Perceived Fatigue for Short- and Long-Haul Flights: A Survey of 739 Airline Pilots

Samira Bourgeois-Bougrine, Philippe Carbon, Charlotte Gounelle, Regis Mollard, and Alex Coblentz

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Background: Fatigue-related incidents in aviation may be self-reported by pilots in confidential systems. The aim of this study was to clarify what fatigue means to pilots on short- and long-haul flights (SHF and LHF, respectively). ***Methods:*** Questionnaires were distributed to pilots through four airlines. Questions concerned the perceived causes of fatigue, its signs and symptoms in the reporting pilot and observed in others, as well as the strategies used to minimize its impact. ***Results:*** Of 3,436 questionnaires distributed, 739 (21.5%) were returned. For LHF, fatigue was seen as mainly due to night flights (59%) and jet lag (45%). For SHF, fatigue was caused by prolonged duty periods (multi-segment flights over a sequence of 4 to 5 d) (53%) and successive early wake-ups (41%). Self-reported manifestations of fatigue in 60% of LHF pilots and 49% of SHF pilots included reduction in alertness and attention, and a lack of concentration. Signs observed in other crewmembers included an increase in response times and small mistakes (calculation, interpretation). When pilots were tired, all the flying tasks seemed to be more difficult than usual. In both LHF and SHF, rest and sleep management were the primary strategies used to cope with fatigue. Analysis showed that duty time is a major predictor of fatigue, but that it cannot be considered independently from the other contributory factors. ***Conclusion:*** For both LHF and SHF, pilots reported acute fatigue related to sleep deprivation, due mainly to work schedules: night flights, jet-lag, and successive early wake-ups. These causal factors could easily be assessed in investigation of accidents and incidents.

Keywords: fatigue, sleep loss, long duty time, work schedules, accident and incident investigation, civil aviation, long-haul flights, short-haul flights.

FATIGUE IS recognized as one of the major factors that can impair human performance, and has often been cited as a cause of accidents and incidents in industry and transport (11). The evidence of a causal influence of fatigue in incidents or accidents is often circumstantial because fatigue is a complex and ambiguous concept with no standard measurement index (2). For example, Lyman and Orlady (10) showed that fatigue was implicated in 77 (3.8%) of 2,006 incidents reported by pilots to the Aviation Safety Reporting System (ASRS). When the analysis was expanded to include all factors that could be directly or indirectly linked to fatigue, incidents potentially related to fatigue increased to 426 (21.2%). The major problem with fatigue issues is the lack of a coherent definition of fatigue itself, and of a reliable and valid assessment tool to measure it. Therefore, fatigue is generally difficult to investigate on a systematic basis and to code into databases (5).

Studies of pilot fatigue have used various methods, usually measuring fatigue by continuously recording pilots' electroencephalograms, electrooculograms, and electromyograms during commercial flights, collecting sleep diaries, and measuring performance on specific tasks (3,6,13). Because of night flights and jet lag, long-haul flights (LHF) have generally received more interest than short-haul flights (SHF) with respect to fatigue (3,12,13,15).

As suggested in a recent symposium (11), fatigue in aviation refers to decreases in alertness, and feeling tired, sleepy, and/or exhausted. This concept of fatigue is based on outcomes that are measured by electrophysiological recording during flight and is therefore difficult to use in accident and/or incident investigations. As fatigue is an internal experience, we each possess a personal knowledge of its causes and manifestations. The aim of the present study was to evaluate this personal experience in order to understand pilots' perception of fatigue in short- and long-haul flights. It is concerned with the physiological, psychological, and operational factors related to the causes of fatigue, with the most striking symptoms, and finally with the strategies or countermeasures used by pilots to counteract fatigue. This study, which is part of a larger program examining aircrew fatigue, may help investigators to easily identify fatigue in analysis of accidents and incidents, as well as improving our understanding of incidents self-reported by pilots to confidential and voluntary reporting systems.

METHODS

The questionnaire was developed to evaluate these aspects and included open and closed questions and

From the Université René Descartes-Paris 5 - Laboratoire d'Anthropologie Appliquée, Paris, France.

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Address reprint requests to: Regis Mollard, Université René Descartes-Paris 5 - Laboratoire d'Anthropologie Appliquée, 45, rue des Saints-Pères, 75006 Paris, France; laa@biomedicale.univ-paris5.fr.

Samira Bourgeois-Bougrine, Ph.D., is a lecturer in Ergonomics at Université Paris 5.

TABLE I. RESULTS OF SIMPLE AND MULTIPLE REGRESSION ANALYSIS FOR SHF AND LHF, RESPECTIVELY.

		Std Coeff (ß)	t-value	p-value
SHF : R = .48; R^2 = .23	Diurnal duty	.48	4.84	<0.001
LHF : R = .33; R^2 = .11; F = 21.89, $p < 0.001$	Diurnal duty	.19	3.77	<0.001
	Nocturnal duty	.29	5.85	<0.001

The dependent variable is fatigue. Independent variables are diurnal duty time for SRH and both diurnal and nocturnal duty for LRH. (Std : standardized; coeff : coefficient).

two kinds of ratings.* For the causes of fatigue, the closed questions included a checklist of factors as well as ratings of the impact of these factors on five-point scales like those generally used in shift work studies (1). For the subjective experience or manifestations of fatigue, visual analog scales were used (9). The questionnaire included five parts:

Demographic information: age, gender, flying experience, function (captain or co-pilot), and flight category (short- or long-haul).

Level of fatigue. A visual analog scale of fatigue was used on which pilots marked their current feeling on a 100-mm line from "fresh" (0) to "tired" (100). Information was also gathered on duty time over the previous 7 d (duty week, DW), including total duty time and the share performed between midnight and 0600 (home time).

Causes of fatigue (3 questions). Which of your usual schedules make you feel tired (open question)? During climb and descent, to what extent do the following situations make you tired? Eight items were indicated and the ratings were made on a 5-point scale of impact (1 = none, 2 = small, 3 = medium, 4 = high, 5 = very high). In general, what is the impact of the following events on your level of fatigue? Five items related to flight changes or difficulties were rated on a five-point scale of impact as above.

Manifestations of fatigue (2 questions). During the flight, what are the symptoms of fatigue for you and for the other crewmembers (open question)? When you get tired, to what extent are the following flying tasks affected by fatigue? Performance on eleven kinds of flying tasks was rated using a 100-mm line where 0 = better than usual, 50 = as usual, 100 = less well than usual.

Coping strategies. What are your strategies to cope with fatigue before and after an exhausting roster, during flight, and during layover (open question)?

Results for LHF and SHF were compared using Mann-Whitney U (nonparametric) tests. Differences related to age and sex were evaluated by ANOVA. Regression analyses were performed to evaluate the impact of the duty time performed over the DW (independent variable) on the level of fatigue (dependent variable).

The aims of the survey were explained by telephone or letter to the heads of flight divisions in five French airlines. The questionnaires and stamped self-addressed envelopes were then provided to the airlines and distributed to each pilot's in-house mailbox. Pilots were invited to participate in the survey and to return the questionnaire anonymously to our laboratory as soon as possible. A reminder letter was subsequently addressed to all the pilots in the five airlines. Pilots from one airline returned their questionnaires after the completion of the data analyses and their results were thus excluded.

* Questionnaire available on-line at http://www.ingentaselect.com/vl=1151019/cl=61/nw=1/rpsv/cw/asma/00956562/contp1-1.htm.

RESULTS

The four study airlines employed a total of 3,436 pilots. Of 3,436 questionnaires distributed, 739 (21.5%) were returned. The response rate for individual airlines ranged from 2% to 33%; 615 of the returns came from one large airline. The sample of 739 pilots comprised 95% men and 5% women, 46% captains and 54% first officers, 72% LHF and 28% SHF. The mean age of the respondents was 42 ± 8 yr (range 25 to 61), and the mean flying experience was 14 yr (range 1 to 39). Age and flying experience were significantly correlated (r = 0.82; $p < 0.001$). The distribution in terms of age, sex, and function in the sample was close to the overall numbers for the airlines in 1997, the year of the survey, as reported by the head of each flight division.

Fatigue and Duty Time

The mean duty time performed by the pilots during the DW was 25 ± 15 h (max: 80 h), and the average level of fatigue was 51 ± 24.5 (max: 99) on the visual analog scale. In this survey, 90% of the SHF pilots performed their duty time during the day, while 80% of LHF pilots performed the whole, or the majority of their duty time between 0 h and 6 h. However, there was no difference between the SHF and LHF with respect to average duty time or average level of fatigue. Simple and multiple regression analyses were performed for SHF and LHF, respectively, with fatigue as the dependent variable and diurnal and nocturnal (for LHF) duty times as the independent variables. As was expected, fatigue increased significantly with duty time in both kinds of flights (**Table I**). In addition, for the LHF, the standardized coefficient values indicated that nocturnal duty was the most important in predicting fatigue. However, the low R^2 values (SHF: R^2=0.23, LHF: R^2=0.11) suggest that the majority of the variability in the level of fatigue cannot be explained by duty time.

Causes of Fatigue

The LHF and SHF pilots reported 704 and 248 examples, respectively, of schedules that made them feel

TABLE II. CAUSES OF FATIGUE DURING CLIMB AND DESCENT.

	Long-haul Flights		Short-haul Flights		
	Mean Score (SD)	High and Very High Scores	Mean Score (SD)	High and Very High Scores	Significance
Significant workload	3.34 (0.92)	46.4%	3.53 (0.85)	53.8%	*
Executing actions in a limited amount of time	3.03 (0.86)	29.4%	3.17 (0.91)	34.6%	
Simultaneous actions	2.97 (0.84)	23.1%	3.05 (0.85)	31.5%	
Interruption during activities	2.76 (0.90)	19.6%	2.88 (0.95)	27.6%	
Problem of coordination with the other cockpit crewmembers	2.68 (1.04)	21.1%	2.79 (1.06)	26%	
Density of verbal exchanges	3.17 (0.95)	38.9%	3.20 (1.03)	41.5%	
Communicating in a foreign language	2.77 (0.96)	21.8%	2.69 (1.04)	19.4%	
Lack of sleep	4.12 (0.86)	78%	4.10 (0.87)	76%	

Ratings on a 5-point scale (1 = no impact, 2 = small impact, 3 = medium impact, 4 = high impact, 5 = very high impact). Mean scores (SD) and the percentages of pilots who scored "high and very high" are reported. *Significant differences between LHF and SHF mean scores; Mann-Whitney U test, $p < 0.05$.

tired. Among these examples, two schedules in particular were frequently reported (8%):

1. LHF: flights on two successive nights with a sleep during a short day layover. For example: Paris-New York-Paris in 48 h with a layover of about 22 h.
2. SHF: long duty periods (more than 10 h) that included 4 to 5 legs per day with successive early wake-ups over a sequence of 4 d.

An analysis of the features of the 952 examples of schedules reported by the pilots indicated that the main causes of fatigue were related to sleep deprivation and biological rhythm disturbances for LHF, and to daily workload and sleep deprivation for SHF. Indeed, LHF fatigue was mainly due to night flights (59% of roster examples), jet lag (45%), and minimum crew (13%). SHF fatigue was associated with schedules of 4 to 5 consecutive days with 4 to 5 legs per day (53%), successive early wake-ups (41%), and night flights (18%).

These results are supported by the pilots' responses to the second question on fatigue causes during climb and descent (**Table II**). Among the 8 items listed, sleep deprivation remained the most important factor generating fatigue during climb and descent: 78% of LHF pilots and 76% of SHF pilots considered that sleep deprivation caused a "high" to "very high" impact on fatigue. High workload and the density of verbal exchanges which characterize the climb and descent flight phases yielded the second and third highest scores, respectively. There was no significant difference between LHF and SHF, except that the latter assigned significantly higher scores to the impact of high workload. Compared with captains, first officers reported sleep loss and problems of coordination with other crewmembers as producing significantly higher fatigue.

Table III shows the impact of five flight events on fatigue. The scores attributed to these five items remained lower than that due to the lack of sleep (Table II). The impact on fatigue was scored "high and very high" by 50% or more of pilots for the following items: dissension within crewmembers; necessity to perform an originally unplanned additional leg; and compliance with time constraints (only SHF).

Two significant differences were observed between the two types of flights. The fatigue effect of the "necessity to perform an originally unplanned additional leg" was significantly higher for LHF than for SHF, while for "compliance with time constraints" the score was significantly higher for SHF than for LHF.

There were no statistically significant differences associated with the gender of the pilots. Age, function, and the duty time performed over the DW yielded the following significant effects:

1. Pilots less than 35 yr of age attributed significantly lower scores to "simultaneous actions," "interrup-

TABLE III. IMPACT OF FLIGHT EVENTS ON AIRCREW FATIGUE.

	Long-haul Flights		Short-haul Flights		
	Mean Score (SD)	High and Very High Scores	Mean score (SD)	High and Very High Scores	Significance
Flight delay	3.01 (1.00)	32.4%	2.93 (0.97)	28.4	
Difficult flight	3.05 (0.99)	34%	3.14 (1.03)	41.2	
Dissension within crewmembers	3.40 (1.10)	51.5%	3.44 (1.11)	50%	
Necessity of performing additional leg not planned originally	3.91 (0.93)	72.4%	3.64 (1.03)	56%	**
Compliance with time constraints	2.80 (1.02)	25.9	3.44 (1.06)	51%	**

Ratings on 5-point scale (1 = no impact, 2 = small impact, 3 = medium impact, 4 = high impact, 5 = very high impact). Mean scores (SD) and the percentages of pilots who scored "high and very high" are reported. **Significant differences between LHF and SHF mean scores; Mann-Whitney U test, $p < 0.001$.

tion during activities," and "communicating in a foreign language."
2. First officers attributed significantly higher scores to the "problems of coordination with the other cockpit crewmembers," "impact of lack of sleep," and "dissension among crewmembers."
3. The level of fatigue related to the duty time over the DW was positively correlated with the scores attributed to the great majority of items: the impact of the different items on fatigue increased with increasing duty time. This relationship was not observed for only three of the items: "problems of coordination with the other cockpit crewmembers," "density of verbal exchanges," and "dissension with other cockpit crewmembers."

Manifestations of fatigue. The pilots reported 1,364 manifestations of fatigue for themselves and their cockpit crewmembers. The pilots' responses were first classified according to their frequency, and then distributed into three main categories: mental, verbal, and sleep-loss related manifestations.

The item "reduction of attention and lack of concentration" was the most frequently reported manifestation of fatigue: 25% for LHF and 23% for SHF. For their cockpit crewmembers, LHF pilots reported a "decrease of social communication" in 31% of cases while SHF pilots reported "small mistakes (calculation, interpretation)" in 26% of cases.

Among the three main categories, mental, verbal, and sleep-loss related manifestations, 60% of LHF pilots and 49% of SHF pilots spontaneously reported manifestations related to sleep loss. For their cockpit crewmembers, pilots reported mainly mental manifestations (42% and 53% for the LHF and SHF pilots, respectively). The most frequent mental manifestations observed in other crewmembers were "small mistakes (calculation, interpretation)" for SHF and "increases in response times" for LHF (26% and 13% of manifestations of fatigue, respectively).

In general, verbal manifestations, such as "a reduction of social communications and bad message reception (air traffic control, crewmembers, . . .)," were more frequently reported for the other crewmembers than for the pilots themselves: 49% of pilots reported this kind of manifestation for the other crewmembers while only 22% of pilots did so for themselves.

When pilots were tired, all the flying tasks seemed to be more difficult than usual (**Table IV**), especially supervisory activities, manual flying, and selecting and entering data. The impact of fatigue on flying tasks did not differ significantly between SHF and LHF except that "utilization of aircraft automation" was more difficult for LHF. "Manual flying" was significantly more difficult for first officers than for captains. Young pilots (less than 35 yr) reported significant fatigue effects on selecting and entering data, checklist, writing official reports, and flight path monitoring.

Coping with fatigue. In the survey, 7% of pilots declared that they had no strategies to cope with fatigue, while 3% failed to respond to this question. The remaining 90% cited a total of 1909 strategies which could be classified into three main types: rest and sleep management, activity management, and lifestyle. Rest and sleep management was the primary strategy used to cope with fatigue in both flight categories before (79%) and after (88%) a duty sequence, as well as during layover (74%). During flight, LHF pilots reported that they took naps lasting 20 to 30 min (41%) while SHF pilots closed their eyes for 5 min (14%). The practice of napping before the rotation increased with age and was reported by 17%, 28%, and 36% of pilots less than 35, 35–44, and more than 44, respectively.

TABLE IV. MEAN (SD) IMPACT OF FATIGUE ON FLYING TASKS.

	LHF	SHF	Significance
Monitoring	62.9 (13.1)	63.5 (13.0)	
Flight path monitoring	68.0 (13.1)	67.6 (12.2)	
Manual flying	72.0 (14.8)	74.7 (14.7)	
Utilization of aircraft automation	66.4 (14.9)	61.6 (15.3)	**
Communication	64.8 (13.8)	64.0 (13.7)	
Crew resources management	66.4 (13.8)	66.5 (14.0)	
Check-list	58.3 (11.8)	57.9 (12.8)	
Briefing	60.5 (12.2)	61.8 (13.3)	
Monitoring supervisory activities	75.3 (13.3)	75.8 (11.9)	
Selecting and entering data	71.6 (13.8)	69.3 (12.7)	
Writing official reports	67.6 (16.2)	6.7 (17.0)	

Analogue scale used: 0 = less difficult than usual, 50 = as usual, 100 = more difficult than usual. **Significant differences between LHF and SHF, Mann-Whitney U-test, $p < 0.001$.

DISCUSSION

The causes of pilots' fatigue are primarily related to sleep loss for both LHF and SHF. Pilots reported that night flights and jet lag were the most important factors that generated fatigue in LHF; for example, two successive night flights to Paris-New York-Paris in 48 h with a short layover of about 22 h. In this case, the sleep taken soon after arrival corresponds to biological day. The poor quality and quantity of this sleep, together with the long period of wakefulness before departure, increased fatigue during the nocturnal return flight. In SHF, multi-leg flights and early wake-ups increased fatigue in SHF. These results confirm those observed by Nicholson et al. (12) for LHF, and Gander et al. (6) for SHF.

In addition, the results indicate that time constraints, high numbers of legs per day, and consecutive work days seemed to increase fatigue in SHF. The effect on fatigue of the necessity to perform an originally unplanned additional leg was significantly higher for LHF than for SHF probably because of the previous long duty time. Alternatively, it may be that SHF pilots are more familiar with this type of request.

When considering themselves, pilots cited the manifestations of fatigue caused by sleep deprivation as a reduction in alertness and attention, and a lack of concentration. However, for their cockpit crewmembers, they reported mental manifestations (increased response times, small mistakes) and verbal manifestations (reduction of social communications, bad message reception). These results suggest that pilots may not really be aware of the effects of fatigue on themselves in terms of the quality of their flight task performance.

The increase in response times for LHF may be due to pilots' ability to manage their activities during the long cruise phase, whereas for SHF, omissions and small mistakes were probably related to time pressure and a high workload during the short, multi-leg flights. When crewmembers are tired, supervisory or monitoring activities become more difficult than usual. This result confirms the finding that sleep loss and fatigue affect the less demanding tasks (type 1) (4). Likewise, Lyman and Orlady (10) have shown that in the majority of ASRS fatigue-related incidents, there is a decrement in monitoring performance (e.g., activities that involve awareness of the actual and desired state and position of the airplane).

Rest and sleep management is the primary strategy used to cope with fatigue in both flight categories before (79%) and after (88%) a duty sequence, as well as during layover (74%). The practice of napping before the rotation increases with age.

Younger pilots seemed better able to resist fatigue than older ones: pilots less than 35 yr of age attributed significantly lower scores to the fatigue impact of "simultaneous actions," "interruption during activities," and "communicating in foreign languages." In addition, for these younger pilots, fatigue had significantly less impact on flying tasks "selecting and entering data," "check-list," "writing official reports," and "flight path monitoring." It is well known that younger drivers are better able to resist fatigue (7, 8, 14). Hamelin found that drivers over the age of 30 have lower strength resources, which limits their ability to compensate for fatigue effects (7). However, younger drivers cause proportionately more accidents related to sleepiness than older ones because they drive more at night (8).

The analysis confirmed that fatigue increased significantly with cumulative duty time during the preceding DW. For LHF, nocturnal duty was the most important predictor of fatigue. Nevertheless, the regression model failed to explain the majority of the variability in fatigue. There are probably two explanations for this result. First, the effect of duty time may be veiled by the many other factors related to the duty sequence, such as the early wake-ups, jet-lag, multiple legs per day, the number of consecutive days of work, the high workload, and time constraints. Second, the ratings of fatigue were made at different times of day and may have been influenced by circadian variations in fatigue, prior sleep loss, and time since sleep. For instance, pilots with relatively low cumulative duty times may rate their level of fatigue as high if they are suffering from sleep loss, or if they make the rating during the night. The predictive model of fatigue showed that duty time may help to predict fatigue but that it cannot be considered, or manipulated, independently from the other factors that control fatigue. A further survey is currently being prepared to extend these preliminary results and to improve the predictive model by taking into account all the features of work schedules. We also plan to examine the other factors that can affect sleep such as the stress due to personal or professional problems, health, and lifestyle.

The outcomes of fatigue reported by pilots, such as the reduction of alertness and lack of concentration, are not specific to sleep loss and are difficult to quantify in analyzing accidents or incidents. However, the main causal factors of pilots' fatigue could be easily assessed; specifically, preceding work schedules could be analyzed to evaluate circadian disturbances caused by night flights or jet lag, sleep loss due to morning or night flights, and cumulative duty time.

We applied this approach to an investigation of a serious incident that occurred on a final approach to Paris-Orly Airport in 1997 to evaluate whether or not the pilots were sleep-deprived (5). Analysis of their work schedules for the prior 30 d indicated no circadian disturbances, but a cumulative sleep loss over the last 7 d prior to the incident due to "short nights off" (finishing late and starting early). Interviews with the pilots confirmed that they felt tired before the incident.

CONCLUSIONS

The fatigue reported by pilots reflected the effects of their work schedules: night flights, jet lag, and successive early wake-ups. For SHF, time pressure, number of legs per day, and consecutive days on duty contributed to increased fatigue. The results of this study emphasize the need to consider chronobiology in the development of aircrew scheduling rules, as well as flight and duty time limitations to allow for the additional fatigue effects of multi-leg flights and work constraints in SHF. Finally, pilots should be made aware that the effects of fatigue include not only the self-reported reduction of alertness and attention, and lack of concentration, but also produces in them the signs that they observed in other crewmembers, including increased response times, small mistakes, a reduction of social communications, and bad air traffic control message reception.

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FATIGUE IN AERONAUTICS

* QUESTIONNAIRE *

UNIVERSITE RENE DESCARTES
U.F.R. BIOMEDICALE
Laboratoire d'Anthropologie Appliquée
45 Rue des Saints-Pères
75270 PARIS Cedex 06
FRANCE

Following earlier studies conducted in the period 1990-1994 that led to a recommendation guide, the Laboratory of Applied Anthropology & DGAC are continuing research & development activities with regard to Fatigue & Vigilance in commercial aviation.

This survey aims to identify the contributory environmental factors that generate fatigue, as well as some striking symptoms.

Targetting technical flight crews, we wish to collect your experience and your knowledge about fatigue situations and conditions, its consequences, its symptoms and strategies or countermeasures involved in facing the phenomena.

We wish to draw your attention that participation to this survey is based on your voluntary and anonymous participation and that information will hence be treated as confidential.

A stamped self-addressed envelopes is provided. If you do decide to be volunteer to this survey, may we kindly ask you to return your questionnaire as soon as you can.

If you would like to contact the laboratory for any information or questions on this survey, please use the following e-mail address: laa@biomedicale.univ-paris5.fr

1. Structure & contents : 5 parts

- Demographic information: age, gender, flying experience, function (captain or co-pilot),
- Flight category performed over the 12 last months and duty time for the last 7 days (questions 1 to 5)
- Causes of fatigue (questions 6 to 8)
- Manifestation of fatigue (questions 9 and 10)
- Strategies to cope with fatigue (question 11)

2. Please read this questionnaire attentively in order to ensure a clear and unambiguous response.

3. Since the questionnaire is anonymous and strictly personal, we ask you to reply as frankly as possible.

Thank you very much to participate in this project. Information collected from the replies will without any doubt contribute to future evolutions with regard to fatigue in aviation.

- Date:............/............/............
- Sex: F ☐ M ☐
- Age:.....................................
- Nationality:.....................................
- Airline name:...
- On which type of aircraft are you qualified at present ?

  ....

  Since how long ?:...

- Current function:

  Captain ☐ Copilot ☐ Flight Engineer ☐

  For how long ?: ....

- Travelling time from residence to work:...
- Beside working as a pilot, do you have any other activity?

  Management position in your company?

  Yes ☐ No ☐

  If yes, indicate number of hours devoted per month: ....

  Any other activity?

  Yes ☐ No ☐

  If yes, indicate:

  - the nature:...
  - number of hours devoted per month: ....

Question 1. Based on the flight categories showed in the following table, indicate the approximate percentage of flights that you have performed over the last 12 months :

Flight categories	**Percentage of flights you performed over the last 12 months**
Short-haul flights (< 2 flight hours):	.........................%
Medium-haul flights (between 2 and 6 flight hours):	.........................%
Long-haul flights (>6 flight hours):	.........................%
	100 %

Question 2. indicate the approximate percentage of flights that you have performed over the last 12 months for the following flight categories :

Flight categories	**Percentage of flights you performed over the last 12 months**
Non-scheduled/Charter flights:	.........................%
Cargo flights:	.........................%
Night mail flights:	.........................%
	100 %

Question 3. Indicate the number of duty hours you performed over the last 7 day period :

Question 4. Indicate for the past 7 days (**D**), the share performed between midnight and 0600 (home time) :

Question 5. Regarding your duty time over the last 7 days, indicate your level of fatigue *(draw a mark on the line between the appropriate adjectives, in accordance with your sensation).*

In good shape |————————————————| Very tired

Question 6. Which of your usual schedules make you feel tired? (open question)

Question 7. During climb and descent, to what extent do the following situations make you tired?
To answer, please tick the corresponding box

	Impact on fatigue				
	None	small	medium	high	very high
Significant workload	☐	☐	☐	☐	☐
Executing actions in a limited amount of time	☐	☐	☐	☐	☐
Simultaneous actions	☐	☐	☐	☐	☐
Interruption during activities by ATC, PNC	☐	☐	☐	☐	☐
Problem of coordination with the other cockpit crew-member	☐	☐	☐	☐	☐
Density of verbal exchanges	☐	☐	☐	☐	☐
Communicating in foreign language	☐	☐	☐	☐	☐
Lack of sleep	☐	☐	☐	☐	☐

Question 8. In general, what is the impact of the following events on your level of fatigue? *To answer, please tick the corresponding box*

	Impact on fatigue				
	None	small	medium	high	very high
Flight delay	☐	☐	☐	☐	☐
Difficult flight	☐	☐	☐	☐	☐
Dissension within crew-members	☐	☐	☐	☐	☐
Necessity of performing additional leg not planned originally	☐	☐	☐	☐	☐
Compliance with time constraints	☐	☐	☐	☐	☐

Question 9. During the flight, what are the symptoms of fatigue for you and for the other crewmembers? (open question)

For you :

For the other crewmember

Question 10. When you get tired, to what extent are the following flying tasks affected by fatigue. *(draw a mark on the line between the appropriate adjectives, in accordance with your feeling).*

	less difficult than usual	As usual	more difficult than usual
Monitoring			
Flight path monitoring			
Manual flying			
Utilization of aircraft automation			
Communication			
Crew resources management			
Check-list			
Briefing			
Monitoring supervisory activities			
Selecting and entering data			
Writing official reports			

Question 11. What are your strategies to cope with fatigue before and after an exhausting roster, during flight and during layover? (open question).

Before the roster

During flight

During layover

After the roster