures, they must realize that safety improvements simply make sense and can add to the bottom line. This realization is particularly important to air carriers because, as Robert Baker, Executive Vice-President for Operations at American Airlines, stated, "the public is very intolerant of circumstances and things that could have been prevented."120

This idea of public intolerance for preventable circumstances is one factor that the airlines should consider in light of the industry's proposed elimination of limited liability under the Warsaw Convention. Beginning in 1933, the Warsaw Convention provided a workable means to assure families of crash victims the certainty of obtaining financial recoveries while giving the airline industry, then in its infancy, the security of being able to meet all of its liabilities.121 Because the 1933 liability limiting provisions did not contain a mechanism to account for inflation, they were amended. The resulting 1966 Montreal Agreement was a "special contract" between airlines operating in the United States and their international passengers to raise the liability

117 Id. (quoting Jim Hall, chairman of the NTSB).
118 See id. ("[A]irline-influenced regulatory language often left jumbo-jet-sized loopholes that allowed carriers to put off changes for years.").
119 See id.
120 Id.
121 See Dave Lenkus, Liability Limits Still Up in Air: Amendment Would Modernize, Harmonize Airline Liability Law, Bus. Ins., May 18, 1998, at 3; see also Convention for the Unification of Certain Rules Relating to International Carriage by Air, Oct. 12, 1929, 137 L.N.T.S. 11 [hereinafter Warsaw Convention]. Pursuant to Article 22(1), "[i]n the carriage of passengers the liability of the carrier for each passenger is limited to the sum of 125,000 francs. . . . Nevertheless, by special contract, the carrier and the passenger may agree to a higher limit of liability." Id.
limit to $75,000 per passenger and to waive the “necessary measures” defense.\textsuperscript{122} 

Unfortunately, the Montreal Agreement is not the only measure the aviation industry has taken regarding the issue of liability. Other nations and airline groups over the past thirty-two years have also addressed liability.\textsuperscript{125} These uncoordinated efforts led to a “multiplicity of liability limits worldwide.”\textsuperscript{126}

Thanks to the International Air Transport Association (IATA) “intercarrier” agreement, integrating the myriad of liability provisions may soon become a moot effort for the legal community, because under the IATA agreement, most of the world’s airlines have waived the Warsaw Convention $75,000 per passenger liability limit.\textsuperscript{127} The intercarrier agreement was drafted in 1995 in response to public pressure and has since been signed by most carriers.\textsuperscript{128} Wanda Potrykus, an IATA spokeswoman, characterized the overwhelming air carrier participation as “a voluntary signal from the airlines that they are willing to have liability cases judged under stricter liability rules.”\textsuperscript{129}

This new system will break down the uniformity of an international system developed in 1929. Under the old system, survivors had to show willful misconduct to avoid liability limits and collect more than $75,000.\textsuperscript{130} By waiving liability limits, the airlines are hoping to avoid the tedious trials that were an inevitable part of pre-intercarrier agreement litigation.\textsuperscript{131}

\textsuperscript{122} See Lenckus, \textit{supra} note 121, at 3; see also, Warsaw Convention, \textit{supra} note 121, Article 20(1) (“The carrier is not liable if he proves that he and his agents have taken all necessary measures to avoid the damage or that it was impossible for him or them to take such measures.”).

\textsuperscript{123} See Lenckus, \textit{supra} note 121, at 3.

\textsuperscript{124} Id.

\textsuperscript{125} See Peter Kaplan, \textit{Relatives Will Find It Easier to Win Damage Claims; Global Accord Avoids Long Court Fight}, WASH. TIMES, Sept. 4, 1998, at A12.

\textsuperscript{126} See id. The Warsaw Treaty forced people to settle for less money, because the burden of proof was so heavy. Accordingly, many cases settled for a fraction of their full value. The plight this caused for victims’ families cast both the Warsaw Convention and the airlines in a bad light. James Kreindler, a New York attorney who represents families of 80 TWA Flight 800 victims said, “[y]ou can’t defend it . . . . Everyone knew it wasn’t fair.” \textit{Id}.

\textsuperscript{127} Id.; see also Matthew L. Wald, 12 U.S. Airlines Waive Limit on Liabilities, N.Y. TIMES, Mar. 9, 1997, at 3. [hereinafter \textit{U.S. Airlines Waive}] (listing the major airlines that signed the intercarrier agreement: American Airlines, Continental Airlines, Delta Air Lines, Hawaiian Airlines, Northwest Airlines, Trans \textit{World Airlines, United Airlines, and USAir}).

\textsuperscript{128} See \textit{U.S. Airlines Waive}, \textit{supra} note 127, at 3.

\textsuperscript{129} See \textit{id}.
Although the new liability system may become more uniform as additional airlines sign on, the current legal consequences of the limitation waiver are unclear. The only certainty now is that "[a] revolution has taken place . . . that is both monumental and all to the public good."

The most inconsistent aspect of the intercarrier agreement is determining the applicable law of the passenger's domicile. The manner in which domicile is determined can have significant financial consequences for plaintiffs. Regarding the intercarrier agreement, this is a particularly troublesome area because despite airlines talking about it as one agreement, it is actually three separate agreements. The intercarrier agreement consists of the IATA Intercarrier Agreement on Passenger Liability (IIA), the Agreement on Measures to Implement the IATA Intercarrier Agreement (MIA), and the Provisions Implementing the IATA Intercarrier Agreement (IPA).

Each agreement proposes that the law of the victim's domicile be applied. According to IIA, "compensatory damages may be determined and awarded by reference to the law of the domicile of the passenger." MIA, however, states that application as an "option available to the carrier." Finally, IPA is silent on the MIA option, but states that "compensatory damages may be determined by reference to the law of the domicile or permanent residence of the passenger."

Increasing the confusion and ambiguity surrounding the legal consequences of the intercarrier agreement, not one agreement bears the signature of each participating air carrier. For example, American flag carriers have signed all three. Many IATA carriers have signed IIA and MIA, while no carrier has signed IPA. Finally, some air carriers, like Lufthansa, have not signed

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130 See id.
132 Id.
133 See id.
134 See Bill Coffin, Rough Air Ahead; Aviation Insurance Industry, BEST'S REV.-PROP.-CAS. INS. EDITION, Mar. 1997, at 88 ("The average liability per passenger fatality within American jurisdiction is about $2 million.").
135 See Kreindler, supra note 131, at 24,668.
136 See id.
137 Id.
138 Id.
139 Id.
any agreement. Accordingly, which airlines have signed which agreements is questionable and any difference thereof effects domicile law determination from carrier to carrier.

While the liability limitation waiver may currently be a source of uncertainty in specific litigation, its effect on the direction of air carrier liability is clear. The industry is now a "no-fault absolute liability system." Eliminating the $75,000, the Warsaw Convention damage cap was not intended to effect that change. The idea was merely to replace the incredibly difficult willful misconduct burden with a negligence standard.

The IATA agreement's evisceration of the fault system is unfortunate and potentially detrimental. Since plaintiffs' lawyers no longer have to prove willful misconduct or negligence, they probably will not attempt to do so. This is a definite negative, because the fault system has materially contributed to higher standards of safety in aviation.

Changing the framework within which the aviation industry has traditionally operated will affect not only plaintiffs and air carriers, but insurers and aircraft manufactures as well. In particular, plaintiffs filing separate suits against air carriers and manufacturers present "double-recovery" problems. This is because the intercarrier agreement, allowing for unlimited liability, does not constitute law or a legal judgment. Although it is partly law, the intercarrier agreement is primarily a contract among airlines to pay unlimited liability damages.

To understand how the intercarrier agreement's contractual basis leaves the door for double recovery open to plaintiffs, consider a plausible course of litigation. Suppose a plaintiff recov-

140 See id.
141 See Kaplan, supra note 125, at A12 ("Lawyers in the Flight 800 case are still arguing over whether TWA should be subject to the Warsaw Convention.").
142 Kreindler, supra note 131, at 24,668.
143 See id. (giving examples of when the willful misconduct standard could or was met). The only situation in which an airline could possibly show that it "took all necessary measures to prevent the damage" is if a missile was fired by a non-airline source. Id. This may seem a preposterous example, but in only one case has an airline sustained an Article 20(1) defense. Melvin Belli, seeking damages in excess of the Warsaw limit, informed the jury that he would "rather have nothing in damages than a verdict of $8,300." Id. The jury obliged his choice for nothing. See id.
144 See id.
145 See id.
146 See id.
147 See id. The liability Article 17 of the Warsaw convention places on air carriers is law. The intercarrier agreement, however, is not—it is contract. See id.
ers from an airline. The intercarrier agreement prevents neither the airlines nor the insurer from seeking indemnification or contribution from the manufacturers. To contest possible liability for indemnification or contribution, a manufacturer is free to assert that the airline’s payment to the plaintiff was voluntary and in no way provides any effective recourse against it. This is, however, a double-edged sword because, should the plaintiff sue the manufacturer in addition to the airline, the plaintiff could, in turn, claim that the manufacturer is not entitled to a “setoff” for damages the airline paid.

Such a situation may further complicate the settlement process. If an insurer makes a “decent offer,” but requests a release for the airline and the manufacturer, the plaintiff’s attorney is not likely to recommend the deal to her client. The result may be scenarios in which an airline makes a fair offer but insists on a general release that the passenger or his family refuses to give because the passenger wants punitive damages from the manufacturer or double recovery.

Thus, the possibilities for potential liability under the intercarrier agreement are tremendous. To aircraft manufacturers blamed for deaths and injuries, these enormous costs include millions of dollars payable to victims and their families in addition to millions more pending a product recall and or repair, not to mention the “incalculable cost of damaged reputation.” Even for the most safety conscious airlines, these are real risks that effect them individually and the aviation industry in general.

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148 See Kreindler, supra note 131, at 24,668.
149 See id. The plaintiff can claim that the airline payment was pursuant to an intercarrier contract to which he was a third-party beneficiary. The plaintiff may then argue that as such, the payment was neither a matter of law nor a legal judgment. Thus, any monies paid were collateral and no different from payments under a life or accident insurance policy, other collateral sources for which a tortfeasor may not claim credit. See id.
150 See id.
151 See id.
152 Acohido, supra note 92, at A1.
153 See Dave Lenckus, Swissair Crash Unlikely to Turn Aviation Market, Bus. Ins., Sept. 14, 1998, at 1 [hereinafter Swissair Crash] (“Claims stemming from the Sept. 2 Swissair crash could consume more than 70% of this year’s worldwide aviation insurance premiums . . .”); see also Edwin Unsworth, Airline Captive Insurer to Bear Swissair Claims, Bus. Ins., Sept. 7, 1998, at 1 (stating that this was Swissair’s first fatal accident since October 1979); Kaplan, supra note 125, at A12 (“Air safety experts consider [Swissair] one of the most tightly run carriers in the world.”).
With the global aviation insurance industry losing money every year since 1988, the Swissair crash may only be a glimpse of how the intercarrier agreement liability limit waiver may affect aviation insurers. This is an especially acute concern anytime American jurisdiction is an issue. For example, market executives predict that the reserve needed to cover Swissair's potential liability could reach half a billion dollars, because a high number of professionals were among the 229 passengers and crew members killed in the crash.

Passenger volume is expected to triple during the next twenty years and some members of the aviation industry consider large aircrafts the best way to meet this expanded demand for air travel. By 2010, this increased air traffic could produce commercial air accidents at a rate of fifty-three incidents per year. Combining these factors with unlimited liability presents a staggering future for the aviation industry.

Table 2 lists passenger fatalities for United States airlines from 1983 to 1996.

III. OTHER TRANSPORTATION INDUSTRY FATIGUE RESPONSES

The aviation industry is not the only transportation industry in which fatigue is a growing problem. Both the railway and trucking industries have had to grapple with increasing con-

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154 See Coffin, supra note 134, at 88.
155 See id. Even before the Warsaw Convention liability limits were waived, American courts have always tended to look favorably upon claimants while other courts interpreted the limits more strictly. In fact, [s]ome (insurers) have specifically declined to provide coverage to (airlines) . . . that fly planes carrying more than 250 Americans. They just don't want to touch those kinds of risks.” Id.
156 See Swissair Crash, supra note 153, at 1.
157 See Coffin, supra note 134, at 88.
159 For example, the average number of persons to die per crash from 1983 to 1996 was 65. See Coffin, supra note 134, at 88. Multiplying 65 by 53 to make a rough estimate of the number of people who could reasonably be expected to die within the year 2010 yields 3,445 as the number of deaths per year. Now multiply 3,445 by two million dollars (the average liability per passenger fatality). See id. 134, at 88. Thus, a conservative estimate of potential liability for the industry is $6,890,000,000. This number could easily be inflated by unlimited liability, because the two million dollar average recovery per passenger death may soar.
160 See Coffin, supra note 134, at 88 (using data from the NTSB). See Appendix for Table 2.
sumer demand and the subsequent effects of employee fatigue. Although not in identical fashions, fatigue's devastating effects have compelled each industry to respond.

A. Trucking

Mark D. Gunther, president and owner of Gunther's Transport Leasing, was sentenced to thirty months in prison because he falsified and destroyed driver logbooks. In an uncommon course of events, Gunther was convicted on two counts of perjury and Transport Leasing was fined $175,000 for its role in conspiracy and making false statements. This marked the "first instance of criminal statutes being applied to Department of Transportation hours-of-service regulations." 

U.S. District Court Judge William M. Nickerson sentenced and fined Gunther far below the respective thirty-five years imprisonment and $1.3 million maximums. In so doing, however, Judge Nickerson remarked that Gunther's Transport Leasing was a "blatant abuser" of the hour-of-service regulations. While Gunther got off relatively easy, this could be the dawn of a new age in dealing with "abusers" of transportation service time regulations.

Addressing the problem of hours-of-service violations and the fatigue it causes in the trucking industry is directly related to public safety. In fact, Gunther drivers have been responsible for several fatigue influenced accidents. Unfortunately, fatigue related accidents are not solely limited to Gunther Transport, but they are commonplace in the industry.

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162 Id. In the past, log-book violations were treated as civil, not criminal, cases. The Gunther case was an extraordinary culmination of a four year Federal Bureau of Investigation and DOT investigation. The resulting conviction gave an unmistakable warning to trucking companies and their drivers that hours-of-service violations will no longer receive a wink and a nod. See id.
163 Id.
164 See id. In September 1995, a driver killed one passenger riding in the truck and injured several construction workers. In 1993, a Gunther truck crashed after its driver fell asleep at the wheel. An investigation revealed the driver had been working 20 hours straight before the crash. See id.
165 See id.
Gunther's conviction represents an attempt to rectify the fatigue problem within the trucking industry. This, however, may be a difficult order to fill because the trucking “culture” routinely forces drivers to exceed hours-of-service rules. Nonetheless, the FHWA has begun the groundwork to revise these rules in an effort to combat the hours-of-service violation problem.

Currently, the FHWA is considering extending the ten-hour commercial truck driving limitation to fourteen-hours, followed by a ten-hour rest period. The Senate Surface Transportation Subcommittee remained unconvinced that this “one-rest-period-fits-all policy” is the best approach “when scientific evidence points to varying sleep and rest requirements among humans.” Dr. Mark Rosekind, an adviser to the United States’ space-travel program, supports these concerns because he feels “none of the existing hours-of-service strictures reflect the known and well established scientific knowledge regarding fatigue.” The reason all of these concerns are valid is that the human body is complex and not easily amenable to arbitrarily set rest-duty regulations.

Because the human body is complex, focusing solely on regulatory duty-rest specifications is a very myopic view of the fatigue problem. According to Chuck Dettmann, AAR’s executive vice

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166 See id. The Federal Highway Administration-sponsored truck/bus safety summit cited fatigue as the biggest dilemma, and according to the NTSB, fatigue is a factor in at least 30% of all truck accidents. See id.

167 See Schultz, supra note 161, at 12. During the trial, many of Gunther’s drivers testified that they were “forced to drive as many as 19 hours straight in order to meet unrealistic shipping schedules.” Id.

168 See id. The rules, which have not been revised in 57 years, limit drivers to 10 hours behind the wheel and 15 hours on duty before a mandatory 8-hour rest period. Thomas J. Donohue, president of the American Trucking Associations (ATA), thinks flexibility is needed. Drivers should be allowed to sleep when they are tired, drive when alert, and not be forced to adhere to mandatory federal regulations. “The current hours-of-service regulations go against the body’s natural rhythms and its needs for sleep . . . . There is no creature on this earth who can work 10 hours, sleep eight and work 10 more again, no matter what the occupation is.” Id. (quoting Todd Spencer, director of Owner Operator Independent Drivers Association).


170 Id. Senator Kay Bailey Hutchison, Subcommittee Chairman, exclaimed “it is time to substitute proven scientific theory and demonstrated technology for the pseudo-science and myths that long have influenced federally imposed on-duty limits.” Id.

171 Id.
president for safety and operations, "[n]o legislative, regulatory or corporate measure can make employees devote their time to resting." 172 Federal Railroad Administrator Jolene Molitoris recognized this truth and initiated a joint labor-management approach to combat fatigue. 173 This type of problem solving, which veers from the duty-rest specifications paradigm to embrace practical considerations and scientific evidence, may not eliminate fatigue from twenty-four hour transportation operations, but it can certainly help to more effectively manage this difficult safety challenge. 174

B. RAILWAY

1. United States

By 1994, increased demands within the railway industry began to push the limits of existing duty-rest regulations. Ronald P. McLaughlin, then Chairman of the Railway Labor Executives' Association and locomotive engineer of thirty-eight years, urged Congress to pass a law allowing locomotive engineers and other operating personnel at least one day off per week. 175 McLaughlin stated:

Under current law, a railroad company may work its engineers up to 112 hours each week. It is indefensible that one of the most safety-sensitive and dangerous transport modes should require train crews to report to work when they are fatigue-impaired. For the sake of public safety, Congress should bite the bullet and legislate what is needed—regular reporting times for employees and one day of uninterrupted rest. 176

McLaughlin's plea, surely a product of experience, gave voice to the underlying problems that had begun to infect the railway industry and undermine public safety. One railroad company tragically familiar with the effects of fatigue on safety is Union Pacific (UP). After a number of fatal collisions in 1997, the Federal Railroad Administration (FRA) announced UP had "a fun-

172 Id.
173 See id. The North American Rail Alertness Partnership is an illustration of this concept. It "stresses employee education and training, predictable days off and work breaks during which naps are encouraged." Id.
174 See id.
176 Id.
damental breakdown in basic railroad operating procedures and practices essential to a safe operation." 177

Accordingly, the FRA began an "unprecedented review" of UP. 178 This review followed the third in a series of fatal accidents that began in June of 1997 and continued throughout the FRA’s increased scrutiny of UP. 179 Widespread employee fatigue greatly concerned the FRA. It found “significant evidence" of inefficient crew use that directly lead to crew fatigue, stress, violations of the hours-of-service law, and reduced ability to comply with operating rules. 180

UP was apparently willing to cast a blind eye on the risks of employee fatigue and reduced safety in operating while it kept an eagle eye on the bottom line. James Brunkenhoefer, national legislative director for the United Transportation Union, said “some problems on UP had been exacerbated by prosperity." 181 In fact, the local union had been raising the fatigue issue for five years before the FRA review without any success. Even after the FRA’s UP review report, the local union still felt safety was a lower priority than “corporate profits 'at any cost.'” 182

UP President, Jerry Davis, tried to explain its 1997 troubles by pointing to overall industry conditions, 183 but nonetheless made the assurance that “[f]atigue and stress of our train crews are critical safety concerns." 184 Thus, UP, in partnership with rail

177 Jack Burke, FRA Sends UP to Woodshed, TRAFFIC WORLD, Sept. 15, 1997, at 8.
178 Id.
179 See id.
180 Id. (“Crews are needlessly working longer hours without getting time off. Cumulative fatigue erodes train and engine service employees’ ability to perform their duties safely. When crews work erratic schedules for days on end, their ability to read and follow instructions, identify and comply with signals, react appropriately in emergency situations and make safety-critical decisions and act on those decisions is lost.”).
181 Id.
182 Id.; see also Rip Watson, Teamsters Enter Row Over Safety Conditions at UP, J. COM., Sept. 16, 1997, at 16A (“Union Pacific Railroad . . . is a 'ValuJet waiting to happen'”).
183 See A View from the Top; U.S. and Canadian Leaders Consider 1997 and 1998 Railway and COO Industry Directions, RAILWAY AGE, Dec. 1997, at 27. According to Jerry R. Davis, president and COO of Union Pacific, “few railroads have ever faced the problems that confronted UP in the latter part of 1997, a fact obvious to all in and out of the industry.” Id. BNSF President and CEO, Robert D. Krebo, stated that “our industry is coping with the greatest demands for rail shipments in its history and, at the same time, perhaps the most serious rail service problems that shippers in the western U.S. have ever experienced.” Id.
labor unions and the FRA, voluntarily introduced a “guaranteed” time off program.185 The question remains whether this “voluntary” initiative adequately addresses the fatigue and safety problems of UP specifically, and the railroad industry in general.186

When FRA Administrator Jolene Molitoris announced the UP time off agreement at a hearing before the Federal Surface Transportation Board in Washington, she emphasized the importance of safe service for the railway industry: “We must never forget that safety and service are inextricably linked. . . . The most critical safety issues facing UP train crews today are fatigue and stress caused by long hours, many consecutive work days without a break, and the unpredictability of work schedules.”187

The two safety audits FRA performed at UP, the nation’s largest railroad, between August 23, 1997 and November 7, 1997, identified several operational problems within UP. They include: (1) a corporate culture with varying attitudes toward safety; (2) inadequate staffing and an insufficient crew management system; and (3) lack of training and extreme work overload.188

UP, its labor organizations, and the FRA initiated the following steps to address the aforementioned concerns: (1) modify the corporate culture by re-emphasizing “safety first,” (2) increase staffing through an “aggressive hiring plan,” and (3) reduce fatigue by guaranteeing a right to time off and a comprehensive fatigue mitigation program.189

The problems UP faced in 1997 resulted in particularized remedies for its collision-plagued railroad, as well as fueling rail labor to lobby Congress to press the FRA for “a firm delivery date on a rulemaking covering fatigue.”190 FRA, rail management, and labor unions seem to agree that a correlation exists

185 See id. It grants “any train and engine service employee who works on 14 consecutive calendar days without taking extra time off . . . the absolute right to voluntarily layoff for up to 48 hours.” Id.

186 See BLE, Union Pacific to Implement Plan for Better Safety, PR NEWSWIRE, Oct. 27, 1997. Preliminary indications may warrant a negative response to this question. “In spite of a 24 hour-a-day, 14 day safety audit of UP in September,” collisions, derailments and backlog problems have persisted. Id.

187 Id. Fatigue management, which includes a new group formed to address job fatigue to study all aspects of work-rest cycles, including crew scheduling, was a critical component of the initiative. See id.


189 Id.

between accidents and work cycles. Accordingly, eliminating operating crew fatigue is emerging as a principal issue in congressional reauthorization of a federal rail safety program.

In 1997, Jim Oberstar, D-Minn., and Bob Wise, D-W.Va., introduced the Rail Safety Reform Act, which would prohibit rotating shifts shown to "wreak havoc on biological clocks." Additionally, the Act would "provide for more advance notice of work assignments, more rest between duty calls, more restful places to sleep while away from home and more undisturbed time at home." Oberstar and Wise believe the Act would "streamline regulatory review of new safety rules . . . and reduce accidents by allowing more rest for train crews."

2. Canada

The United States is not alone in its recent efforts to improve the safety of its railways. Canada has made some groundbreaking discoveries in the area of fatigue and railway safety. The Canadian Alertness Assurance Program (CANALERT '95) provides a novel understanding of various factors that influence train-crew fatigue and alertness.

CANALERT '95 is a joint management-labor initiative, the first of its kind in the world rail industry, that has spawned enthusiastic responses and piqued the interest of the transportation industry. Ed Dodge, a rail industry executive vice-president of operations, said CANALERT '95 "gives railways a new benchmark for performance." Fortunately, the initiative's principles do not end with the railroad industry, but are universally applicable.

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191 See id. (stating that railway employee fatigue is responsible for as many as one-third of all train accidents).
192 See id.
193 Id.
194 Id.
195 Rip Watson, House Bill Seeks Rail Safety Rules; Democratic Sponsors Envision Streamlined Reviews and Additional Inspectors for Industry, J. Com., Sept. 12, 1997, at 13A. Created in response to the rash of UP and other fatal rail accidents, the "bill mandates eight hours of undisturbed rest for train crews that now are regularly interrupted during off-duty hours." Id. It requires train crews to receive 10 hours of rest after 10 hours of work, bans night-time split shifts, and provides for 24 consecutive hours off duty at least once a week. See id.
197 Id.
198 See id. "This project is a scientific advance that could benefit railway employees and their families for many years to come. As well, it has the potential to
CANALERT '95 is so progressive and visionary because it dares to move beyond set industry paradigms. Its countermeasures are an alternative to the “traditional regulatory approach to rail safety, under which hours-of-work rules are arbitrarily prescribed in federal legislation and collective bargaining agreements.”

This method of duty/rest time regulation is simply not adequate to accommodate the physiological causes of fatigue.

The project was conducted within a five-month period during actual operating conditions. By analyzing the resulting physiological and subjective data collected, “researchers identified the root causes of train-crew fatigue and designed countermeasures to enhance on-track alertness.” Some of the countermeasures tested during the pilot project were regular work schedules, new sleep strategies, locomotive cab audio systems, and customized “lifestyle” training.

These CANALERT '95 countermeasures helped the railway industry successfully respond to years of government pressure to

benefit shift workers in many fields around the world.” Id. The railway industry has participated in a project with “wide-ranging potential for workplace improvement, not only in [its] own industry, but in many other round-the-clock work environments, including the air, marine and trucking industries.” Id.

See id. (stating that researchers monitored the alertness levels of locomotive engineers at work and at rest, gathering data from EEG (brain wave) and EKG (heart rate) recorders).

Id.

See Canadian Railways, supra note 196. The fatigue counter measures tested include:

- Regular train-crew work schedules. With standardized time pools, or shifts, engineers developed regular work/rest and sleep/wake patterns, promoting increased on-the-job alertness and improved health and quality of life.
- Radical new sleep strategies. During the study, locomotive engineers respond favorably to en-route naps, sleeping for up to 20 minutes while their trains were stopped in sidings. As well, tests proved the benefits of strategic napping before and after duty.
- Locomotive Cab Audio Systems. Engineers tested headsets that block out locomotive noise and provide music stimulation during train runs. The music automatically cut out when engineers were communicating by radio with conductors or rail traffic controllers.
- Customized ‘lifestyle’ training for crews and their families, a counseling program that covered such shiftwork issues as the biological clock, sleep habits, nutrition and family relationships.

Id.
combat crew fatigue. Help arrived not a moment too soon. Human error accounts for about seventy-five percent of all train accidents, and railways have been seeking ways to lower that number. Implementing the countermeasures “decreased fatigue, improved train crew alertness and reduced employee absenteeism.”

IV. THE AVIATION INDUSTRY’S RESPONSE TO FATIGUE

The American aviation industry has not produced a corollary to CANALERT '95. However, Mark Rosekind, Ph.D. and fellow researchers in the NASA Ames Research Center initiated a Fatigue Countermeasures Program (FCP). Launched in 1980, FCP has had three stated goals: “(1) To determine the extent of fatigue, sleep loss and circadian disruption in flight operations, (2) To determine the effect of these factors on flightcrew performance, and (3) To develop and evaluate countermeasures to reduce adverse effects of these factors and to maximize flightcrew performance and alertness.” The study’s practical result is scientific findings that destroy the myth that pilots and aircrews have “endless endurance and ability to sustain alertness indefinitely.”

The NASA countermeasures include planned napping, caffeine use, and using replacement crews on extended-range trips. These initial published results added “substantially to the general knowledge of how urgent the need is for adequate rest in many aviation operations” and helped prompt FAA proposed revised flight and duty-time standards. Unfortunately, the resulting notice of proposed rulemaking at the end of 1995 satisfied no one.

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203 See Alex Binkley, Canadian Study Tests Ways to Stop Train Engineers’ Fatigue, TRAFFIC WORLD, June 10, 1996, at 5.
204 See id. This is a frightening statistic, especially considering the fact that the NTSB has found that in many of its train accident investigations, in which fatigue was a factor or cause, that train crews were in full compliance with federally imposed rest requirements. See supra note 169, at 18.
205 Binkley, supra note 203, at 5.
207 Id.
208 See id.
209 Id.
210 See New Flight/Duty Time Proposal to Focus on ‘Reserve’ Issue, WEEKLY OF BUS. AVIATION, May 4, 1998, at 195; see also Pilots’ Coalition Reports Safety Support, But No Promises, on Capital Hill, AVIATION DAILY, Sept. 23, 1997, at 522. The Coalition of Airline Pilot Associations (CAPA) is “concerned that the FAA has taken no action
Because the FAA failed to act on the notice of proposed rulemaking the agency issued in 1995, pilots complain that they have been working under rules mostly unchanged since the 1930's and are lobbying for new flight and duty time restrictions.\(^{211}\) Pilots are facing particular difficulty with international flights, because essentially, "no federal maximum duty-time regulations . . . cover international service."\(^{212}\) Even in the face of antiquated and non-existent regulations, the CAPA still has an uphill battle ahead of it.

The first thing they must do is galvanize enough pilots to support the new duty and flight-time regulations. This may be easier said than done because the "culture of aviators has been one of superiority and invincibility."\(^{213}\) While some pilots may "cling" to this myth and "culture," researchers know otherwise; nobody is immune to the deleterious effects of fatigue.\(^{214}\)

In fact, testing in recent years has clearly documented fatigue's "deleterious effects . . . on performing complicated tasks as well as on judgment."\(^{215}\) These tests further support and document that flying and fatigue are a dangerous combination.\(^{216}\) Fatigue degrades every aspect of human capability, everything imaginable, including decision making and reaction time.\(^{217}\)

Pat Andrews, manager of global aircraft services for Mobil Business Resources Corporation, who chaired the Fatigue Countermeasures Task Force, said the aviation industry has to be
“proactive . . . on anything that degrades performance.”\textsuperscript{218} “One of the most helpful findings of the FCP on this issue is the “beneficial effect of planned napping.”\textsuperscript{219} However, “naps must be short (less than thirty minutes) and scheduled in advance” to be safe and effective.\textsuperscript{220}

Unfortunately, controlled rest is not currently sanctioned in the United States.\textsuperscript{221} Therefore, although it may provide a significant benefit, controlled rest is “not a panacea for all fatigue-related problems in the cockpit.”\textsuperscript{222} As humans, limitations to our performance exist that are purely a reflection of our physiological capabilities and are independent of training, motivation, and experience.

Simply put, according to the NASA analysis, “[t]here is no easy ‘cure’ to fatigue issues in aviation operations.”\textsuperscript{223} “The only known way to recover from their lack of sleep is to sleep.”\textsuperscript{224} Sleep is an “absolutely essential” physiological need that in the “24-hour world of aviation” becomes a lower priority than being on time.\textsuperscript{225} These efforts to remain awake and maintain a timely schedule may be noble. It’s important, however, to remember that despite efforts to dodge sleep, when the body needs sleep, it will do what it can to initiate short episodes of sleep, or attempt to pass into a longer state of sleep.\textsuperscript{226}

These sleep realities are forcing the aviation industry to look even further for solutions than “NASA naps.” “One of the strategies being considered for long-haul crews . . . is isolating or ‘quarantining’ crews the day before a flight in order to provide the opportunity for maximum rest.”\textsuperscript{227} The NTSB suggests that even “off-duty hours must be ‘managed’ with a view toward flight safety.”\textsuperscript{228}

\textsuperscript{219} Parke, supra note 206, at 64. (“Short naps can consistently increase alertness for as long as several hours.”) These suggested scheduled rest periods have been dubbed “NASA Naps.” See Reingold, supra note 216, at 84.
\textsuperscript{220} Parke, supra note 206, at 64.
\textsuperscript{221} See id.
\textsuperscript{222} Reingold, supra note 216, at 84.
\textsuperscript{224} Parke, supra note 206, at 64.
\textsuperscript{225} Reinhart, supra note 223, at 84.
\textsuperscript{226} See id.
\textsuperscript{227} Parke, supra note 206, at 84.
\textsuperscript{228} Richard N. Aarons, Examining the Causal Factors, \textit{Bus. & Com. Aviation}, Nov. 30, 1995, at 102. The NTSB made this observation after the April 29, 1993
Dr. Rosekind, although in a non-regulatory, neutral, scientific position, feels “the ultimate benefits of the research are that safer, more thoughtful scheduling and flight- and duty-time standards will be established.”\textsuperscript{229} This may be a misplaced feeling, because the study upon which it is based has been criticized.\textsuperscript{230} Though the Air Transport Association (ATA) lauded Rosekind and NASA’s Ames Research Center as having been “instrumental in supplying data,” it does not believe regulation is the best use of the information. The ATA believes the countermeasures studies are best used to help pilots by educating them about the type of rest required.\textsuperscript{231} 

The criticism FCP has faced may be due in large part to underlying economic motivations. According to the National Air Transportation Association (NATA), Regional Airline Association, and Air Transport Association, the FAA’s flight and duty time proposal is “unworkable” and “economically catastrophic.”\textsuperscript{232} At an estimated implementation cost of $1.97 billion, NATA told the FAA that its proposal “is unjustified as a preventative fatigue countermeasure, is operationally unworkable for the industry on which it is proposed, . . . and is unenforceable in the manner in which the provisions were drafted.”\textsuperscript{233}

V. CONCLUSION

Rapidly evolving technology has stretched the limits of aviation regulations that were enacted decades ago and have remained substantially unchanged. As pilots push themselves to

\textsuperscript{229} Parke, supra note 206, at 64.

\textsuperscript{230} See generally, Not All Criticism of Flight/Duty Proposal is Deserved, Air Safety Week, July 1, 1996, at 27. “Although there is a sound, scientific basis for regulating the length of a pilot’s work day,” sound airline and pilot groups say the FAA misapplied research to justify the regulation. \textit{Id.} The airlines have criticized the science itself: “There is no scientific evidence in published studies that fatigue causes operationally-significant performance problems.” \textit{Id.}

\textsuperscript{231} Airlines Criticize Study on Pilot Fatigue, Aerospace Daily, Apr. 13, 1994, at 71.


\textsuperscript{233} \textit{Id.}; see also NATA Sees ‘Ruin’ for On-Demand Operators in Duty Time Rules, Aviation Daily, June 21, 1996, at 483. NATA estimates that the FAA’s proposed flight-duty-time rules could bring “financial ruin” to its segment of the industry. “[C]harter pilots would lose $617 million in “pay” and “increased costs and lost revenues would combine for a loss of $6.5 billion to implement the rules.” \textit{Id.}
maintain their “invincible superman” culture in the face of ever increasing flight demands, fatigue is becoming a veritable cryptonite.

While the aviation industry has recognized the need to change some of its oldest policies, it has been incapable of making similar strides in the field of duty time regulation. This seems a bit puzzling in that the industry explicitly acknowledges the inextricable link between pilot fatigue and consumer safety. Nonetheless, revised duty and rest time regulations have been stalled since 1995 and do not currently appear to be near resolution.

Although the United States has studied fatigue and countermeasures just as its Canadian sister has, it has not been as successful in implementing FCP findings. At the nebulous core of this standstill is the ever-present economic factor of revision and change. No one wants exhaustion and fatigue to be intrinsic job characteristics for pilots, but few people are thrilled with increasing airline operating costs by billions of dollars to implement more responsive fatigue solutions.

Faced with the daunting problems of ineffective antiquated regulations, financially impractical new regulations, and unlimited liability in the face of growing pilot fatigue problems, the aviation industry must take a decisive step soon. The safety of its consumers and potential viability of the industry may very well hang in the balance.
### TABLE 1234

<table>
<thead>
<tr>
<th>No. of Pilots</th>
<th>Duty period hours</th>
<th>Flight time hours</th>
<th>Minimum rest hours</th>
<th>Reduced rest hours(^{235})</th>
<th>Rest hours following reduced rest (compensatory)</th>
<th>Extended duty hours(^{236})</th>
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</thead>
<tbody>
<tr>
<td>1 (part 135)</td>
<td>NMT 14</td>
<td>NMT 8</td>
<td>10</td>
<td>9, may only be reduced if duty period has not exceeded 14</td>
<td>11</td>
<td>Up to 16 only if due to operational delays</td>
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<tr>
<td>2</td>
<td>NMT 14</td>
<td>NMT 10</td>
<td>10</td>
<td>9, may only be reduced if duty period has not exceeded 14</td>
<td>11</td>
<td>Up to 16 only if due to operational delays</td>
</tr>
<tr>
<td>3</td>
<td>NMT 16</td>
<td>NMT 12</td>
<td>14</td>
<td>12, may only be reduced if duty period has not exceeded 16</td>
<td>16</td>
<td>Up to 18 only if due to operational delays</td>
</tr>
<tr>
<td>3 Each pilot must have sleep opportunity and approved sleeping quarters must be available</td>
<td>More than 16, but NMT 18</td>
<td>NMT 16</td>
<td>18</td>
<td>16, may only be reduced if duty period has not exceeded 18</td>
<td>20</td>
<td>Up to 20 only if due to operational delays</td>
</tr>
<tr>
<td>4 Each pilot must have sleep opportunity and approved sleeping quarters must be available(^{237})</td>
<td>More than 18 but NMT 24</td>
<td>NMT 18</td>
<td>22</td>
<td>20, may only be reduced if duty period has not exceeded 24</td>
<td>24</td>
<td>Up to 26 only if due to operational delays</td>
</tr>
</tbody>
</table>


\(^{235}\) Rest periods may be reduced only when the actual duty period does not exceed the maximum scheduled duty period for that crew composition and if the pilot is provided a compensatory rest period.

\(^{236}\) The flights to which the pilot is assigned must at block out time be expected to reach their destination within the extended duty period.

\(^{237}\) Applies only to duty periods with one or more flights that land or take off outside the 48 contiguous states and DC.
### TABLE 2

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<td>1996</td>
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</tbody>
</table>

\[238\] See Loffin, *supra* note 134, at 88.