RESEARCH ARTICLE

Alaska Air Carrier Operator and Pilot Safety Practices and Attitudes: A Statewide Survey

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Introduction: Aviation crashes are a leading cause of occupational fatalities in Alaska, with Alaskan pilots having nearly 100 times the fatality rate of U.S. workers overall. A survey was designed to study pilot and company practices and attitudes in order to develop intervention strategies that would reduce aviation fatalities. ***Methods:*** Two surveys were administered: one of air carrier operators and one of active commercial pilots. Surveys from 153 air taxi and public-use operators were received at a 79% response rate. ***Results:*** There are almost 2000 pilots employed in Alaska during peak season by air taxi operators and public agencies. Surveyed operators and pilots generally agreed that improved weather information and regional hazards training would be effective ways to prevent crashes. Operators were more in favor of operator financial incentives ($p < 0.05$) and better pre-employment hiring checks on pilots ($p < 0.05$) compared with pilots' survey responses. There were 48% of pilots of large operators and 73% of pilots of small operators who considered their jobs to be at least as safe as other jobs. ***Conclusions:*** The results of operator-pilot comparisons suggest that financial pressures on operators may influence their views on what measures would be effective in preventing crashes, and that Alaskan pilots underestimate their occupational fatality risk.

Keywords: Alaska, aviation, air taxi, survey, occupational injury, CFR Pt. 135.

A DISPROPORTIONATE number of all U.S. aircraft crashes occur in Alaska. Between 1990 and 2002, there were 434 crashes in Alaska under Code of Federal Regulations (CFR) Part 135, which is 36% of all U.S. CFR Part 135 crashes. The state with the next highest number is Florida, with only 54, or 4% of all U.S. CFR Part 135 crashes. Of the Alaska Part 135 crashes, 67 were fatal, resulting in 194 deaths (21% of all U.S. aircraft deaths under Part 135) (National Transportation Safety Board Aviation Accident Database, 2004).

Aviation crashes are a leading cause of occupational fatalities in Alaska. Between 1990 and 2002, aviation crashes in Alaska caused 130 occupational pilot deaths. This is equivalent to 385 per 100,000 pilots per year, nearly 100 times the mortality rate for all U.S. workers (4 per 100,000; Census of Fatal Occupational Injuries Summary, 2002) and over 5 times the rate for all U.S. pilots (70 per 100,000). Thus, an Alaska pilot would run an 11% risk of death from aircraft crash over a 30-yr career.

These statistics may reflect some of the unique features of aviation in Alaska. Although more than half of the population lives in the state's three major cities, much of the remaining population lives in remote villages. In 1994, commuter airlines in Alaska served 238 locations, only 5 of which had road connections to the airline hub (14). Commuter and air taxi operators serve as the main link between these villages and regional hubs, transporting people, cargo, and mail. Approximately 85% of the aircraft are single-engine (14). These operations are a vital component of the transportation system in Alaska.

Additional unique Alaska features that affect aviation include its large areas of both high mountainous terrain and flat marshy tundra, and an extensive coastline. These factors at Alaska's northern latitudes result in diverse climatic zones and associated variable and often harsh weather. Poor visibility and rapidly changing weather are common and contribute to the problems of air transportation in Alaska.

Due to Alaska's high accident rate, the Federal Aviation Administration (FAA), National Transportation Safety Board (NTSB), and others have investigated many aspects of the regional airline industry. Most of these studies have focused on accident report data (4–6,10,11,13,17), and a few have initiated surveys of pilots (1,2,8,12,14) or audits of operators (7). The studies based on accident reports have described common accident profiles identifying several commonly fatal scenarios including take-off and landing errors, and flying visual flight rules into instrument meteorological conditions resulting in a controlled flight into terrain. Subsequently, several papers have focused their survey efforts on comparing pilots working for operators with

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high numbers of controlled flight into terrain or take-off/landing crashes (2,7,8). These studies have resulted in many recommendations regarding improved training, changing the safety culture, and providing better and more accessible weather information. Many changes have occurred since the early reports, including the placement of 16 remote video weather cameras in Alaska during 1995–2000 for use by pilots. However, the previous investigations did not provide an in-depth survey of both pilots and their employers which addressed current safety practices, training, attitudes toward regulations, and potential safety measures.

In fall 2001 and winter 2002, the National Institute for Occupational Safety and Health (NIOSH) sponsored a survey of air transportation safety among Alaska commuter and air taxi operators and pilots to provide information for a multi-agency initiative, in cooperation with industry, to reduce aviation-related injuries and fatalities and promote aviation safety in Alaska. This survey was intended to identify the perceptions, policies, and practices of air carrier operators and pilots that could affect the safety of flight operations in order to develop interventions for reducing the incidence of commuter and air taxi crashes.

METHODS

NIOSH contracted with the University of Alaska Anchorage, Institute of Social and Economic Research (ISER) to design and administer two statewide aviation safety surveys: one of air carrier managers and one of active commercial pilots. Both surveys addressed pilot and company demographics, pilot flight hours (total, aircraft type, and instrument hours), Alaska flying experience, attitudes about safety, flying practices, and other salient risk factors.

Operator Survey

ISER drew the sample from the FAA Vital Information System (VIS) database. This is the database that the FAA uses to track their regulatory and licensing actions. ISER selected all companies supervised by the FAA Alaskan Region that were certified under CFR Part 135 (commuter airlines and air taxis), stratifying operators both by size and geography. This included commercial operators, federal, state, and local public agencies, and one non-profit, non-commercial corporation (Civil Air Patrol). The only CFR Part 91 operations (general aviation) included in the study were those of government and Part 135 operators flying under Part 91. Private lodge owners, guides, etc., were not included if they did not have a Part 135 certificate. Most commercial operators in Alaska employ just one or two pilots. However, larger operators account for most flight hours in Alaska. In order to get information from operators and pilots having the most flight hours, as well as address the diversity across Alaska, ISER attempted to survey all of the 123 operators recorded in the VIS as having 3 or more pilots ("large" operators), and one-third of the 285 operators recorded as having 1 or 2 pilots ("small" operators). Geographically, the FAA's Anchorage Flight Standards District Office (FSDO) (Southcentral and Southwest Alaska) supervises 78% of the small operators, with the Fairbanks and Juneau FSDOs (covering Interior and Northern Alaska, and Southeast Alaska, respectively) supervising 11% each. To ensure geographic representation that captured the variations across the state in weather, terrain, remoteness of destinations, and aviation infrastructure, we stratified the small operator sample by the supervising FSDO. We randomly drew a sample of 60 small Anchorage operators (about 27% of the population), 18 Fairbanks operators (56%), and 16 Juneau operators (53%). The Fairbanks and Juneau regions were over-sampled relative to the Anchorage region due to the small total number of operators in those regions.

We developed and pre-tested a primary questionnaire for large operators. For small operators, we combined this questionnaire with the instrument developed for the pilot survey, eliminating duplicate questions. Unlike large operator respondents, the individual answering the small operator questionnaire also completed the pilot survey. Combining the instruments allowed us to reduce both our costs and the time burden on the small operator respondent by obtaining both operator and pilot information in one contact. In a few cases, an operator was drawn into the sample in the large operator stratum, but had only one or two pilots when we spoke to them. Those operators were still treated as large operators in survey administration.

ISER interviewed operators from August 2001 through January 2002. Initially we mailed surveys to all selected companies, and followed up by telephone and fax as necessary. In cases where telephone contact was unsuccessful or where the operators preferred, interviewers completed the interview in person. There were three events that occurred during the course of the operator survey that may have affected many operators' responses. The tragic events of September 11, 2001 at the World Trade Center and Pentagon shut down aviation operations nationwide. In response to the uncertainty in the aviation industry and concern among respondents, we stopped interviewing for 1 wk. During the following month, two serious air crashes in Alaska occurred. On October 10, 2001, one of the largest regional operators in Alaska sustained the worst commercial crash in Alaska since 1987—a crash on take-off that killed all 10 aboard. On October 18, 2001, another of Alaska's largest regional carriers crashed a helicopter into Cook Inlet, killing three people. A series of events of this magnitude is likely to have affected operators' attitudes, perceptions, and business practices, but the extent of these effects is unknown. Our response rate for the operator surveys was 79%.

Pilot Survey

The pilot survey targeted pilots currently employed by the operators who responded to the operator survey. For large operators, ISER asked the company to provide sampling data and contact information for their pilots. Respondents were asked about flight practices, attitudes, and perceptions. In pre-testing the questionnaires we identified and then addressed sensitivity to questions about practices that are contrary to federal aviation regulations (FARs). In addition to an understandable reluctance to admit to breaking the law, some pilots also raised concerns that their survey responses to such questions might be used for enforcement purposes. For the same reasons, we chose not to ask pilots questions about their employers that might call for explanations of practices or procedures contrary to FARs.

We generated the pilot sample from interviews with the air carrier operators. Pilots were randomly selected from large operators (three or more pilots). Small operators answered both operator and pilot questions in a single, combined questionnaire in order to minimize respondent burden, since the operator was nearly always a pilot. The minimum sampling fraction of pilots from large operators was 22%, averaging 25% overall.

Survey Representativeness

Because we stratified the sample, we weighted the responses by the inverse sampling fraction of each stratum in order to estimate the characteristics and attitudes of Alaska Part 135 operators as a whole. Since the population numbers from the VIS include operators no longer in business in Alaska, we first calculated adjusted population numbers. For each of our four strata (large operators, and small operators supervised from Anchorage, Fairbanks, and Juneau), we adjusted the VIS stratum numbers by the percentage of the sample that was found not to be working in Alaska. The adjusted VIS stratum number is the inferred population for each stratum. We then divided the inferred population of each stratum by the number of completed interviews in that stratum. Pilot weights were obtained by dividing the operator weights by the fraction of pilots interviewed, which varied by company.

Sample weights cannot correct for bias in who responds to the survey. Tests for non-response bias were limited to variables for which information exists for non-respondents as well as respondents. Available test variables included company size, location, and number of accidents. None were associated with a greater likelihood of response or refusal/non-contact. Although Juneau's response was lower than other areas, the total number of small operators in Juneau is too small for the lower rate to be statistically significant.

Other factors important to the analysis may differ between respondents and non-respondents. For example, operators with limited concern for safety or who are experiencing financial difficulties may systematically refuse to respond. We have no way to measure these potential effects; however, the 79% response rate appears high enough to suggest a representative sample.

Survey Data Analyses

A primary objective of the study was to provide an industry profile of operator and pilot characteristics, practices, attitudes, and beliefs that might be related to safety. In addition to an industry overview, we performed additional statistical analyses to compare the responses of operators to pilots on related questions, particularly with respect to attitudes and beliefs. This analysis used only the large operator and pilot survey responses. Since the pilots of small operators we interviewed were speaking for the company as well (and were often the sole pilot), there was no opportunity to test for differences between the operators and pilots working for small operators.

Questions about attitudes, beliefs, and preferences were designed with Likert scale responses. While one could compare the qualitative responses directly, we chose instead to compare the means of the ordinally scaled variables, in order to have a clear indicator of the direction of the difference in response. We conducted statistical tests for the operator-pilot comparisons to examine differences between the operator's response and the mean response of only their surveyed pilots in paired sample tests. The paired tests take into account the potential similarity of views between operators and the pilots they hired. We used 0.05 as the significance level for the difference of means tests (t-tests). Due to the large number of tests performed, the overall or experiment-wise error rate could be higher than 0.05. As with most survey results, it is the pattern of the results that may be most meaningful. Since many of the questions on the same subject had to be worded differently for pilots than operators in order to make sense in the respective contexts, these tests address differences in questions that are related but not identical. Consequently, the operator/pilot comparisons were exploratory.

To estimate the total number of pilots employed in Alaska, we drew on Alaska Department of Labor (AKDoL) data for the numbers of pilots working for companies not included in our sampling frame. AKDoL data, drawn from unemployment insurance data, include all pilots who work for companies that employ 20 or more people in Alaska (total employment, not just pilots). What CFR Part governs a pilot is not relevant to their inclusion in AKDoL data. It was, however, key to sample selection for our survey. The survey focused on air operators who fly under CFR Part 135, and public agencies. As a result, some pilots were counted in one data source, some in the other, some in both, and a few in neither. For example, our survey did not include pilots flying exclusively for large airlines (CFR Part 121, e.g., Alaska Airlines, Northwest). ISER, as the contractor, was able to view the company names, match the survey data with the AKDoL data, and identify pilots not included in our survey. The estimated total number of CFR Part 135 pilots during the peak summer season was combined with the AKDoL described pilots who were excluded from our original survey universe. Although the AKDoL numbers are not exact, the error is measurement error, not sampling error, and thus it does not increase the confidence interval around the estimated number of pilots.

RESULTS

Industry Profile

We asked each operator how many pilots they currently employed, classifying them as large (three or more pilots) and small (one or two pilots) for analysis based on those responses. These categories refer to the number of pilots employed at the time of the interview and may differ slightly from the sample stratification, which is based on FAA data. Several companies that were sampled as small, based on FAA data, were considered large for our analysis, and vice versa. These results are based on responses from 85 large companies and 68 small companies. Of the 85 large companies, 5 were governmental and 1 a non-profit organization. We also asked how many pilots each company typically employed in the fall, winter, spring, and summer seasons. Based on those responses, we generated an estimate of statewide seasonal employment. The total estimated number of pilots employed by Alaska-based Part 135 operators and public agencies varied from 1,426 in winter (95% confidence interval: 1247–1631) to 1907 during peak summer season (95% CI: 1731–2116). Companies employed from 1 to 105 pilots. Over half of all companies employed only one pilot, and two-thirds employed just one or two pilots. Only 10% employed 10 or more pilots. Companies hired a mean of 1.7 pilots in 1999, 1.9 in 2000, and 1.8 in 2001. The one-third of companies with more than two pilots hired about 95% of pilots.

With the addition of the AKDoL data for the other CFRs, the final estimate of pilots employed in Alaska during peak season was 2742 (95% CI: 2551–2932). This estimate excludes people who fly for companies that are both very small and not regulated under CFR Part 135. Typical examples are fish spotters, pilots providing "incidental transportation" for lodges under Part 91, and some flight instructors.

In 2000, Alaska Part 135 and public use operators statewide flew an estimated total of 420,000 scheduled flight hours (95% CI: 275,000–565,000), and 415,000 unscheduled flight hours (95% CI: 370,000–460,000). A higher percentage of large operators surveyed had formal programs to implement risk reduction measures, including training and supervision measures (**Table I**). Of the large operators, eight also had Part 121 certificates, while none of the small operators did. Nearly all companies permitted pilots to cancel flights. However, only 30% of large operators and 19% of small operators required higher than the minimum regulatory weather conditions for flying, and only 12% of large operators and 4% of small operators had a written list of launch conditions.

Of the 261 pilot responses we received, 197 were from pilots employed by large operators and 64 from pilots who flew for small (1- or 2-pilot) operators. Essentially all of them have commercial and instrument ratings (93–100%). These ratings are required for pilots flying for Part 135 operations, but not for those flying for public agencies. Many pilots are more highly qualified than required, with 72% of large operator pilots and 42% of small operator pilots having either Certified Flight Instructor or Airline Transport Pilot certificates. More pilots of large operators had multi-engine land ratings than small operators, and the reverse was true of single-engine sea ratings (**Table II**). Some of the measures of pilot experience—flight hours, years of experience, year-round Alaska experience—have similar means and medians, especially among the small operators' pilots. In those cases, the mean or median fairly represents the experiences of many pilots, with a few having substantially more or less experience than average. However, median hours of instrument flight experience (Alaska and total) were well below the means, indicating that many pilots had few or no hours, and a few had many hours. Although almost all pilots were instrument rated, 16% had zero hours of instrument flight in Alaska.

TABLE I. CHARACTERISTICS OF LARGE AND SMALL OPERATORS.

	Large Operators	Small Operators
Number of respondents	85	68
Operator Characteristics		
Mean flight hours 2000	5507	766
Median flight hours 2000	2739	500
Mean increase in insurance costs in past 18 mo (%)	39	15
Median increase in insurance costs (%)	20	15
Operators who pay pilots overtime (%)	33	0
Risk Reduction Measures in Place (%)		
Higher than FAA weather minimums required	30	19
White-out pilot training	50	16
Low visibility pilot training	60	19
Flat light pilot training	52	15
Recovery from IMC pilot training	66	19
White-out pilot check rides	42	11
Low visibility pilot check rides	49	14
Flat light pilot check rides	38	11
Recovery from IMC pilot check rides	53	15
Written list of launch conditions	12	4
Pilots can cancel flights	100	99
Other employee can cancel flights	88	26
Outside person can cancel flights	18	6

IMC = instrument meteorological conditions.

Pilots had been flying for an average of 16 yr (ranging from less than 1 yr to 50 yr). Of large operators' pilots, two-thirds had flown year-round (rather than seasonally) throughout their Alaska careers, ranging from 1 to 40 yr, with a mean of 9.6 yr. Of those with seasonal flight experience, the mean was 4.5 yr of Alaska experience. Over their entire career, pilots had worked for a mean of 4.2 companies. Pilots are typically male (95%); 60% are in their thirties and forties. Most (84%) have education beyond a high school diploma; 45% have a bachelor's or higher degree.

Most pilots appear to work long hours during the busy summer season. The average reported work day was 11.5 h, and work week, 71 h. Over 86% of pilots reported that they worked more than 50 hours per week during the busy season. When asked whether a pilot's job is more dangerous than other jobs, among pilots working for large operations, 9% said much safer, 8% slightly safer, 31% as safe, 44% slightly more dangerous, and 7% much more dangerous. Pilots for small operators were even more optimistic: 8% much safer, 13% slightly safer, 52% as safe, 21% slightly more dangerous, and 6% much more dangerous.

TABLE II. PILOT CHARACTERISTICS BY SIZE OF OPERATOR.

	Pilots/Large Operator		Pilots/Small Operator	
Number of respondents	197		64	
Pilots holding various aircraft ratings (%)				
Single-engine land	86		81	
Multi-engine land	70		43	
Single-engine sea	56		73	
Multi-engine sea	15		20	
Other	18		6	
Demographics				
Female pilots (%)	6		2	
Mean age (yr)	42		49	
Mean number of employers (as pilot)	4.3		3.6	
Average work day ($h \cdot d^{-1}$, peak season)	12		11	
Average work week ($h \cdot d^{-1}$, peak season)	72		67	
	Mean	Median	Mean	Median
Length of flight career (yr)	15	13	20	19.5
Year-round Alaska flight experience (yr)	9.5	6	5.3	6.3
Flight hours, total	9,408	7,034	10,918	10,006
Flight hours, in the last 12 mo	636	600	482	400
Flight hours, Alaska	7,084	5,044	9,731	9,427
Flight hours, Alaska in the last 12 mo	595	600	457	400
Instrument hours, total	1,096	337	690	110
Instrument hours, Alaska	797	150	284	50

Interventions to Improve Alaska's Air Transportation Safety

Operators and pilots generally agreed that improved weather information, especially via video weather cameras, weather reporting by and consultation with trained weather observers, improved decision-making policies and skills, and regional hazards training would all be effective ways to prevent crashes (**Table III**). There was not very much optimism about improving passenger understanding of weather (i.e., passengers bringing pressure to fly into adverse weather or visibility) as being a successful prevention strategy. There was very little enthusiasm expressed by any of the groups for changes to the current allocation and management system for bypass mail (commercial pilots carrying U.S. mail to remote villages).

Comparison of Large Operator and Pilot Responses

Many pilots believe that some routes need higher than FAA weather minimums to keep an adequate margin of safety. Pilots reported receiving training for flying in adverse weather conditions, but also stated that their companies had no written training program; that is, training programs were informal. On effective-

TABLE III. PERCENTAGE OF OPERATORS AND PILOTS RATING VARIOUS ACCIDENT PREVENTION MEASURES AS "VERY EFFECTIVE."

	Large Operators	Small Operators	Pilots of Large Operators
Weather Information			
More locations with manned weather reporting	79	82	76
Increased accuracy of existing weather reporting	77	77	76
More locations with automated weather reporting	64	59	75
Increased use of video weather cameras	62	75	75
Improved passenger understanding of weather hazards	33	34	18
Training			
Decision-making training	75	68	79
Regional hazards training	70	68	82
White-out/flat light training	48	60	73
Meteorology training	36	48	55
Rewards and Incentives			
Financial incentives for operators for no accidents/incidents	50	39	23
Salary-based pay	34	28	42
Pilot rewards for flights or flight hours without accident/incident	26	23	27
Pilot Experience			
Better checks of a pilot's flying history before hiring	42	28	20
More flight time for new pilots	39	40	41
Other			
More time to deliver bypass mail	33	9	13
Written criteria for go/no-go decisions	30	31	37
Changes in how bypass mail is given to operators	25	10	11

TABLE IV. DIFFERENCE BETWEEN LARGE OPERATOR AND PILOT RESPONSES TO ANALOGOUS QUESTIONS.

Survey question:	operator-pilot mean	*t*-statistic	p-value
Attitudes toward FAA oversight:			
Regulations interfere with getting the job done	−0.045	−0.540	0.591
Higher than FAA weather minimums sometimes needed	−0.533	−7.788	**0.000**
Company provides formal pilot training for:			
White-out	−0.198	−2.475	**0.016**
Low visibility	−0.175	−2.443	**0.017**
Flat lighting	−0.165	−2.219	**0.030**
Recovery from IMC	−0.130	−1.715	0.091
Perceived effectiveness for preventing crashes:			
Improvements in meteorological pilot training	−0.196	−1.765	0.082
Improvements in decision-making pilot training	−0.023	−0.283	0.778
Improvements in white-out pilot training	−0.203	−1.994	**0.050**
Improvements in regional hazards pilot training	−0.134	−1.702	0.093
Better checks on pilot's history	0.306	2.741	**0.008**
Better passenger understanding of weather hazards	0.274	2.376	**0.020**
Changes in the way bypass mail is given to operators	0.377	2.745	**0.009**
More time for bypass mail	0.505	3.678	**0.001**
Financial incentives for operators with no accidents	0.538	4.351	**0.000**

IMC = instrument meteorological conditions.

ness questions, pilots generally viewed additional training to be more effective in preventing crashes than did operators, with a significant difference for white-out training (**Table IV**). Companies viewed better pre-employment hiring checks to be more effective for crash prevention. These results appear to reflect the differing perspectives of the two parties. Pilots viewed better weather reporting as more effective, but differences for additional automated weather stations and additional video cameras were not significant. On the other hand, pilots are less enthusiastic than operators about better passenger understanding of weather hazards, changes in bypass mail policies, and financial incentives for safety. These measures directly affect company finances. Pilots were not as optimistic as operators that financial incentives for operators not having accidents would result in improvements in safety.

In addition to these differences, there may be differences between operator and pilot perception of fatigue. Among large operators, only 6% responded that fatigue was perceived as being a major problem in scheduling, 46% that it was a minor problem, and 48% that it was not a problem. Pilots were asked how often during the peak season they would have preferred to decline a flight due to fatigue, but flew anyway. Among pilots for large operators, 15% made such a decision weekly during the peak season, 7% monthly, 24% less than monthly, and 54% never made such a decision. Among small operators, the respective proportions were 13% weekly, none monthly, 25% less than monthly, and 63% never. The questions for operators and pilots are not strictly comparable, however, so a difference of means would not be a meaningful statistic.

DISCUSSION

Operators and pilots both strongly supported improving meteorological services and consultation, including weather prediction, reporting, deployment of more video weather cameras in critical locales, and increased numbers and involvement of trained weather observers. While there are ongoing increases in deployment of weather cameras, and constant refinement of weather prediction and web-based access to these predictions and current conditions, the funding and administrative support for weather observers and Flight Service Station personnel has been controversial in Alaska for some time. Narrative responses to open-ended portions of the questionnaires and discussion in focus groups reflected a wide distrust of the accuracy of automated weather observation (beyond the direct form afforded by the video/weather-cams) and a strong desire to be able to talk with someone in destination and en-route communities to consult on current conditions, near-term weather prediction, and advisable/best routing. The National Weather Service has been responsive to some of these concerns with the recent development of real-time weather consultations between pilots and personnel via the "mike-in-hand" program (http://www.alaska.faa.gov/at/notices/WX.htm).

The strong support expressed by both operators and pilots for improvement and wider utilization of training in decision-making (particularly for visual flight rules into instrument meteorological conditions), flat light, white-out, and regional hazards should facilitate the implementation of such measures. As there was almost as strong support for pilots needing more supervised flight time, particularly in their own region, and better checking of pilot's pre-employment flying history, such changes should also be reasonably well-received. As there was detectable support, though not as strong, for written criteria for go/no-go decisions, pilot rewards for safe flying, and improved passenger understanding of weather hazards, these interventions, if pursued, should be implemented more cautiously, with active consultation and collaboration with industry leaders and pilots.

Strategies involving changes in time allowed for delivery and how service is allocated for bypass mail were the least popular for this industry. While the majority of large operators expressed some enthusiasm for affording more time for delivery of bypass mail, and a slim majority for changes in how it is allocated, neither of these measures were supported by smaller operators. Pilots working for larger operators only deemed increasing delivery time as "somewhat effective," while the majority responded that allocation changes would not be effective. In general, the results of operator-pilot comparisons suggested that the differing financial pressures and incentives on operators and pilots may influence their views on what measures would be effective in preventing crashes. Results indicated that the respondent's position in the company (operator or pilot) was more influential in determining their responses than the company they worked for.

Large and small operators differed in their ability to provide procedural and operational risk-reduction measures. A higher percentage of large operators had formal programs to implement risk reduction measures, including pilot training and check rides. Several of the large firms also operated under CFR Part 121, and the larger firms also employed the vast majority of pilots in the state. The larger, more diverse operators would likely be more able to provide formal training procedures to their pilots. Pilots from large and small firms were similar in regard to total flight hours, although pilots varied greatly in their instrument experience. Almost all pilots had the ability to cancel flights.

A consistent finding from both the operator and pilot surveys was the high intensity of work during the peak season. The average reported work day for a pilot was 11.5 h, and work week, 71 h. Over 86% of pilots reported that they worked more than 50 hours per week during the busy season. The hours reported were duty hours, not flight hours. Although the CFR provides strict rules for the number of flight hours a pilot may undertake, true rest during non-flight hours cannot be enforced. Fatigue can occur from disrupted sleep due to changing schedules, as well as a lack of sleep, and cumulative sleep loss can lead to impaired performance and diminished alertness (15). Operators and pilots had different perceptions regarding fatigue. Only 6% of large operators responded that fatigue was perceived as being a major problem in scheduling. Pilots of these firms indicated that fatigue during the peak season was more of a problem, with 22% responding that they made a decision to fly when fatigued either weekly or monthly. For small operators, where the operator may be the only pilot, a small percentage (13%) of pilots responded that they made a decision to fly when fatigued on a weekly basis and none responded that they made the decision monthly.

The numbers of pilots and operators reporting fatigue as a problem is surprisingly low considering the number of hours the pilots work. Fatigue, whether perceived or not, has been shown to be an important contributor to aviation crashes (9,15,16). The FAA reported that 21% of the reports in the Aviation Safety Reporting System either directly or indirectly mentioned issues of fatigue (3). Information for pilots on how to identify their degree of fatigue should be addressed in future aviation initiatives.

In opinions expressed about likely effectiveness of interventions, pilots viewed additional training as more effective than did operators, while companies often viewed pre-employment hiring checks to be more effective. These differences appear to reflect the differing perspectives of the two parties. Similarly, pilots viewing better weather reporting as more effective, but being less enthusiastic than operators about better passenger understanding of weather hazards, changes in bypass mail policies, and financial incentives for safety also seem to reflect differing perspectives.

Unfortunately, pilots' reported perception that their risk for fatal injury while working is low to moderate is not consistent with reality. The risks for this occupation are quite high: between 1990 and 2002, aviation crashes in Alaska caused 130 occupational pilot deaths. This is equivalent to 385 per 100,000 pilots per year, almost 100 times the mortality rate for all U.S. workers. The pilot fatality rate in Alaska is nearly 5 times the rate for all U.S. pilots (70 per 100,000 per year). This equates to a 12% risk for a commercial pilot in Alaska being killed in an aircraft crash over a 30-yr career.

Many of the responses received in these surveys were largely consistent with the objectives for three major new programs in Alaska. The Medallion Foundation is a non-profit, private/government collaboration to provide organizational tools, training, and technical support to the aviation industry in Alaska (http://medallionfoundation.org/dw/foundation.htm). The approach advocated by this new Foundation incorporates many of the procedural and training interventions mentioned in the survey and largely supported by the respondents. The FAA's Circle of Safety program (http://ww.alaska.faa.gov/flt_std/Community/Logo.htm) is a consumer education program emphasizing passenger understanding of the hazards of flying. While the industry expressed only guarded enthusiasm in the survey for passenger understanding of weather as being a helpful intervention, there was clear consensus among survey respondents that passengers bringing pressure to fly into adverse weather or visibility was an unhelpful and potentially dangerous influence. The Capstone Program (http://www.alaska.faa.gov/capstone/pp/phl_files/slide0259.htm) introduces high-technology navigational avionics in a compact suite of equipment designed for use in small aircraft. Currently being evaluated in approximately 200 aircraft, predominantly single-engine commercial aircraft in Southwestern Alaska, this innovative technology may provide much better information to inform pilot decision-making and navigation.

In summary, these surveys have provided insight into the current operations of Alaska's aviation industry and assessed the acceptability of a wide range of potential interventions to the industry.

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