CRANFIELD UNIVERSITY

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ASPECTS OF A EUROPEAN AIRLINE PILOT COMMUTE

SCHOOL OF AEROSPACE, TRANSPORT AND MANUFACTURING
Safety and Accident Investigation Centre

MSc
Academic Year: 2014–2015

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This thesis is submitted in partial fulfilment of the requirements for the degree of Master of Science.

ABSTRACT

In the highly regulated aviation industry, the means by which airline pilots commute to work is one of its most unknown practices. Given that commutes, both before and after flight duty, can be time-consuming and stressful, this aspect of the aviation industry could impact negatively on aviation safety.

This study highlights various aspects of commute situations for European airline pilots. It investigates various issues, including the frequency of pilot commutes, motivations of pilot commutes, the reduction of work commitments in connection with pilot commutes and the stress levels generated by commutes from a pilot's place of residence to home base. These findings are derived from a comprehensive survey.

The study reveals that pilot commuting is an industry standard and more than half of the European airline pilots' surveyed experienced problems, like delays or flight cancelations on their way to work. Commuting causes stress and pilots compensate in various ways to integrate the burden of commuting into their lives. It appears that in managing the commuting issue, the majority of compensatory acts occur at a micro/individual pilot-level and only a few acts are visible at the macro/industry-level.

Keywords:

Pilot commuting, Europe, intermediate housing, commuting benefits, home base

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My strong commitment to the Masters of Science programme was informed in no small part by my father's dedication to, and support of, my aviation career. I am happy that before leaving this world he was able to see the early results of his investment. He left me with the wind from his sails, which continues to be a great source of inspiration. His sincerity, philanthropy and tolerance will always be part of me.

I recognise that a person is only as good as the people around him and I am grateful for the support of my beloved wife, Nicole, and the advice of my mother.

Thanks to Angela Schoibl from Salzburg University for her statistical lecturing and insights into SPSS.

I would also like to thank the great team at the Accident Investigation Centre of Cranfield University for this very interesting academic study. I would especially like to mention Professor Graham Braithwaite and Dr Matthew Greaves, my thesis supervisor, who both made the Masters of Science programme a pleasure to participate in and an outstanding professional experience.

This thesis respects both genders. However, to avoid the laborious use of addressing both genders the term “the pilot” or masculine terms have been used and should be read as referring to both males and females. The author appreciates the understanding of his female readers.

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LIST OF ABBREVIATIONS

AC	Advisory Circulars (ACs) - Federal Aviation Administration
ACA	Austrian Cockpit Association
ALPA	Airline Pilot Associations
EASA	European Aviation Safety Agency
ECA	European Cockpit Association
FAA	Federal Aviation Administration
FRMS	Fatigue Risk Management System
ICAO	International Civil Aviation Organisation
NTSB	National Transportation Safety Board
ONS	Office for National Statistics

1 INTRODUCTION

Commuting to and from home bases is an issue in the careers of most pilots. Changing economic situations, route networks and aircraft types can fundamentally alter a pilot's working situation from one day to the next.

Personally, commuting has been an issue for me since I first became an airline pilot. The question of commuting to home base first arose the day after I signed my work contract and since then, I have had to constantly consider how to commute from my place of residence to my designated crew base. Indeed, commuting continues to be an issue for me today.

Changes to the aviation industry fail to reflect the fact that many crew members and airline pilots experience commuting issues that adversely impact their situation at work and their life overall. Life developments, including graduation, marriage, the birth of a child, divorce, the cost of housing and the decision to purchase property, impact significantly on a pilot´s life and his commuting habits. My interest in these issues formed the basis for which the hypothesis of this thesis was derived. Specifically, this thesis investigates commuting issues and the commuting habits of European airline pilots.

Shortly after commencing the literature review on pilot commuting, it became evident that, overall, very little is known in respect of pilots' commuting situations and their travel from home base to place of residence. Indeed, in many regards uncertainty prevails in relation to the type, mode and duration of the commutes of pilots. Further, little research had been conducted in relation to how challenging such commutes are for pilots. Still less is known about how commuting influences an individual pilot's decision-making processes and the circumstances that surround and influence a pilot's commuting process.

Presently, it appears that pilot commuting and, specifically, how an airline pilot commutes to and from his designated home base, has not been addressed by any scientific studies. Nor is pilot commuting governed by any regulations. It is important to note that this thesis is not a fatigue study. Nor is the issue of pilot fatigue addressed in this thesis. Rather, this study aims to look at various pilot commuting issues and the stress that such commutes to home base have on pilots.

This thesis will provide an overview of the current studies conducted in relation to commuting and the theories relating to pilot commuting. It will also consider the relationship between commuting and stress. The thesis will then outline the empirical research conducted by the author and the statistical outcomes of this research. Next, the results and implications of the study will be discussed. Finally, conclusions will be drawn and consideration given to possible future research.

Pilots are constantly required to make the "right" decisions in an operational environment where they are actively handling an aircraft in flight and have a primary interest in safety. However, to meet their personal obligations to families and friends, European pilots also have their own personal commuting interests to consider. An examination of such commuting processes and issues, as outlined by the hypothesis of this study, is the purpose and objective of this thesis. To "clear the clouds" on the European pilot commuting situation, this study aims to paint an unbiased picture, based on empirical research, about issues surrounding the commute of European airline pilots.

1.1 Hypothesis and Research Questions

The author conducted a survey entitled "European Airline Pilot Commute Study", which will be referred to as "the study" throughout this thesis. The study targeted airline pilots living in Europe or working for a European operator. The relationship between commuting and stress became evident during the literature review and before the "European Airline Pilot Commute Study" was developed. Indeed, research shows that some scientific studies have already specifically considered this topic (Koslowsky, 1997; Stutzer and Frey, 2004). In relation to commuting, adjacent to the issue of stress, the issues of personal wellbeing and life satisfaction have also been explored extensively by various studies (Stutzer and Frey 2008; Novaco and Gonzalez, 2009; Humphreys, Goodman and Ogilvie, 2013) as well as the issues of gender differences (Roberts, Hodgson and Dolan, 2011) and having children (Sandow, 2008).

On the basis of these recent commuting and stress/wellbeing studies and taking into consideration the overall airline pilot situation, the author`s hypotheses are as follows:

- Pilots with dependent children commute more often for social family needs (Hypothesis I);
- Commuting pilots reduce working hours to accommodate private commuting (Hypothesis II); and
- Commuting pilots experience more stress due to their commute (Hypothesis III).

Empirical survey data and statistical analyses from the European Airline Pilot Commute Study and current scientific literature will be used to address these hypotheses.

1.2 Thesis Structure

Adopting a progressive approach, this thesis will commence with a literature review that considers studies on commuting and stress in the general population across a variety of occupations. It will then specifically consider the occupation of airline pilots in relation to commuting and stress. The main body of the thesis will be dedicated to the research methodology and statistical analysis of the three stated hypotheses and a discussion of the findings in relation to the hypotheses. Finally, this thesis will close by drawing conclusions and making recommendations for future research.

2 LITERATURE REVIEW

2.1 Commuting

2.1.1 Finding a definition

Commute has been defined as: “to travel regularly to and from a place and especially between where you live and where you work“(Merriam-Webster, 2014). This definition contains two essential parts: the place where “you” work and the place where “you” live. Throughout this thesis, the place “where you live” will be referred to as “residence” or “place of residency” and the place “where you work” will be referred to as “home base“ and will encompass any place at which pilots work. In a fatigue study conducted by the United States National Research Council, the word “domicile” was used instead of “home base”; any reference to “domicile” in this thesis should also be considered as a reference to “home base”.

An additional characteristic of “commute” is that it is conducted in an individual’s personal time; that is, it is time off work and work duties. Thus, despite being directly connected to work, commuting is, in fact, part of an individual’s leisure time. Indeed, in the aviation pilot context, the United States National Research Council emphasises that “commuting is one of many activities that usually takes place during a pilot´s off-duty time” (National Research Council, 2011, p. 3)

2.1.2 A pilot commute

Pilot commuting has been described as “the period of time and the activity required of pilots from leaving home to arriving at the domicile (airport—in the crew room, dispatch room, or designated location at the airport) and from leaving the domicile to returning back to home” (National Research Council, 2011, p. 17). It has also been stated that pilot commuting “differs from the commuting of other workers in terms of frequency and variability, distance, transport modes, and time of day” (National Research Council, 2011, p. 17).

Another variable in pilot commuting includes when pilots are “reassigned to different domiciles with seasonal or economic fluctuations”. Further, in comparison to the general commuting population, “a pilot must consider many things in order to arrive fit for duty such

as time of day and time zone at start of duty, availability of seats on commuting flights, affordability and availability of sleep facilities, airline policies, and possible delays" (National Research Council, 2011, p. 18). A variety of possible variables have been identified as affecting pilot commutes (see Figure 2.1, which details a sample pilot commute and possible variables affecting such commutes).

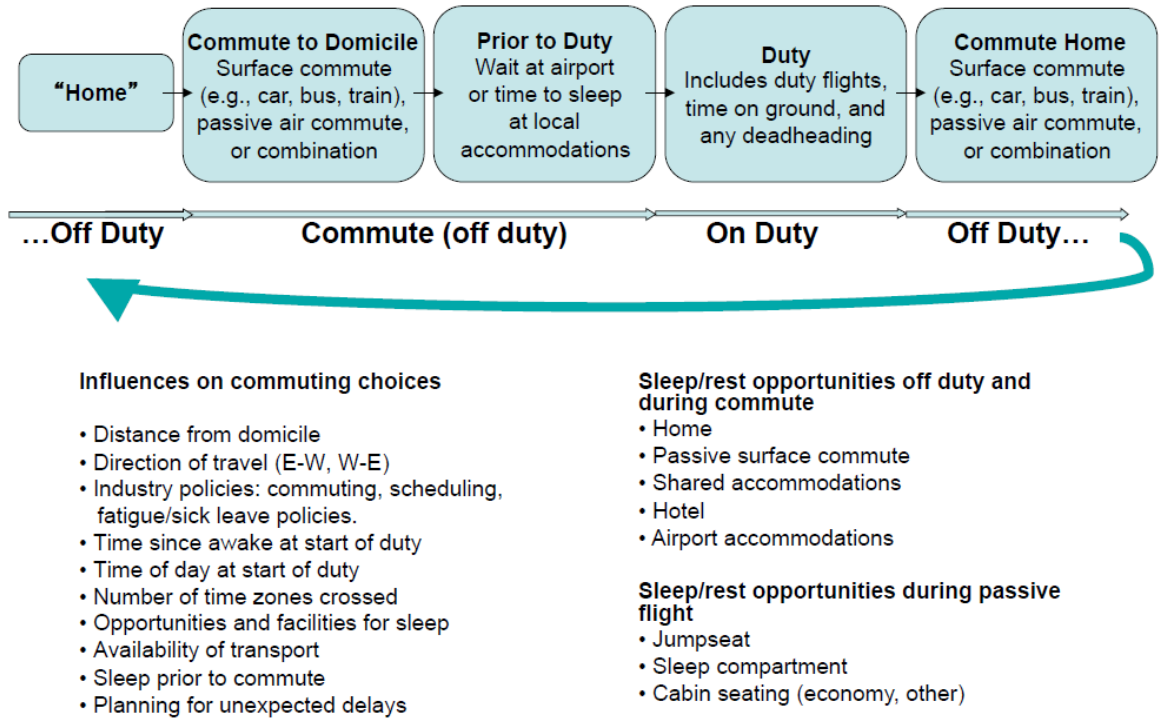


Figure 2.1 - Sample Pilot Commute

(Source: National Research Council, 2011)

"NOTE: The figure maps a pilot's commuting and duty cycle along a timeline of variable start time and duration, noting the opportunities for rest and sleep and the many influences on commuting. Commuting can be active (driving oneself) or passive (allowing opportunities for rest or sleep). Deadheading (which involves passive traveling by air while on duty) counts toward work time and is not part of commuting." (National Research Council, 2011, p.18)

2.1.3 Commuter/home base commuter

For this study, and in the context of empirical analysis of the pilot commuting survey conducted by the author, the definitions of “commuter” or “home base commuter”, in normal travel flow periods and disregarding the mode of transport used, are as follows:

- Commuter: A pilot who lives outside a travel time distance radius of 45 minutes one-way travel time from place of residence to home base.
- Home base commuter: A pilot that lives within a travel time distance radius of 45 minutes one-way travel time from the place of residence to home base.

As there is no pilot-specific commuting study based on empirical analysis available in Europe in relation to commuting time and modes of transport, the author set the threshold for this study on the basis of the average daily commuting time one-way of 23 minutes and “a total of 46 minutes a day” (Stutzer and Frey, 2007, p. 4) and adjusted it to the value of 45 minutes for a one-way commute.

45 minutes one-way commuting time takes into account the special work place of an airline pilot for this study. An airport is seldom close to a central business district and away from normal commuting streams. 45 minutes one-way commuting time is set as the dividing line for commuters and home base commuter.

The British aviation safety agency defines pilot commuting as being more than 1.5 hours travel time to work. In contrast, the FAA advisory circular, on Fitness for Duty, AC-120 FIT, sets a 2-hour threshold for pilot commuting times (Federal Aviation Administration, 2010c; U.S. Department of Transportation, 2010b) (National Research Council, 2011, p.18). Further the National Research Council comments on these values and sees “these dividing lines are arbitrary” (2011, p.19), indicating that there is an uncertainty among official institutions about pilot commuting times.

2.1.4 General population commuting studies

The majority of studies conducted to date have focussed on investigating and discussing the daily commute (Stutzer and Frey, 2007; Guell, Panter, Jones, and Ogilvie, 2012; Novaco and Gonzalez, 2009; Gutiérrez-i-Puigarnau and Van Ommeren, 2013; Rouwendal and Nijkamp, 2004, Sandow, 2008, Van Ommeren and Fosgerau, 2009; Koslowsky 1997; Humphreys et al., 2013; Páez and Whalen, 2010; Roberts et al., 2010). In relation to the commuting variables of mode of transport, commuting distances and commuting time, these studies have considered the following:

- Urban Economical Theory;
- Commuting paradox – stress/compensation;
- Income;
- Gender issues;
- Dependent Children and predominant household care;
- Wellbeing and life satisfaction;
- Cost of commuting; and
- Value of time.

These are summarised in Table 2.1.

Table 2.1 - Studies in relation to Different Aspects of Commuting

AUTHOR(S)	YEAR	SCIENTIFIC ASPECTS OF COMMUTING	DATA SOURCE
Office for National Statistics	2014	Wellbeing	Customised weighted 12 month APS micro-data set
Stutzer and Frey	2007	Life satisfaction	German Socio-Economic Panel (GSOEP), 14-year period
National Academies Press	2011	Pilot fatigue	National Research Council, home to domicile distances
Guell et al.	2012	Active travel behaviour	Cambridge Area Census, 2001
Novaco and Gonzalez	2009	Wellbeing	General
Stutzer and Frey	2008	Economic model: Wellbeing	GSOEP
Gutiérrez-i-Puigarnau and van Ommeren	2013	Economic theory: Household income – commuting distances	GSOEP
Rouwendal and Nijkamp	2004	Economic theory: Value of time	General
Sandow	2008	Gender/children	Northern Sweden labour market
Van Ommeren and Fosgerau	2009	Cost of Commuting	Dutch labour supply panel survey (OSA), 1999–2001
Koslowsky	1997	Stress	General
Humphreys et al.	2013	Active commuting and wellbeing	Commuting and Health Study Cambridge, 2010
Páez and Whalen	2010	Transportation modes	McMaster University Survey, 2008
Roberts et al.	2011	Gender/children	British Household Panel Survey (BHPS), 1991–2004
Van der Klis and Karsten	2009	Dual residence	General
Green et al.	1999	Long-distance commuting, dual residence	General

2.1.5 The duration of a commute

Compared to the general public commute situation, the airline pilot commute situation is unique; for example, the lowest average daily commute time in Europe, for a the general public commute was reported as being 29.2 minutes per day in Portugal, while the highest average daily commute time was reported as being 51.2 minutes per day in Hungary (Stutzer and Frey, 2007, p. 2). On average, the daily commuting time was reported as being 23 minutes one-way, with "a total of 46 minutes a day" (Stutzer and Frey, 2007, p. 4) for the general public. Numbers about the European airline pilot commute are not available at this time.

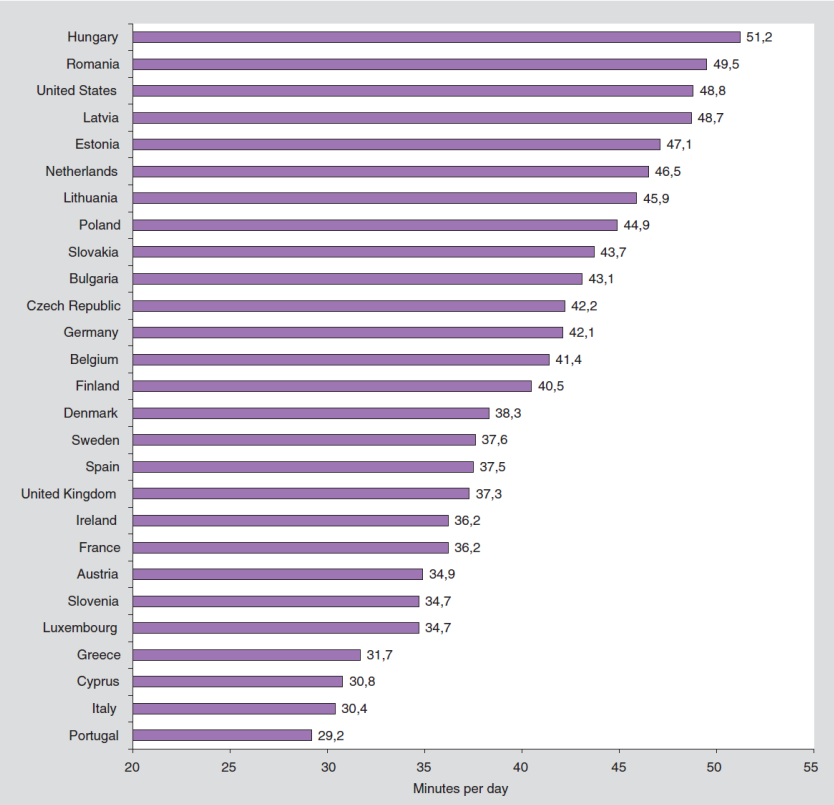


Figure 2.2 - Average Daily Commuting Times in Europe and the United States

(Source: Stutzer and Frey, 2007)

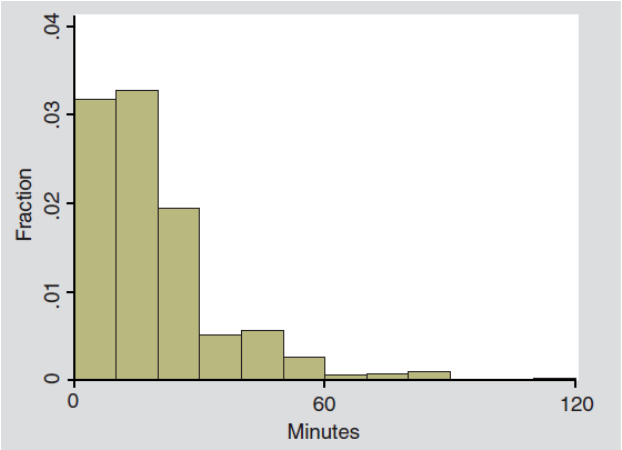


Figure 2.3 - Average Daily Commuting Time

(Source: Stutzer and Frey, 2007)

NB: There is a typographical error in the original graph - on the fraction scale, the correct values should read 0.1, 0.2, 0.3 and 0.4.

2.1.6 Residence: central business district commuting and residence – airport commuting

When comparing general commuting times to airline commuting times, the studies conducted to date have one significant shortfall; that is, they consider the journey from residence to "central business district" (CBD) as the basis to predict the time for the commute and the related modes of transport, price of transport and stress experienced (Rouwendal and Nijkamp, 2004, p. 289). In general population commutes such variables are quite heterogeneous. Accordingly, it is interesting that presently no occupational specific commute studies have been conducted to better understand heterogeneous variables and discover more homogeneous occupation-specific answers.

No occupation-connected commuting studies had been undertaken at the time this thesis was written (i.e., 2014). Thus, the author refers to the studies available and outlines the shortcomings and differences of these studies in relation to the specific commuting issues experienced by pilots. As the National Research Council pointed out in its study entitled "The Effects of Commuting on Pilot Fatigue" (2011) there is "no comprehensive data on the

frequency of pilot commuting, the lengths of commutes, or such trip characteristics as the transportation modes used in commuting" available.

Currently, general commuting research has considered economic commuting theory, planning commuting streams, modes of transport, the areas of urbanisation and suburbanisation, optimising commuting time and psychological commuting research (which investigates commuting stress, wellbeing and life satisfaction in relation to commuting and gender differences, children and other household influences on commuting).

2.1.7 Long-distance commuting: intermediate resting facilities

Green, Hogarth and Shackelton (1999) conducted a study on long-distance commuting and addressed the issue of weekly commutes and "second" and "semi-permanent" homes (p. 61). Such second and semi-permanent homes are also prevalent in the aviation industry. Additionally, some commuting pilots also use intermediate housing facilities (known as "crash pads") to rest when they finish work at an assigned home base that is not proximate to their place of residency (National Research Council, 2011, p. 130).

Van der Klis and Karsten (2009) expand the dual household approach further and stated that the "traditional daily commute of the commuting partner is … replaced by a (bi)weekly long, and sometimes international, commute between the communal residence and the work location, in combination with a short daily trip between the workplace and a residence near this workplace" (2009, p. 235), which is often the case in the airline pilot situation using an intermediate housing facility.

An increase in "dual career households" as a result of equal sex occupational opportunities was found to lead to an increase in long-distance weekly commuting lifestyles, which were found to positively influence on socio-economic wellbeing (Green et al., 1999, p. 51).

The interaction of career progression, or job availability at certain locations, typically in relation to highly-skilled individuals, and "geographical fixity"- as an unwillingness to move the household- in relation to overall economic stability issues, showed a trend in dual career households and, additionally, dual residence households (Green et al., 1999).

"Geographical fixity", as an attribute for the basis of the family home, tends to show that "dual career households display a strong residential preference for accessible semi-rural areas with good communications links" (Green et al., 1999, p. 52). It was also found that "there is some evidence that residential locations are sought … to maximise commuting potential and to minimise the need for future residential migration" (Green et al., 1999, p. 52). Influencing factors for the emergence of dual location households are depicted in Figure 2.4 below.

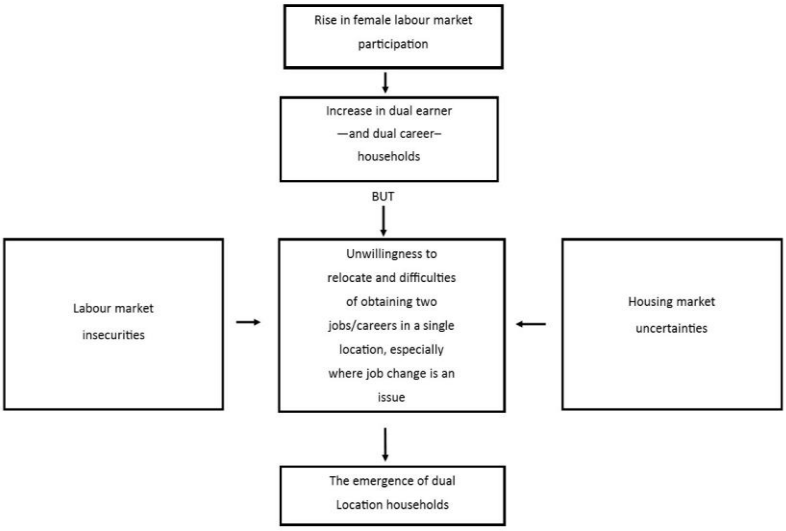


Figure 2.4 - Long-Distance Weekly Commuting and the Emergence of Dual Location Households

(Source: Green et al, 1999)

Such intermediate housing facilities may "vary from a private bedroom regularly assigned and available to the pilot to a shared room with multiple bunk beds in which the pilot takes a

'hot bunk' open for the night. Thus, shared accommodation can achieve the ideal of a quiet, dark, temperature-controlled sleeping area, or they can fall well short of the ideal" (National Research Council, 2011, p. 41). However, due to special variables in the occupation of pilots; for example duty schedule, home base selection and commercial changes, an intermediate housing facility is seldom a long-term investment.

2.1.8 Urban economic theory

Urban economic models provide "a causal relationship between household income and commuting distance, because the endogenously chosen location of the residence depends on income" (Gutiérrez-i-Puigarnau and Van Ommeren, 2013, p. 6). The development of dual career and dual households mean that families, commuting practises and residential location decisions have become an additional aspect of modern commuting and the economic decision-making process (Green et al., 1999).

2.1.9 Income

It appears that the development of highly-skilled individuals in the marketplace (see Green et al., 1999) coincides with the finding "that rich households tend to move farther away from the workplace" (Gutiérrez-i-Puigarnau and Van Ommeren, 2013, p. 17). Further, "travel times have increased much less than journey-to-work distances" (Green et al., 1999, p. 55) due to the utilisation of faster modes of transport and better designed transport systems.

Generally, "the home is viewed as a socio-spatial system that represents the fusion of the physical unit, or house, and the social unit, or household. The home is regarded as a fundamental base from which people's daily lives commence" (Van der Klis and Karsten, 2009, p. 235). Moving home might result in positive aspects for the commuter, but have negative consequences for the whole social-economical family system. Decisions not to move may be informed by a "household perspective [that] there may be positive benefits from staying rather than moving" (Green et al., 1999, p. 52).

2.1.10 Gender issues/dependent children/predominant household care

Roberts et al., (2011, p. 1066) considered gender in the commuting paradigm and found that "individuals may also commute for the good of the household i.e. they bear the cost to their

own psychological well-being because the compensation of a higher income or better housing accrues to their partner and/or their children." Roberts et al., (2011) have proven that in terms of commuting time, women tend to commute less than men and stated that these results "suggest that it is women's greater responsibility for day to-day household tasks (including childcare and housework) that makes them more sensitive to time spent commuting" (Roberts et al., 2011, p. 1074). This is also supported by "the fact that the largest adverse effects are found for women who have pre-school age children (a small effect is also found for men with young children), whereas neither women nor men are affected by commuting if they are single with no children (in this group presumably men and women face similar day-to-day household tasks), if they have flexible working hours (which will allow them to more easily manage the competing demands on their time) and if their partner provides the most childcare" (Roberts et al., 2011, p. 1074).

It would be a shallow approach to recommend moving of residence, if all the connecting and affected variables; for example, family, social bonds, church and community, were neglected in the equation.

2.1.11 Commuting paradox – stress/compensation

Stutzer and Frey (2008, p. 3) found that "people with long journeys to and from work are systematically worse off and report significantly lower subjective well-being. For economists, this result on commuting is paradoxical." Different compensation models, including household-level compensation, were investigated in this study and Stutzer and Frey concluded that: "for many people, commuting seems to be a stress that doesn't pay off." (2004, p. 22). It is important to note, however, that this study and, indeed, the majority of commuting studies, only consider daily commuting and do not consider weekly or other irregular commuting practices.

With this in mind, reflecting on the study of Green et al., (1999) it is possible that compensation levels for long-distance weekly commuting might well be achieved at a household level given that significantly lower stress is experienced (compared to daily commuting), by developing "a route to maintaining household income, in order that the commuter's family [can] live as they [have] become accustomed" (1999, p. 60)

Positive factors reported by weekly commuters, who make use of the divide of space and time, include being able to work long hours and concentrate better on the work and the acquisition of expandable weekends due to their having time to concentrate during the week (Green et al., 1999). Indeed, the commute from home base to residence is often seen as a chance to bridge the spatial divide and provides a transition period from work time to home time (Green et al., 1999)

However, commuting need not always be viewed a disutility. Páez and Whalen undertook a study with university students and found that "utility for travel has three components: the utility for the activity at the destination, the utility for activities that can be conducted while traveling and the enjoyment of the act of travel itself" (2010, p. 538). Given that, a weekly commuter may be positively looking forward to travelling to his residence and meeting with family and friends, the first component of weekly commuting can be considered to be positive. Further, utilising the travel time actively; for example to read a book, make phone calls or socialise with other passengers and engage in other positive behaviours, will positively affect the travel experience and, thus lower the stress exposure (Páez and Whalen, 2010).

To a large degree the subjective experience of stress depends on having "control over the travel" (Páez and Whalen, 2010, p. 538). Waiting times, flight cancellations, weather delays, technical breakdown of aircraft and queuing at busy airport counters are outcomes of a pilot commute that could be adding unnecessary stress to a pilot's commute.

2.1.12 Wellbeing, life satisfaction and the mode of commuting

A recent study published by the Office for National Statistics (ONS) (2014) considered the compensation model and wellbeing aspects of commuting with different variables, including time and mode. It also compared commuters with non-commuters. One of the key results of this study was its finding that "holding all else equal, commuters have lower life satisfaction, a lower sense that their daily activities are worthwhile, lower levels of happiness and higher anxiety on average than non-commuters" (ONS, 2014, p. 1)

Interestingly, the ONS study sheds an interesting light on commuting with its finding that: “When commuting time reaches three hours or more, the negative effects on personal well-being disappear, suggesting that the small minority of people with this commuting pattern have quite different experiences to most other commuters” (ONS, 2014, p. 2). Similarly, Green et al., (1999) described a similar phenomenon in relation to long-distance commutes. This finding is also relevant to the commutes of pilots, as this different experience could suggest an impact in commuting experiences based on the mode of travel. Indeed, as suggested by the ONS (2014) study, one might hypothesise that the mode of transport, particularly in relation to aircraft travel, significantly influences commuting experiences and the sense of wellbeing of commuters.

“Only one form of commuting beyond 15 minutes was associated with increased personal well-being and that was “travelling by another method”. Given that information about the specific form of travel was not collected, it is unclear what this entails. It could, for example, include people travelling to work by plane, helicopter or boat. People who said that they “travelled by another method” had significantly higher life satisfaction than those travelling only 15 minutes or less to work and none of the other measures of personal wellbeing were affected by their commute, either positively or negatively. About half (51 per cent) of those who responded in this way also said that their journey to work took three hours or more” (ONS, 2014, p. 14).

Key to the analysis is a consideration of the mode of transport, such that heightened commuting experiences may have a positive correlation on life satisfaction.

This ONS (2014) statement suggests a possible comparison about heightened commuting experiences could be drawn in relation to pilot commute situations in respect of mode and distance/time of commute; however, the ONS (2014) study did not specifically look at the occupational aspects of commuting and, thus, the facts are left open to a wide range of interpretations.

2.1.13 Value of time

Bearing this in mind and reflecting on positive commuting behaviours, Roberts et al., (2011) found a correlation between gender differences and commuting. Rouwendal and Nijkamp (2004, p. 288) also consistently found "that female workers have a higher value of time than would be expected on the basis of their income [and] some studies have found very low figures for the value of time, and it has recently been argued that the actual value of commuting time may well be positive in a number of cases."

Thus, commuting, and the value of time of commutes, can be viewed as a positive transfer between the residence and home base (Green et al., 1999; ONS, 2014; Páez and Whalen, 2010). "For many people, commuting is not as burdensome as one would be inclined to think on the basis of analyses that stress the resistance against traveling as the shaping force of the spatial organisation of metropolitan areas. The commuting trip may instead be viewed as the time during which one is free from the duties from work of family." (Rouwendal and Nijkamp, 2004, p. 299)

2.1.14 Cost of commuting

One aspect that does not distinguish between a daily, a weekly or an infrequent commuting style is the cost of commuting. Of course, the frequency of commuting has an important influence on direct costs, but pecuniary costs, social costs and time costs also need to be accounted for. Given that "we know surprisingly little about the size of these commuting costs" (Van Ommeren and Fosgerau, 2009, p. 38), further research into these costs is warranted.

The cost equation is difficult to understand. Indeed, generally, such costs are difficult to determine due to multiple variations in relation to the value of time, differences in speed of travel and possible subsidies; for example, tax exemptions and refunds. Further, factors such as preferred carriage and reduced or free airline pilot commuting tickets make it difficult to determine and calculate the true cost of commuting. Notably, a special benefit received by airline pilots it is that, when an airline is part of an interline agreement of airlines, their commuting or air fares are offered at significantly reduced rates. Such factors, also do not take into account the mental stress factors commuting can impose and the subsequent

medical costs that arise out of such mental stress. Thus, no clear price tag can be put on a commuting at this time. However, it is evident that current economic commuting theories have significant deficiencies in their holistic views on commuting.

2.2 Stress

2.2.1 Finding a definition

Stress has been defined as:

- a state of mental tension and worry caused by problems in your life, work, etc;
- something that causes strong feelings of worry or anxiety; and
- a physical force or pressure (see Merriam-Webster, 2014).

Being a pilot is widely seen as a quite stressful job. Indeed, pilots face a variety of challenges, including weather, scheduling difficulties, aircraft rotations, unforeseen maintenance problems, crew rotations, sleeping away from home and diversions in flight, and this is just to list a few variables that face pilots in their operational decision-making processes on a day-to-day basis. In recent years, economic issues like mergers, base closures, furloughs and the bankruptcy of various operators have added another interesting facet to an industry that is highly dependent on the safety of the operation. Homan (2002, p. 15) has stated: “Challenging approaches, systems malfunctions, medical emergencies, and even hijackings can all turn an otherwise routine flight into a complete nightmare. Add organisational pressures like on-time arrivals, frustrating delays, company mergers, furloughs, and bankruptcies, and you begin to realise how stressful the airline environment really is.”

Are pilots more resistant to stress or better able to cope with all the stressors that approach them constantly in their day-to-day work? The current literature on pilot stress and coping with stress, especially in connection to commuting, is indistinct. For the purpose of this discussion and thesis, Homan’s view of Miller and Smith’s (1993) definition of stress has been adopted; that is, "Stress is the state of dynamic tension created when you respond to perceived demands and pressures from outside and from within yourself."

2.2.2 Physical and emotional stress

In aviation medicine and physiology, stress has been subdivided into two forms (Sloan and Cooper, 1986; Jeeva and Chandra Mohan, 2008); that is:

- Physical Stress; and
- Emotional Stress, which includes:
    - Cognitive Stress
    - Affective Stress.

Physical stress is a purely physical response to one's body perceptions; for example, responses to "extremes of heat and cold, vibrations, oxygen deficiency, etc" (Sloan and Cooper, 1986, p. 16). Whereas, emotional stress, "as an issue in flying, has found … general acceptance" (Sloan and Cooper 1986, p. 17), is seen as arising from a pilots' personality and has been subdivided into cognitive stress and affective stress.

In relation to pilots, cognitive stress has been "defined objectively as the nature of the task presented to the operator, excessive cockpit workload being one of its most frequent forms" (Sloan and Cooper 1986, p. 17). Comparatively, affective stress is "subjective in nature", affects "within seconds of its onset and can bring" the pilot to a complete standstill of action in the cockpit, also known as "freezing at the controls" (Jeeva and Chandra Mohan, 2008, pp. 60– 61).

Sloan and Cooper (1986) have stated that affective stress is the most dangerous type of stress as it is both cumulative and additive and might result from a combination of various forms of individually sources of stress which can normally be coped with, such as sleep deprivation, home stress and other forms of occupational stress, and can add up to a dangerous combination of affective stress outcomes.

2.2.3 Life events

Similarly, “life events” are also considered as a stress additive to pilots lives (Sloan and Cooper, 1986, p. 23). Examples of life events, include divorce, marriage, birth of a child or, in relation to pilot commutes, change of residence. Table 2.2., based on research of Holmes and Rahe (1967), outlines life events ranked in order of significance.

Table 2.2 - Holmes and Rahe: Most Significant Life Events

(Source: Holmes and Rahe, 1967)

Life Event	Rank
Death of spouse	1
Divorce	2
Marital separation	3
Jail term	4
Death of close family member	5
Personal injury or illness	6
Marriage	7
Fired at work	8
Marital reconciliation	9
Retirement	10

Life events are considered to add significantly to a pilot’s emotional stress experience and increase the likelihood for aviation accidents and incidents (Alkov, Gaynor and Borowsky, 1985; Sloan and Cooper, 1986). Sloan and Cooper (1986, p. 24) further stated that: “pilots should be classified as a high-risk group when it comes to the amount of life changes that they are subject to on a routine basis” and that, on balance, life events are influential in accident and incident causation (p. 117).

Based on the research to date, it can be concluded that in addition to the daily stress and stressors that every normal human being is exposed to and which present as physical stress, it is essential in the aviation environment to anticipate and control physical stressors in pilots’ environments. Even if only a relatively small environmental issue impaired an aviation safety system; for example, cockpit temperature control, a small change in temperature in the cockpit could be the one stressor that contributes adversely to the conduct of the operation.

Additionally, discussions in recent years have also turned to operational pressures and duty/rest times, putting increased pressures on cockpit checks. Financial restructuring, leading to cuts in on-duty meals and breakfast cuts for cockpit crews, have also been seen as endangering the physical needs of flight crews.

Indeed, small changes in crew rotations and schedules can lead to extensive impacts on crew rest and sleep quality (Bennett, 2011). Similarly, savings in relation to crew accommodation and shifting crews to cheaper hotels has often adversely been connected to sleep quality and rest and has resulted in increased sick leave for operators (Bennett, 2011).

2.2.4 Stress and performance

Interestingly, pilots are very often recalcitrant when it comes to their own personal health and in allowing tests and the possible results of illness or mental or physical complaints to become known. Passing medical examinations is one of many legal requirements, and a requisite to being able to act as a crewmember. Accordingly, such medical examinations are another source of pressure to pilots (Young, 2008)

Managing these variations of "life stress", or as Young defines them, "physical and psychological symptoms (e.g., muscle tension, worry or preoccupation, disrupted sleep/fatigue, change in appetite, or alterations in social interactions such as withdrawal, irritability, or difficulty concentrating) … are often a product of difficult life circumstances" (2008, p. 1). The Yerkes-Dodson Model is a good visual presentation of the stress/performance level outcome.

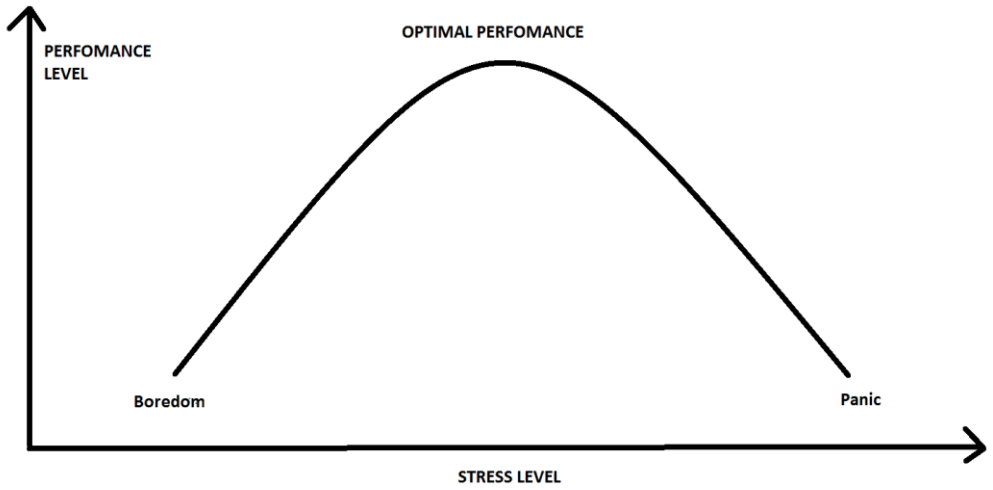


Figure 2.5 - Yerkes-Dodson Model

(Source: Homan, 2002)

However, Homan (2002, p. 15) has stated: “In fact, stress creates the spark the body needs to boost performance. A key characteristic of stress is that it is self-imposed and it is the individual's reaction to the stressor that counts.”

At the beginning of most pilots’ careers and in the recurrent training and checking schedules (as required by the administration and company policies) pilots are frequently and repeatedly checked and assessed on their ability to cope and handle extremely stressful situations. In these demonstrated emergency situations a pilot’s resistance to stressors is tested in the field of occupational and professional subjects. Similarly, “line checks” on an actual aircraft evaluate issues for a specific flight or line of flights. Such checking routines do not take account of variables such as personal problems, commuting stress or family issues. Indeed, they only draw a picture of a moment.

The author suggests that each of us reacts to demands as appropriately as we can in each specific situation, taking into account the specifics of time, situation and exposure to “life stress” (Young, 2008, p. 1)

2.2.5 Stress imposed through commuting

As we have seen thus far, stress is a subjective cognition and differs greatly among different people (Homan, 2002). How stressful a pilot's commute to work is, is also a very subjective issue and "there is insufficient research as to whether a 90-minute car drive is more fatiguing than a 90-minute train ride or a 90-minute plane ride" (National Research Council, 2011, p. 22).

Some commute studies have shown that higher levels of stress are generated through modes of transport and factors that are not in the commuter's sphere of influence (Koslowsky, 1997; Green et al., 1999; Stutzer and Frey, 2007; ONS, 2014). A train causes more stress and, thus, results in decreased feelings of wellbeing because the passivity in riding a train as a passenger is less interactive than driving a car or riding a bike (ONS, 2014). Such results can be related back to having the option of making free choices.

A common conclusion across many studies is that unpredictability leads to stress (National Research Council, 2011, p .22). The question that then arises is how does this affect pilots?

The author speculates that in a regular airline pilot situation a pilot works on a long-term, monthly schedule, where he is able to predict and plan his commuting well ahead of time in relation to both mode and time, and the use of intermediate resting facilities.

Again, this is a unique situation and reflecting on the study of Green et al., (1999), entitled "Long Distance Commuting Dual Residence", there appears to be a possibility that pilots could positively use the travel time between home base and residence for a relaxation period.

Some operators and airlines are now taking the responsibility of providing a well-rested, unstressed pilot one step further, and allow pilots to book a jump seat well ahead of time to remove the stress of unpredictability from the commute (National Research Council, 2011). Other operators have implemented some fictive travel time before and after duty, to extend the minimum rest requirements and compensate for the travel time.

The most rigorous and most responsible step an operator could take would be to include "the time spent in commuting from the pilot's home airport to the domicile in the

calculation of duty time with respect to the limits established by the labour contract" (National Research Council, 2011, p. 22). However, different stakeholders in the aviation industry safety system, such as the pilots, the airline and the administrators, are constrained in accommodating pilots' commutes in the overall safety system.

Indeed, the aviation industry has now attempted to shift the entire responsibility of commuting to the pilots. A joint effort of all stakeholders is required to manage "predictive hazard[s]" (International Civil Aviation Organisation (ICAO), 2011, p. 8), that currently, "do not take into account the impact of workload or personal and work-related stressors" (ICAO, 2011, p. 10), including commuting, and sets commuting as a hazard, with a personal mitigation to the pilot.

A joint effort by a team of stakeholders would ensure responsibility was not left to one person and would set a standard to regulate and manage the commute and resulting stress. This view is also shared by a European Aviation Safety Agency (EASA) study that stated "that the [Fatigue Risk Management System (FRMS)] would need to take account of a wide range of factors including both the time spent commuting and the influence of the body" (EASA, 2008, p .25).

2.2.6 Coping strategies for pilots

"The typically personality of a pilot may not be an optimum one for handling emotional problems since he/she is a person who typically denies his/her emotional life and may possess inadequate strategies for coping with emotional situations" (Ursano, 1980 in Jeeva and Chandra Mohan, 2008, p. 61).

However, one of the pilot's domains of mastery is in the management of variables, such that "stress management" (Sloan and Cooper, 1986) can be broken down into individual actions and demands; enabling the stress that is evident in every pilot's job to be adequately managed. Each pilot develops sophisticated approaches to master the demands of coping with the individual life stressors so that they can perform safely and securely on an aircraft flight deck.

Sloan and Cooper (1986) were the first to look at the stress coping processes of pilots and through questionnaire and interview style study found a highly interesting underlying trend in “pilot coping strategies” (1986, p. 163). This trend is outlined in Table 2.3. The four trends in pilot coping strategies are:

- Stability of relationship and home life (46 per cent);
- Reason of logic (13.5 per cent);
- Social support (11.5 per cent); and
- Wife’s involvement (8.4 per cent).

Table 2.3 - Underlying Trends in Pilot Coping Strategies

(Source: Sloan and Cooper, 1986)

	Loadings
Trend 1 (46%): stability of relationships and home life	
Stability of relationship with wife	0.77
Home life that is smooth and stable	0.70
Home life that provides a psychological platform	0.64
Home that is a refuge	0.63
Talking to an understanding wife	0.56
Wife who is efficient in "looking after things"	0.49
Wife who modifies her own behaviours and demands to suit you	0.43
Wife who has known you through your flying career	0.36
Trend 2 (13.5%): reason and logic	
Unconsciously separating home and work	0.55
Deliberately suppressing emotion	0.55
Staying emotionally aloof or shrugging things off	0.53
Deliberately avoiding confrontation	0.52
Trend 3 (11.5%): social support	
Talking to understanding friends	-0.82
Talking to understanding colleagues	-0.71
Talking to an understanding wife	-0.34
Trend 4 (8.4%): wife's involvement	
Wife who involves herself and is interested	0.67
Home life that is geared to flying (in practical terms)	0.60
Wife who had prior knowledge of flying or who flies	0.58
Wife who has known you through your flying career	0.50

2.2.7 Stability of relationship and home life

It is significant that almost half of the pilots involved in this study (46 per cent) reflected on the importance of their relationship and home life as the main factor in their ability to coping with the stress of being a pilot. This reflects a need for a stable home and shows that it plays a "massive role" in the overall coping process (Sloan and Cooper, 1986, p. 177).

2.2.8 Reason of logic

This factor shows that to minimise stress and keep stress from flowing into different areas of their lives, pilots have a tendency to separate their business life ("flying life") from their

private home life (Sloan and Cooper, 1986). The “separation applied to the day-to-day stresses that exist both at work and home” which ought to be avoided (Sloan and Cooper, 1986, p. 166).

The long-distance commute study of Green et al., (1999) showed that the travelling and transition time between work, “semi-permanent homes” (or intermediate housing facilities) and the place of family residence is an important time in which commuters can re-adjust. Further, the “cooling off” time provided by the distance and time travel “helps in this mental change” (Sloan and Cooper, 1986, p. 167).

2.2.9 Social support

As in every occupation that requires the management of stressful situations, speaking about such problems with relatives, family members or friends is an important step in the coping mechanism.

In recent years, various organisations in highly demanding fields, such as disaster relief, have implemented a concept known as “peer group support” to assist team members to deal with the coping process after the occurrence of stressful events. Such peer group support is also applicable to a pilot’s situation and, indeed, “the relationship with one´s supervisor … seem[s] to be critical in mediating stressful experiences” (Sloan and Cooper, 1986, p. 169). Sloan and Cooper concluded that “not being able to talk to friends, not being able to talk to colleagues and not being able to talk to one´s wife will result in impaired coping with stress” (1986, p. 196).

2.2.10 Wife’s involvement

Connected to a stable relationship and home life, the involvement of a wife or any life partner is of tremendous importance to the ability of a pilot to cope and function.

Sloan and Cooper (1986) saw the weakness of this factor as being related to the stability of the relationship and a partner’s involvement in the coping mechanisms. Similarly, problems in a relationship also have the potential to generate stress.

As demonstrated by Yerkes-Dodson Model, stress is not always negative; in fact, a certain level of stress enhances our private and occupational life. Nevertheless, overwhelming stress, a combination of multiple stressors or a lack of coping mechanisms can lead to incidents and accidents in the high-risk aviation industry.

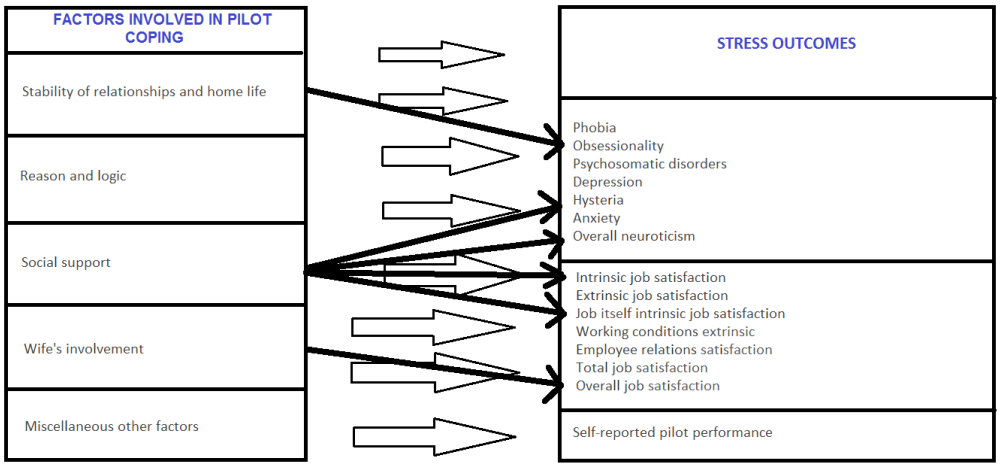


Figure 2.6 - The Relationship between Pilot Coping Strategies and Stress Outcomes

(Source: Sloan and Cooper, 1986)

An important aim for the aviation industry from a macro-level perspective is to avoid pilot stressors, even if individual pilots have developed personal micro-level, coping strategies as barriers (Reason, 1997). “Pilots as a group are motivated, goal-directed, assertive individuals” (Sloan and Cooper, 1986, p. 180). Such traits are an essential part of macro-level stress management, fatigue avoidance and management system barriers. Such micro-level experiences should be incorporated into legislative knowledge.

It is the responsibility of the aviation industry, legislature and operators not to develop a latent condition of stress in cockpit crews that imposes risks on the overall aviation safety system (Reason, 1997).

3 RESEARCH METHODOLOGY

3.1 Empirical Research Methodology

From the literature review it was evident that no previous research had been conducted on the subject of occupation-specific commuting by European airline pilots. Thus, an empirical pilot questionnaire was administered as an on-line survey (on professional web-based survey software), hosted at the domain: www.pilot-commute.eu .

The survey was promoted and conducted under the title "European Airline Pilot Commute Study" on the related topic of the commuting of airline pilots and the adjacent stress experienced in the commuting process. The study also investigated the mode, time and distance of commutes as well as the form of housing and intermediate housing used in commutes.

The survey was conducted between 10 July 2014 and 31 August 2014.

Multiple answers from the same IP address were allowed due to the possibility that company computers may be used. For better sorting, and so as not to dilute the sample, a second domain www.pilot-commute.eu/II was used for the direct target group of European airline pilots. The significant differences in relation to the return of surveys on the different domains will be discussed later in this Chapter.

It is important to note that an on-line survey depends on the correctness of the answers of its participants and is subject to the participants' retrospective recall of events, habits and performance. The author aimed to build a strong, reliable, valid, reproductive and unbiased sample to examine the hypotheses in this thesis.

3.1.1 Procedure

The survey was designed to accommodate different variables and aspects of commuting. It was also important to the author that non-commuting travel to work by a home-based pilot was reflected in the survey (see also Chapter 1).

The survey consists of:

- 82 questions for commuters, using an intermediate housing facility;
- 73 questions for commuters, not using an intermediate housing facility; and
- 56 questions for non-commuters.

All of the questions included a modified part of Sloan and Cooper´s (1986) questionnaire, which consisted of 15 questions on "The Measurement of Self-Reported Pilot Performance" and measured the self-performance by pilots reported on a five-point scale. The original questionnaire was modified and set in relation to commuting. Thus, the introduction text for the commuters was re-phrased to read:

> *Think about your last few flights recently on days where you commuted to work.*
>
> 1. *Consider how well or badly you performed.*
> 2. *Examine the list of elements below; they are different ways of assessing performance.*
> 3. *Please rate yourself on the scales by marking your answer.*
>
> *Remember, we are relying on you to make this as accurate of a scientific measure as possible.*

The part of the questionnaire for non-commuters was unchanged from the original version used by Sloan and Cooper (1986).

The stress questions were: "How satisfied are you with your life, all things considered?" (Stutzer and Frey, 2007, p. 4). Responses ranged on a scale from "0: completely dissatisfied" to "10: completely satisfied" (Stutzer and Frey, 2007, p. 4) and "How do you feel about your commute?".

3.1.2 Ethical considerations

The survey and research was conducted in compliance with Cranfield Science and Engineering Research Ethics Committee as a Low Risk Project and was approved by the

Committee. The initial survey time period was extended by one month, with the Committee's approval, to meet a broader participant number.

3.1.3 Survey

The Survey followed a set procedure and all participants started with the General/Personal Data section. There were 21 questions in the General/Personal Data section (see Appendix A).

Question 22 can be viewed as the dividing question that led participants into the commuter or non-commuter part of the questionnaire. It is a compulsory question and provides the first indication of how far a participant travels to work.

Subsequently, the questionnaire was a mixture of compulsory and non-compulsory questions, allocated on the basis of their importance to the study, and designed not to annoy too many participants with "compulsory question warning" reminders.

The aim was to gather data and build a strong and robust sample group from an unbiased mixture of various European nationals and operators. This was achieved, as evinced by the distribution of participants to the study residing in 29 different countries and working for operators in 31 different countries.

The general question layout was devoted to these topics:

- General/Personal Data 21 questions;
- Commuting/Non-Commuting 1 questions;
- Career Options/Decisions 5 questions;
- Employer 7 questions;
- Commute 3 questions;
- Employer Resting Facilities at Home Base 4 questions;
- Frequency of Commuting to Place of Residence 4 questions;
- Cost of Commuting 2 questions;
- Use/Cost of Intermediate Housing 7 questions;
- Commuting from Intermediate Housing Facilities 3 questions;
- Rostering 4 questions;
- Reason for Commuting 4 questions;
- Stress 2 questions;
- Sloan and Cooper Questions – 15 questions;
  Pilot Self-Assessment Questions.

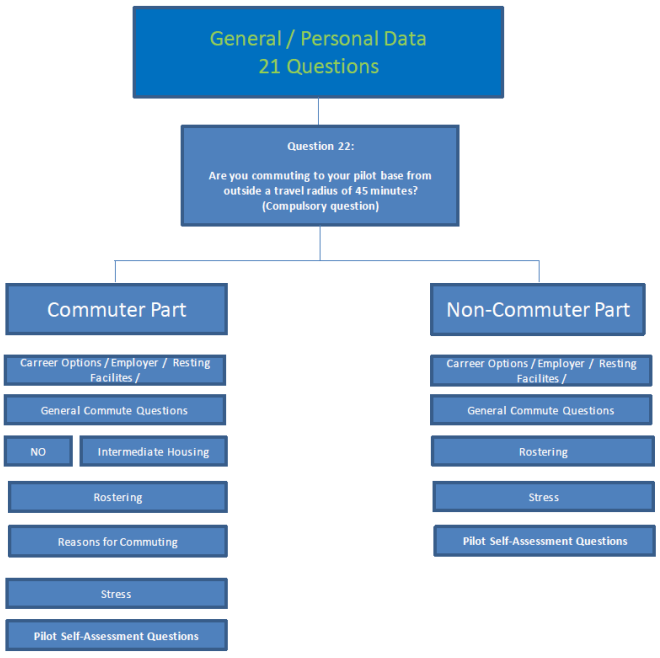


Figure 3.1 - Questionnaire Layout

3.1.4 Survey limitations

During the planning and creation of the survey questions, the author had originally intended to consider two further hypotheses. However, during the process of planned distribution via the European Pilot Association National Member organisations, there was also close co-ordination with the Austrian National Alpa, an in-depth review raised issues of bias in relation to some of the proposed questions. Resultantly, so in order not to endanger distribution channels, the author elected to remove parts of the questionnaire due to the reservations of the Austrian National Alpa.

Questions/Question Groups omitted from the original planned version were:

- **Fatigue Risk management.**
  - I am familiar with the responsibility of my employers Fatigue Risk Management System?
  - I think pilot commuting should be part of a Fatigue Risk Management System?
  - I consider pilot commuting as an aviation industry standard and it should be incorporated in the proposed EASA Rulemaking process?

- **Call in sick/unfit to fly**
  - I have used the Call in Sick possibility in the past to cover for commuting issues?
  - I used the unfit to fly possibility to cover up commuting issues?

- **Personal safety concerns of commuting**
  - I think that commuting influences a pilot's professional performance?
  - On commuting days I sometimes see some effect of the commuting on the commuting pilot performance?
  - My personal professional performance has been influenced negatively by commuting issues?
  - On some commuting days I am generally more tired than on other days?
  - I think about the safety issues connected with my commuting?
  - I have occasionally disregarded Company Procedures (Check out Procedures, etc.) to meet my commuting plans?
  - I have occasionally disregarded Safety issues to meet my commuting plans?

3.1.5 Hypothesis changes

As the removal of these questions created subsequent difficulties in proving the planned hypotheses, the author elected to remove the following two hypotheses from the thesis:

- Commuting influences a pilots operational decision-making process in connecting to their commute; and
- Commuting pilots take steps to adjust procedures to accommodate personal commuting.

3.1.6 Data collection: sample

It was intended that the sample would consist of members of the European Pilot Association National Member organisations (which have approximately 37,000 members). However, shortly before launching the survey, the European Pilot Association politely declined the distribution.

The Austrian Alpa, which the author is a member of, distributed the survey, as agreed, to its pilot members.

If the participant had not been directed to the "European Airline Pilot Commute Study II" (which was offered to airline pilots via a direct link personal invitation from the author or the Airline Pilot Associations (ALPAs)), the eligibility criteria to participate in the questionnaire was that the participant had to be:

- a certified airline pilot; and/or;
- working for a European airline and/or working for an airline outside Europe, but living in Europe.

3.1.7 Airline Pilot Associations (ALPAs)

An invitation (see Appendix C) to the survey was also distributed via email to 37 European National Pilot Organisations:

Table 3.1 - List of National Airline Pilot Associations

(Source: European Cockpit Association, 2014)

Austria	Austrian Cockpit Association (ACA)
Belgium	Belgian Cockpit Association (BeCA)
Bosnia and Herzegovina	Association of Airline Pilots in Bosnia and Herzegovina (ALPAB)
Bulgaria	Bulgarian Airline Pilots Association (BUL-ALPA)
Croatia	Croatian Air Line Pilots' Association (CRO-ALPA)
Cyprus	Cyprus Airline Pilots Association (PALPU)
Czech Republic	Ceské sdružení dopravních pilot CSA (CZALPA)
Denmark	Danish Airline Pilots Association (DALPA)
Estonia	Estonian Airline Pilots Association (Estonian ALPA)
Finland	Finnish Pilots Association (FPA)
France	Syndicat national des Pilotes de Ligne (SNPL)
Germany	Vereinigung Cockpit (VC)
Greece	Hellenic Airline Pilots Association (HALPA)
Hungary	Hungarian Airline Pilots' Association (HUNALPA)
Iceland	Félag Íslenskra Atvinnuflugmanna (FIA)
Ireland	Irish Airline Pilots Association (IALPA)
Italy	Associazione Nazionale Piloti Aviazione Commerciale (ANPAC)
Latvia	Pilots' Trade Union of Latvia (PTUL)
Lithuania	Lithuanian Airline Pilots' Association (LIT-ALPA)
Luxembourg	Association Luxembourgeoise des Pilotes de Ligne (ALPL)
FYR Macedonia	Air Line Pilot Association of the Former Yugoslav Republic of Macedonia (ALPA-FYROM)
Malta	ALPA-M
Montenegro	Montenegrin Airline Pilots' Association (MonALPA)
Netherlands	Vereniging van Nederlandse Verkeervliegers (VNV)
Norway	Norsk Flygeerforbund (NF)
Poland	Polish Airline Pilots Association (POLALPA)
Portugal	Associação dos Pilotos Portugueses de Linha Aérea (APPLA)
Romania	Romanian Airline Pilots Union (RO-ALPU)
Russia	The Cockpit Personnel Association of Russia (CPAR)
Serbia	Serbian Cockpit Association (SCA)
Slovenia	Air Line Pilots' Association of Slovenia (ALPA-SL)
Spain	Sindicato Español de Pilotos de Líneas Aéreas (SEPLA)
Sweden	Svensk Pilotförening (SPF)
Switzerland	Pilotenverband Swiss (AEROPERS)
Turkey	Türkiye Havayolu Pilotlari Dernegi (TALPA)
Ukraine	Ukrainian Air Line Pilots' Association (UALPA)
United Kingdom	British Airline Pilots Association (BALPA)

The following four National ALPAs responded positively to requests to distribute the questionnaire and confirmed that invitations to participate had been forwarded to their ALPA members:

- Austria Austrian Cockpit Association (ACA);
- Iceland Félag Íslenskra Atvinnuflugmanna (FIA) (568 Members);
- Serbia Serbian Cockpit Association (SCA);
- Malta ALPA-M (101 Members).

After evaluating the survey, German ALPA, Vereinigung Cockpit (VC) declined to distribute the survey.

The National ALPAs that distributed the survey invitations were unable to state how many members had been sent survey invitations. Any invitations sent via the APLA directed participants to the questionnaire: “European Airline Pilot Commute Study II”.

3.1.8 Operators/direct mail invitation to European airline pilots

As agreed with the Cranfield University Ethics Approval Board, the use of social networks, including closed group contacts, could be used to promote the survey. Thus, the author elected a social network “site designed specifically for the business community. The goal of the site is to allow registered members to establish and document networks of people they know and trust professionally” to generate contacts to airline pilots that match the required criteria (techtarget.com, 2014, accessed 3 September 2014). The search of the social network LinkedIn was conducted by an “advanced people search” feature, which utilised the following mixture of settings:

- All people in contact with the author via:
    - First Connections;
    - Second Connections; and
    - Group Members.

These settings reflected the closed group restriction required by the Cranfield University Ethics Approval Board.

Further settings used in the airline pilot search were:

- Keyword: pilot;
- Company [respective company name]; and
- Employment status: current.

The respective company names were derived from a list of 115 randomly selected European airline operators. For the 62 operators on this list, a valid pilot email address could be established from the available information of a pilot's first and last name and the airlines' Internet domain. Via these pilot generated email addresses, a direct invitation was sent to 3,906 randomly selected pilots from 62 randomly selected companies throughout Europe. The invitations were sent directly to pilots' email addresses and participants were directed to the questionnaire "European Airline Pilot Commute Study II". For a sample of the invitation email please see Appendix D.

3.1.9 European Airline Pilot Commute Study II

This domain was utilised to directly invite pilots who received direct emails and invitations from ALPAs. When the survey closed on 31 August 2014, recorded and saved on the domain were:

- 381 fully completed surveys;
- 314 partly completed surveys; and
- 361 clicks without starting the survey.

Of the questionnaires, 528 were useable, taken from the domain and subject to statistical analysis. Braun Hamilton (2009) sees a "total response rate – 13.35%" (2009, p.2) as average for an online survey and defines responses "as the respondent submitting at least one answer to a question on the survey" (2009, p.2). 13.51 per cent response rate in this study represent only useable questionnaires completed a minimum up to and including question 22 of this study. A return rate of 13.51 per cent of useable questionnaires is slightly above average for an online survey.

3.1.10 Social networks: closed group/social network advertising

The use of formal social network groups was used as a second approach to attract and invite airline pilots to participate in the questionnaire.

Initially, an invitation providing links to the survey was posted in:

- 19 closed group discussions in the business social network; and
- 25 closed group postings in a formal social network.

All closed groups were connected to aviation and European airlines.

Additionally, during the initial phase of the study and in the time period between 10 July 2014 and 21 July 2014, commercial advertising was also conducted on social networks with advertisements inviting individuals to participate in the survey. These advertisements generated:

- 36 clicks from the business social network; and
- 9 clicks from the formal social network.

All of these clicks were directed to the European Airline Pilot Commute Study domain, so that these responses could be separated from the participants who had been directly invited to participate.

3.1.11 European Airline Pilot Commute Study

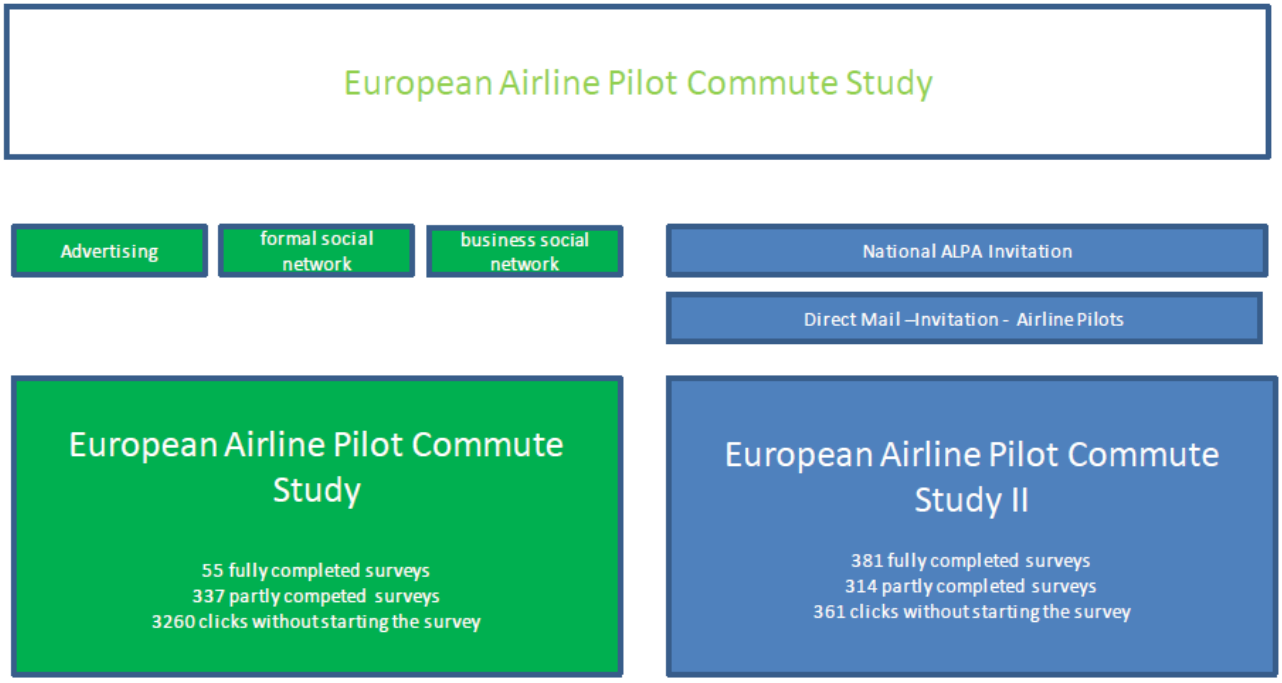
Of the European Airline Pilot Commute Study, recorded and saved were:

- 55 fully completed surveys;
- 337 partly competed surveys; and
- 3,260 “clicks” without starting the survey.

There were 103 useable questionnaires that were not taken from this domain and subject to statistical analysis due to significant differences in responses to the General/Personal Data part of the questionnaire and other differences that would have required an in-depth analysis for proving the validity of the sub-sample.

Additionally, the author elected not to contaminate the sample in the European Airline Pilot Commute Study II with this small sub-sample, as the European Airline Pilot Commute Study II had sufficient data sets for statistical analysis of the hypothesis from its target group. Had the sub-sample been used, possible sources of difference could have arisen due to the different ways of approaching participants via different forms of media. Additionally, the open access to the questionnaire meant that the pilot positions could not be confirmed.

Figure 3.2 - European Airline Pilot Commute Study Overview



4 Analysis

4.1 The Sample: European Airline Pilot Commute Study II

4.1.1 Biographical data

Interpreting the general, biographical data derived from this study, the sample size and valid responses included 528 pilot data sets that add valuable information about the general distribution of the European airline pilot corps.

A study conducted by Carsenat & Rossini (2014) from a database of 650,000 airline pilots, analysed the percentage of female pilots worldwide and found that “in the USA, about 5.12 per cent of airline or commercial pilots are women” (gendergapgrader.com, 2014). Similarly, Goyer (2014) found that “the U.S. Department of Labor reports that only 4.3 per cent of the [United States] population that reports making a living as a pilot or flight engineer is female”.

This study had a 4.5 per cent participation rate by women Europe wide. Thus, the study seems consistent in terms of its percentage of female participants.

By far the largest group of European airline pilots were men aged 31–40 years (38.3 per cent), followed by men aged 41–50 (32.2 per cent). The results showed that just over 70 per cent of the total pilot corps had an age between 31 and 50 years.

The majority of pilots were married (64.4 per cent) or co-habiting (21.4 per cent) and living in stable partnerships. Only 14.1 per cent of pilots were single, separated or divorced.

Of the total participants surveyed, 70.6 per cent stated they had children of their own, while 56.4 per cent had dependent children living in their household.

Just over one third of participants (that is, 38.2 per cent) had children of school age (i.e., between 7–17 years).

Table 4.1 - Biographical Data: Descriptive Statistics

	Number	Percentage
Participants	528	100
Sex	528	100
Female	24	4.5
Male	504	95.5
Age	527	100
19-30	67	12.7
31-40	202	38.3
41-50	170	32.2
51-60	80	15.2
61-65	8	1.5
Marital status	528	100
Single	53	10.0
Cohabiting	113	21.4
Married	340	64.4
Separated	6	1.1
Divorced	16	3.0
Divorced before	528	100
Yes	58	11.0
No	470	89.0
Number of own children	528	100
0	155	29.4
1	101	19.1
2	175	33.1
3	79	15.0
4	15	2.8
5	3	0.6
Dependent children living in household	528	100
0	230	43.6
1	101	19.1
2	137	25.9
3	52	9.8
4	7	1.3
5	0	0.0
6	1	0.2
Age of youngest Child	340	100.0
Valid Answers		
0 -6 years	180	52.9
7 – 17 years	130	38.2
18 years or older	30	8.8

4.1.2 Country of residency/operator/crew base

Participants came from 28 European Nations and five other nations (as specified in the questionnaires). The five top source countries of residency were:

- Austria 23.1 per cent;
- United Kingdom 16.1 per cent;
- Iceland 10.6 per cent;
- Finland 8.7 per cent; and
- The Netherlands 5.5 per cent.

Invitations to participate in the study were sent randomly to pilots in Europe. One possible reason for the cluster around these five top source countries could be that the National ALPAs of these countries elected to participate in the study, endorsed it, and distributed it to their members.

In any event, the mixture of the sample, including ALPA members and non-members from various different countries, and the randomisation of the selected pilots involved, suggests an unbiased representative sample result.

Table 4.2 - Country of Residency

	Number	Percentage
Austria	122	23.1
Belgium	16	3.0
Croatia	1	0.2
Cyprus	3	0.6
Czech Republic	2	0.4
Denmark	12	2.3
Finland	46	8.7
France	23	4.4
Germany	17	3.2
Greece	2	0.4
Hungary	2	0.4
Iceland	56	10.6
Ireland	1	0.2
Italy	13	2.5
Luxembourg	1	0.2
Malta	11	2.1
The Netherlands	29	5.5
Norway	28	5.3
Poland	1	0.2
Portugal	2	0.4
Romania	5	0.9
Serbia	5	0.9
Slovenia	1	0.2
Spain	4	0.8
Sweden	23	4.4
Switzerland	8	1.5
Turkey	4	0.8
United Kingdom	85	16.1
Other	5	0.9
Total	528	100.0

On the other hand looking at country of operators, the five top source countries of operators were:

- Austria 23.7 per cent;
- United Kingdom 18.6 per cent;
- Iceland 11.0 per cent;
- Norway 8.9 per cent; and
- Finland 8.5 per cent.

Table 4.3 - Country of Operator

	Number	Percentage
Albania	1	0.2
Austria	125	23.7
Belgium	8	1.5
Croatia	1	0.2
Cyprus	3	0.6
Czech Republic	1	0.2
Denmark	3	0.6
Finland	45	8.5
France	11	2.1
Germany	14	2.7
Greece	3	0.6
Hungary	5	0.9
Iceland	58	11.0
Ireland	8	1.5
Italy	6	1.1
Latvia	1	0.2
Luxembourg	5	0.9
Malta	8	1.5
The Netherlands	20	3.8
Norway	47	8.9
Poland	1	0.2
Portugal	8	1.5
Romania	6	1.1
Serbia	4	0.8
Slovenia	1	0.2
Spain	2	0.4
Sweden	11	2.1
Switzerland	10	1.9
Turkey	7	1.3
United Kingdom	98	18.6
Other:	7	1.3
Total	**528**	**100.0**

Further, adding a European dimension of pilot commuting, the five top source countries for crew bases were:

- Austria 23.7 per cent ;
- United Kingdom 17.0 per cent ;
- Finland 9.1 per cent ;
- Norway 7.0 per cent; and
- Iceland 8.3 per cent.

Table 4.4 - Country of Crew Base

	Number	Percentage
Albania	1	0.2
Austria	125	23.7
Belgium	10	1.9
Croatia	1	0.2
Cyprus	3	0.6
Czech Republic	1	0.2
Denmark	3	0.6
Finland	48	9.1
France	21	4.0
Germany	19	3.6
Greece	3	0.6
Iceland	44	8.3
Ireland	1	0.2
Italy	14	2.7
Latvia	1	0.2
Luxembourg	5	0.9
Macedonia	1	0.2
Malta	8	1.5
The Netherlands	20	3.8
Norway	37	7.0
Poland	1	0.2
Portugal	1	0.2
Romania	10	1.9
Russia	1	0.2
Serbia	5	0.9
Slovenia	1	0.2
Spain	6	1.1
Sweden	11	2.1
Switzerland	8	1.5
Turkey	7	1.3
United Kingdom	90	17.0
Other	21	4.0
Total	**528**	**100.0**

4.1.3 Housing

The majority of European pilots indicated that they preferred to own their place of residency (78.6 per cent). Slightly over two thirds of pilots surveyed (66.9 per cent) lived in houses followed by just under one third who lived in apartments.

Table 4.5 - Form/Mode of Housing at Place of Residency

	Number	Percentage
Form of housing at place of residency	528	100
House	353	66.9
Apartment	163	30.9
Shared housing	12	2.3
Mode of housing	528	100
Ownership	415	78.6
Rent	111	21.0
Other	2	0.4

4.1.4 Type of operation/job position

No surprising trends arose out of the professional parameters of the survey. Over two thirds of pilots (70.3 per cent) worked in mid and short-haul operation while around one quarter (23.7 per cent) worked in long-haul environments. Just under half of the participants (49.4 per cent) were ranked as captain and 50.6 per cent were ranked as various forms of co-pilots.

Table 4.6 - Type of Operation/Job Position

	Number	Percentage
Type of operation	528	100
Long-haul Ops	125	23.7
Mid and Short-haul Ops	371	70.3
Domestic Only	32	6.1
Job position	528	100
Captain	261	49.4
First Officer	173	32.8
Senior First Officer	89	16.9
Second Officer	5	0.9

4.1.5 Commuting

Considering the "normal" European population commuting habits (discussed in the previous commuting Chapter), to be considered a "commuter" for this study an individual had to meet a minimum of a 45 minute one-way commute from place of residency to home base. Surprisingly, many European pilots met this definition "commuter". Indeed, the study revealed that more than half of the total pilot population (56.8 per cent) commuted more than 45 minutes one-way from their residence to home base. Thus, commuting forms a significant part of a pilots' work/private life.

Table 4.7 - Commuting

	Number	Percentage
Are you commuting to your pilot base from outside a travel radius of 45 minutes?		
Yes	300	56.8
No	228	43.2
Total	**528**	**100**

4.2 Analysis Hypothesis I

In the course of this research, various hypotheses evolved out of the literature review and were examined in terms of their validity in relation to pilot commuting. Empirical data from the defined sample was statistically examined and tested against the hypotheses.

Hypothesis I:

- Pilots with dependent children commute more often for social family needs.

The author examined two qualities of a pilot commute in relation to dependent children. The first quality was the subjective reason why pilots thought they were commuting to the residence. This quality was highly subjective in nature. The second quality was the objective number of commutes to places of residency. The sample group was made up of the pilots who declared themselves to be commuters in response to the question: “Are you commuting to your pilot base from outside a travel radius of 45 minutes?”.

Further factors for the investigation into this hypothesis were taken from answers to the following questions:

- Personal Status?
- Have you been divorced before?
- Number of own children?
- Dependent children living in household?

The number of dependent children in each household was calculated for all pilots in the study.

Information about the frequency and the personal motivations for commuting were derived from the following questions.

- How often per month, in an average duty schedule do you commute to your place of residence?
- My family situation influences the decision to commute?
- What is your main reason for commuting?

4.2.1 Hypothesis I: sample

The sample for this hypothesis was derived from the Airline Pilot Commute Study II and, thus, is in the most aspects identical to that sample. For this reason, the discussion will focus on the new results and any differences or additions to the results discussed previously.

Table 4.8 - Biographical Data: Descriptive Statistics

	Number	Percentage
Participants	528	100
Sex		
Female	24	4.5
Male	504	95.5
Marital status	528	100
Single	53	10.0
Cohabiting	113	21.4
Married	340	64.4
Separated	6	1.1
Divorced	16	3.0
Have you been divorced before?	528	100
Yes	58	11.0
No	470	89.0

4.2.2 Children/household

An additional and new descriptive aspect was that the average number of children per pilot for this sample was 1.45 children per pilot. Almost exactly one third of pilots (i.e., 33.1 per cent) had two children and roughly 30 per cent were childless.

Of the sample pilots, 43.6 per cent lived together in a household with dependent children, and of these 25.9 per cent had two dependent children. Only 11.3 per cent of pilots lived with three or more children. This results also showed that 43.6 per cent of pilots had children who had either already moved out of home or did not have dependent children living with them.

Table 4.9 - Children and Household

	Number	Percentage	Average	Standard deviation	Median
Number of own children?			1.45	1.172	2.00
0	155	29.4			
1	101	19.1			
2	175	33.1			
3	79	15.0			
4	15	2.8			
5	3	0.6			
Total	528	100.0			
Dependent children living in household?			1.07	1.119	1.00
0	230	43.6			
1	101	19.1			
2	137	25.9			
3	52	9.8			
4	7	1.3			
6	1	0.2			
Total	528	100.0			
Dependent children in household?					
Yes	230	43.6			
No	298	56.4			
Total	**528**	**100.0**			

4.2.3 Commuting qualities

In investigating the commuting frequency of 232 pilots (i.e., 43.9 per cent) it was found that on average there were 4.99 commutes per month in an average duty schedule, between place of residency and home base. Interestingly, 15.9 per cent of pilots surveyed answered that this journey would be taken more than nine times per month and 65.5 per cent of commuting pilots indicated that they commuted four or more times per month. This descriptive data alone provides a clear picture in relation to pilot commuting. 70.3 per cent of the total sample of pilots surveyed worked in mid and short-haul operations, which could increase commuting frequency.

Of commuter pilots, 77.6 per cent had very strong feelings (totally agreed and agreed) that their family situation influenced their decision to commute. While 33.9 per cent saw their family situation as their main reason for commuting and 37.2 per cent said that they mainly commuted because of a better quality of life at their places of residency.

Table 4.10 - Commuting Qualities

	Number	Percentage	Valid Per cent	Average	Standard deviation	Median
How often per month, in an average duty schedule do you commute to your place of residence?	232			4.99	2.851	4.00
0	4	0.8	1.7			
1	13	2.5	5.6			
2	21	4.0	9.1			
3	42	8.0	18.1			
4	52	9.8	22.4			
5	28	5.3	12.1			
6	8	1.5	3.4			
7	10	1.9	4.3			
8	12	2.3	5.2			
9	5	0.9	2.2			
> 9	37	7.0	15.9			
Total Valid	232	43.9				
Missing (incl. non commuters)	296	56.1				
Total	528	100				
My family situation influences the decision to commute?	218			1.91	1.114	2.00
Totally Agree	100	18.9	45.9			
Agree	69	13.1	31.7			
Neither agree / nor disagree	30	5.7	13.8			
Disagree	6	1.1	2.8			
Totally disagree	13	2.5	6.0			
Total Valid	218	41.3				
Missing	310	58.7				
Total	528	100.0	100			
What is your main reason for						

commuting?			
Higher income			
Cheaper housing at place of	10	1.9	4.6
residency	11	2.1	5.0
Social bands at place of			
residency	28	5.3	12.8
Better life quality at place of			
residency	81	15.3	37.2
Family situation			
Other:	74	14.0	33.9
	14	2.7	6.4
Total Valid			
Missing	218	41.3	
Total	310	58.7	
	528	100.0	100

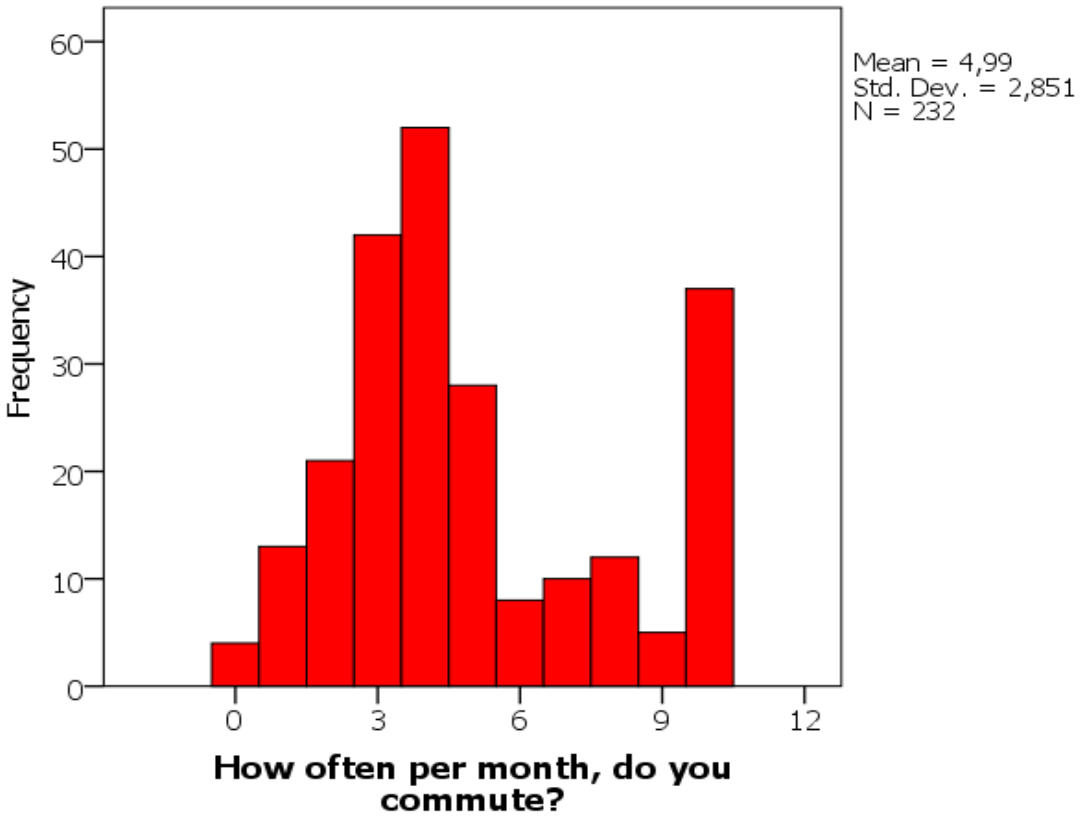


Figure 4.1 - Frequency of monthly commute histogram

4.2.4 Hypothesis I: testing

Statistical hypothesis testing was performed out of the bivariate data analysis.

4.2.5 Cross-table

The cross-table indicates that pilots who have at least one dependent child living in the household tend to agree more often to the question that their family situation influences their decision to commute, as did pilots without children.

Table 4.11 - Case Processing Summary Hypothesis I

	Valid	Per cent	Missing	Per cent	Total	Per cent
Dependent children in household (yes/no)						
Versus						
My family situation influences the decision to commute						
Total	218	41.3	310	58.7	528	100

Table 4.12 - Cross-table: Hypothesis I

	My family situation influences the decision to commute					
	Totally agree	**Agree**	**Neither agree/nor disagree**	**Disagree**	**Totally disagree**	**Total**
No dependent children in household						
Total Number	40	30	16	4	9	99
Per cent of dependent children in household	40.4	30.3	16.2	4.0	9.1	100
Per cent of total	18.3	13.8	7.3	1.8	4.1	45.4
Minimum 1 dependent child in household						
Total Number	60	39	14	2	4	119
Per cent of dependent children in household	50.4	32.8	11.8	1.7	3.4	100
Per cent of Total	27.5	17.9	6.4	0.9	1.8	54.6
Total per cent of dependent children In household	100 45.9	69 31.7	30 13.8	6 2.8	13 6.0	218 100

4.2.6 Testing

Two independent samples (commuter/non-commuter) and one dependent variable ("my family situation influences the decision to commute/metric") were tested for normal distribution, with a Kolmogorov-Smirnov test and a Lilliefors Significance Correction was applied. The resulting significance approached 0.000.

Table 4.13 - Test for Normal Distribution Hypothesis I

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	**Df**	**Significance**	**Statistic**	**Df**	**Significance**
My family situation influences the decision to commute	.252	218	0.000	0.767	218	0.000

The significance of Kolmogorov-Smirnov test on normal distribution was less than 0.05; for a normal distribution to be asserted it must be greater 0.05. Thus, a normal distribution was not found and, as an alternate to a t-test, a Mann-Whitney U-test was applied.

4.2.7 Mann-Whitney U-test

The Mann-Whitney U-test revealed the mean ranks for no dependent children in the household as 118.59 and the minimum for one dependent child in household as 101.94.

Table 4.14 - Ranks Hypothesis I.

My Family Situation Influences the Decision to Commute/Dependent Children in Household (Yes/No)

	N	**Mean Rank**	**Sum of Ranks**
No dependent children in household	99	118.59	11740.00
Min. 1 dependent child in household	119	101.94	12131.00
Total	218		

4.2.8 Test statistics

Table 4.15 - Test Statistics Hypothesis I

Applied Group Variable: Dependent Children in Household (Yes/No)

	My family situation influences the decision to commute
Mann-Whitney U	4991.000
Wilcoxon-W	12131.000
Z	-2.081
Asymp. Sig. (2 tailed)	0.037

4.2.9 Explorative data analysis: dependent children in household (yes/no)

Table 4.16 - Case Processing Summary Hypothesis I

My family situation influences the decision to commute	Valid	Per cent	Missing	Per cent	Total	Per cent
No dependent children in household	99	43.0	131	57.0	230	100.0
Min. 1 dependent child in household	119	39.9	179	60.1	298	100.0

4.2.10 Descriptives

For the combination of family situation influences, the decision to commute when there were no dependent children in the household had an average of 2.11, with a median of 2.0 and a standard deviation of 0.125 calculated on a five-point scale, which indicated that pilots of the sample elected mostly “agreed”.

Pilots with a minimum of one dependent child in household were more family orientated and elected a calculated average of 1.75, with a median of 1.0 and a standard deviation of 0.089 and indicated a tendency of “agree” and “totally agree” in their answers.

Table 4.17 - Descriptive Hypothesis I

My family situation influences the decision to commute	Number	Percentage	Average	Standard deviation	Median
No dependent children in household			2.11	0.125	2.00
Min. 1 dependent child in household			1.75	0.089	1.00

4.2.11 Main reason for commuting

A further comparison was conducted for the commuter and non-commuter groups to investigate the main reason for the commutes. For this sample analysis, a nominal scaled characteristic was found and neither a t-test nor a Mann-Whitney U-test could be conducted. Accordingly, a Cramer V-test was conducted to calculate valid results.

The significance calculation for the Cramer´s V-test was 0.000. For this reason, a significant difference between the groups of commuters and non-commuters became evident. The remaining risk of “no difference” was approaching zero.

Pilots with dependent children living in their household answered significantly more often that their main reason for commuting was their family situation.

Table 4.18 - Case Processing Summary Hypothesis I: Main reason for Commuting

	Valid	Per cent	Missing	Per cent	Total	Per cent
Dependent children in household (yes/no) What is your main reason for commuting?	218	41.3	310	58.7	528	100.0

Table 4.19 - Cross-table: Dependent Children in Household (Yes/No) and What is your Main Reason for Commuting?

	What is your main reason for commuting?						
	Higher income	**Cheaper housing at place of residency**	**Social bands at place of residency**	**Better life quality at place of residency**	**Family situation**	**Other**	**Total**
No dependent children in household							
Total number	10	4	16	40	27	2	99
Per cent of dependent children in household	10.1	4.0	16.2	40.4	27.3	2.0	100.0
Per cent of Total	4.6	1.8	7.3	18.3	12.4	0.9	45.4
Minimum 1 dependent child in household							
Total Number	0	7	12	41	47	12	119
Per cent of dependent children in household	0.0	5.9	10.1	34.5	39.5	10.1	100.0
Per cent of Total	0.0	3.2	5.5	18.8	21.6	5.5	54.6
Total	10	11	28	81	74	14	218
Per cent of dependent children in household	4.6	5.0	12.8	37.2	33.9	6.4	100.0

Table 4.20 - Symmetric Measures

	Value	Approx. Significance
Nominal by Nominal Phi	0.32	0.000
Cramer V-test	0.32	0.000
Valid Cases	218	

4.2.12 Frequency of commute

4.2.12.1 Test for normal Distribution

Comparing the two groups of commuters versus non-commuters with dependent children in household in relation to their frequency of commute (i.e., how often per month do you commute?), a metric variable become apparent. A test for normal distribution was performed and it was found that no normal distribution was found due to a significance of less than 0.05.

Table 4.21 - Test for Normal Distribution – Frequency of Commute

Lilliefors Significance Correction Applied

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	Df	Significance	Statistic	Df	Significance
How often per month, do you commute	.205	232	0.000	0.893	232	0.000

Significance must be greater than 0.05 to indicate a normal distribution. A Mann-Whitney U-Test was used.

Table 4.22 - How Often Per Month Do You Commute vs. Dependent Children in Household

How often per month, do you commute Versus	N	Mean Rank	Sum of Ranks
No. dependent children in household	105	107.48	11285.5
Min. 1 dependent child in household	127	123.96	15742.5
Total	**232**		

Table 4.23 - Test Statistics (a)

Grouping Variable: Dependent Children in Household (Yes/No)

	How often per month, do you commute
Mann-Whitney U	5720.500
Wilcoxon-W	11285.500
Z	-1.884
Asymptotical Significance (2-tailed)	0.060

The significance of 0.060 is greater than 0.050. Thus, there is no significant difference between pilots with children and pilots without children in relation to the frequency of commuting.

4.2.13 Results: Hypothesis I

Considering the hypothesis:

- Pilots with dependent children commute more often for social family needs.

Hypothesis testing, in relation to the variables and qualities of the commute, revealed interesting details about the subjective views of commuting pilots.

The average of 4.99 commutes from home base to place of residence during an average duty schedule period indicates an interesting commute situation for European cockpit crew members. Given that the majority of such work occurs in mid and short-haul operation

environments, such commutes could have a tremendously negative influence on the work/rest relationship.

As outlined in Chapter 1, commuting takes place in a pilots' off-time (National Research Council, 2011) and, thus, reduces the rest-time period for commuting pilots.

As evidenced by the statistical analysis and hypothesis testing, pilots with dependent children living in their households feel a subjective pressure to commute home. Further, commuting for family reasons is more of an influence on pilots who have dependent children living in their households than on pilots who do not have dependent children living in their households. It is important to note that a pilot's family situation may also include variables that were not further considered or analysed by the current study. Thus, the "family situation" answer set could only be analysed in relation to whether pilots indicated that they had dependent children living in their households or not and conclusions were drawn on the basis that pilots indicated they commuted and had dependent children living in their households or not. A distinct set of questions in relation to whether pilots had dependent children in their households and whether this influenced their choice to commute would have helped to clarify the results.

Nevertheless, it is clear that a subjective pressure exists in relation to the objective frequency of commutes.

Upon analysing the actual numbers of commutes and the differences in commuting between pilots with and without dependent children in their households, it became apparent that there was no significant difference in the amount and number of commutes. Thus, the hypothesis was objectively refuted due to the fact that there was no difference in the number of commutes. Also, a high willingness to commute for family situation was evident for pilots with dependent children in their household.

This shows the significance of the analysis in relation to the high levels of pressure pilots subjectively feel that influences their decisions to commute.

4.3 Analysis Hypothesis II

Hypothesis II:

- Commuting pilots reduce working hours to accommodate private commuting.

For this second hypothesis, the author examined work commitment reductions and various other career factors in relation to pilot commutes.

First, the following question about general commutes was asked to divide pilots into either the commuter or non-commuter pilot category:

- Are you commuting to your pilot base from outside a travel radius of 45 minutes?

Following this categorisation, a further evaluation, in relation to a person's willingness to adjust their work commitments, was determined by the following questions:

- Would you like to reduce your work hours/days (part-time employment) to accommodate your commuting?
- To what percentage did you reduce your working obligation/month?

Based on the combination of replies to these questions the hypothesis testing process was initiated.

4.3.1 Hypothesis II: sample

In investigating this hypothesis, a sample of 528 pilots from the European Airline Pilot Commute Study II was used. Based on the question: "Are you commuting to your pilot base from outside a travel radius of 45 minutes?", pilots were divided into categories of commuters or non-commuters.

Of the 528 pilots, 56.8 per cent were categorised as commuters compared to 43.2 per cent who were categorised as non-commuters, living within 45 minutes of their designated home base.

Table 4.24 - Hypothesis II: Sample

	Number	Percentage
Are you commuting to your pilot base from outside a travel radius of 45 minutes?		
Yes	300	56.8
No	228	43.2
Total	528	100

A closer look at work commitments and pilots' willingness to undertake a reduction in work was considered and 496 valid answers were recorded in relation to the first question (see Table 4.26). Interestingly, only 25.6 per cent of pilots stated that they had no interest in reducing their work commitments; however, 27 per cent stated they had thought about a permanent or temporary reduction in work hours and 22 per cent of pilots stated they had reduced their work hours in the past or were presently working part time.

Table 4.25 - Work Commitment Reductions

	Number	Percentage	Average	Standard deviation	Median
To what percentage did you reduce your working obligation/month?	308		47.44	34.713	64.50

Note: The return of answers to this question suggests that many participants to misinterpreted the meaning of the question and gave the percentage by which the working obligation was reduced as an answer. This resulted in the large standard deviation in the analysis process.

Table 4.26 - Would you like to reduce your work hours/days (part time employment) to accommodate your commuting?

Would you like to reduce your work hours/days (part time employment) to accommodate your commuting?	Valid	Per cent	Valid Per cent
I think about permanent reduce	79	15.0	15.9
I think about temporarily reduce	58	11.0	11.7
I reduced the work hours in the past	41	7.8	8.3
I have reduced it	68	12.9	13.7
Maybe in future	123	23.3	24.8
No, I'm not interested in reducing it	127	24.1	25.6
Total	496	93.9	100
Missing	32	6.1	
Total	528	100	

4.3.2 Hypothesis II: testing

4.3.2.1 Commuter/Non commuters: Work hour reduction

To test the hypothesis that commuting pilots reduce working hours to accommodate private commuting, 496 valid answers were taken from the European Airline Pilot Commute Study II. However, of the total number (528) of survey responses, 32 surveys had missing answers.

In comparing the two pilot groups of commuters and non-commuters in relation to their agreement to the question: "Would you like to reduce your work hours/days (part-time employment) to accommodate your commuting?" a nominal scale became evident and, thus, the Cramer´s V-test was used for hypothesis testing.

Table 4.27 - Case Processing Summary: Hypothesis II

	Valid	Per cent	Missing	Per cent	Total	Per cent
Are you commuting to your pilot base from outside a travel radius of 45 minutes?	496	93.9	32	6.1	528	100.0
VS.						
Would you like to reduce your work hours/days (part-time employment) to accommodate your commuting?						

4.3.3 Cross-table

The cross-table shows that non-commuters are much less interested in reducing their work commitments (41.3 per cent) compared to commuters (14.5 per cent).

Further, compared to non-commuters, commuters were more interested in, and had thought about, a temporary or permanent decrease in their work hours, had reduced their work hours in the past or were currently working part-time. The Cramer´s V-value of 0.320 (where significance equals 0.000) indicates a mid-range effect.

Table 4.28 - Cross-table: Hypothesis II

	Would you like to reduce your work hours/days (part-time employment) to accommodate your commuting?						
	I think about a permanent reduction	**I think about a temporary reduction**	**I have reduced my work hours in the past**	**I have reduced it**	**Maybe in future**	**No, I'm not interested in reducing it**	**Total**
Are you commuting to your pilot base from outside a travel radius of 45 minutes?							
YES							
Total number	56	39	29	51	73	42	290
Per cent within Are you commuting?	19.3	13.4	10.0	17.6	25.2	14.5	100.00
Per cent of Total	11.3	7.9	5.8	10.3	14.7	8.5	58.5
NO							
Total Number	23	19	12	17	50	85	206
Per cent within Are you commuting?	11.2	9.2	5.8	8.3	24.3	41.3	100.0
Per cent of Total	4.6	3.8	2.4	3.4	10.1	17.1	41.5
Total	79	58	41	68	123	127	496
Per cent within Are you commuting?	15.9	11.7	8.3	13.7	24.8	25.6	100.0
Per cent of Total	15.9	11.7	8.3	13.7	24.8	25.6	100.0

Table 4.29 - Symmetric Measures

	Value	Approx. Significance
Nominal by Nominal Phi	0.320	0.000
Cramer V-test	0.320	0.000
Valid Cases	496	

4.3.4 Results: Hypothesis II

Hypothesis II that is, commuting pilots reduce working hours to accommodate private commuting, was supported by the data in testing. The results showed a mid-range effect, indicating that commuting pilots, compared to non-commuting pilots, were more willing to decrease their work hours, had thought about doing so and had decreased their hours in the past, or were presently working part-time.

Commuting caused pilots to decrease their work commitments to compensate for the inconvenience and by-products of commuting.

In addition to the statistical results, the relevance of this hypothesis and the results show a clear and significant trend for work-time reduction by commuting pilots.

Thus, the results could potentially influence the ability to plan rosters and the roster stability of pilots. These results could also form the basis for future research whereby the combination of reducing work obligations and the subjective stress experienced by pilots could be explored in relation to factors such as mode and distance of commutes.

4.4 Analysis

4.4.1 Hypothesis III

Hypothesis III that is, commuting pilots experience more stress due to their commute, was considered in relation to the overall stress experienced by commuting pilots as well as compared with non-commuter/home base commuter pilots.

A set of questions in the survey directly asked about stress levels imposed on pilots by commutes. The questions used to analyse this hypothesis were:

- How do you feel about your commute?
    - Commuting imposes stress on my life;
    - Commuting imposes stress on my partner;
    - Commuting leads to discussions in my relationship;
    - Commuting limits the socialisation time with my friends;
    - Friends turned away from me because of my commuting/time issues;
    - Commuting makes me think about the safety issues connected to my commuting;
    - I think that commuting influences the quality of my colleagues work; and
    - Commuting influences my overall life happiness.

The five-point Likert scale response options were as follows:

- Totally Agree;
- Agree;
- Neither agree/nor disagree;
- Disagree; and
- Totally disagree.

From these results a total stress value was calculated and compared.

4.4.2 Hypothesis III: sample

4.4.2.1 Commuting and stress

Table 4.30 - How do you Feel about your Commute?

	Number	Percentage	Average	Standard deviation	Median
Commuting impose stress on my life	219		2.16	1.102	2.0
Commuting imposes stress on my partner	219		2.25	1.186	2.0
Commuting leads to discussions in my relationship	219		2.84	1.283	3.0
Commuting limits the socialisation time with my friends	219		2.07	1.196	2.0
Friends turned away from me because of my commuting/time issues	219		3.36	1.282	3.0
Commuting makes me think about the safety issues connected to my commuting	219		2.58	1.273	2.0
I think that commuting influences the quality of my colleagues work	219		2.84	1.216	3.0
Commuting influences my overall life happiness	219		2.34	1.195	2.0

4.4.2.2 Total stress level

This value indicated the amount of stress commuting had on the pilots. It was derived from taking the averages of the eight items (set out above) under the survey question:

- How do you feel about your commute?

Before calculating the total scale a reliability-scale, a stress-level calculation was taken which proved that the eight items measured stress. For this reason a Cronbach´s Alpha was calculated using a reliability-scale: stress level.

Table 4.31 - Case Processing Summary: Total Stress Level

	Number	Per cent
Valid	396	75.0
Excluded (a)	132	25.0
Total	528	100.0

Note: List wise deletion based on all variables in the procedure.

Table 4.32 - Case Processing Summary II: Total Stress Level

Cronbach´s Alpha	Number of Items
0.921	8

A Cronbach´s Alpha value of 0.921 was calculated, which indicates excellent internal consistency for the eight items and confirms these items measure stress.

In investigating the Cronbach calculation further, it became obvious that the question: “I think that commuting influences the quality of my colleagues work”, was the only item with an adverse influence on the internal consistency. The results in relation to this item were deleted, the remaining items had a Cronbach's Alpha value of 0.924.

However, this question was developed to complete the set eight questions. Further, the subjectivity and positivity of the answers in relation to colleagues is important to this study. Given that it had only a minor influence on the calculation, it was not deleted.

4.4.2.3 Considering further the total stress level calculation

Table 4.33 - Total Stress Level – Statistics

	Number	Percentage	Average	Standard deviation	Median
Valid	396		2.7027	1.05278	2.5000

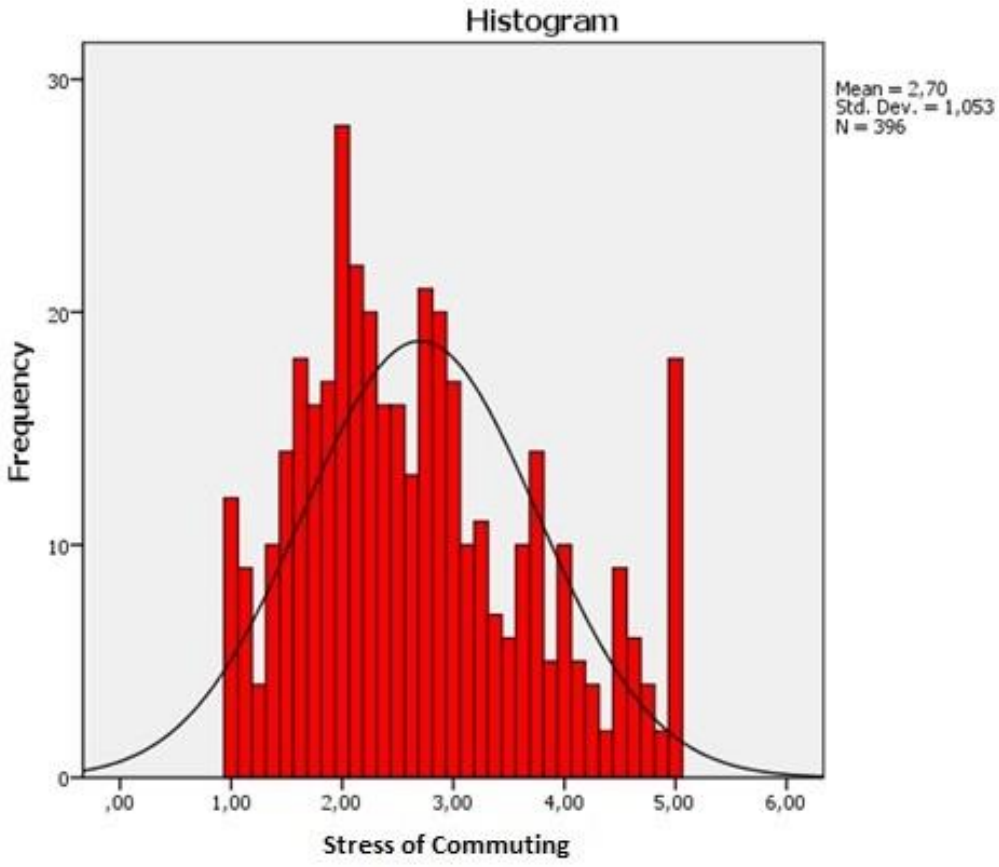


Figure 4.2 - Total Stress Level Statistics

4.4.3 Hypothesis III: testing

Hypothesis III:

- Commuting pilots experience more stress due to their commute.

4.4.3.1 Commuter vs. home base commuters

The stress level was metrically scaled meaning that every value between the two end-scale points of one and five was possible. A test of normality was undertaken and a calculated significance value of 0.000 was derived. For a normal distribution, a value greater than 0.05 must be obtained, thus, a normal distribution was not found and the Mann-Whitney U-test was used for further testing.

Table 4.34 - Test for Normal Distribution Hypothesis III

Lilliefors Significance Correction Applied

	Kolmogorov-Smirnov(a)			Shapiro-Wilk		
	Statistic	**Df**	**Significance**	**Statistic**	**Df**	**Significance**
Total Stress from commuting	0.096	396	0.000	0.953	396	0.000

Table 4.35 - Ranks: Hypothesis III

		N	**Mean Rank**	**Sum of Ranks**
	Are you commuting to your pilot base from outside a travel radius of 45 minutes?			
Stress/Commuting	Yes	219	184.93	40499.50
	No	177	215.29	38106.50
Total		**396**		

Table 4.36 - Test Statistics (a): Hypothesis III

(a) Grouping Variable: Are you commuting to your pilot base from outside a travel radius of 45 minutes?

	Stress imposed through commuting
Mann-Whitney U	16409.500
Wilcoxon-W	40499.55
Z	-2.627
Asymp. Sig. (2 tailed)	0.009

The Mann-Whitney U-Tests showed a result of 0.009. This shows a significant difference between the commuting pilots and home base commuters.

Table 4.37 - Case Processing Summary: Hypothesis III

		Cases					
	Are you commuting to your pilot base from outside a travel radius of 45 minutes?	**Valid** N	Per cent	**Missing** N	Per cent	**Total** N	Per cent
Stress/Commuting	YES	219	73.0	81	27.0	300	100.00
	NO	177	77.6	51	22.4	228	100.00

Table 4.38 - Descriptives: Hypothesis III

		Average	Median	Std. Deviation
	Are you commuting to your pilot base from outside a travel radius of 45 minutes?			
Stress/Commuting	YES	2.5537	2.3750	0.93463
	NO	2.8870	2.7500	1.15918

4.4.4 Results: Hypothesis III

The sample groups differ slightly around the mean and the median. The confidence intervals around the average do not intersect, which indicates an area of vagueness in the conclusion drawn from the average of the sample to the sample as a whole.

On average commuters had a 95 per cent confidence interval between 2.4292 and 2.6781 and non-commuters had a 95 per cent confidence interval between 2.7151 and 3.0590.

Thus, the statistical results derived from the survey show that commuting cockpit crewmembers have more stress than non-commuting cockpit crewmembers. It is also worth noting that, in addition to commuting-related stress, stress is already a challenging factor in the work of pilots. An analysis of individual answers indicate that pilots mostly 'agreed' that commuting imposes stress on their lives (i.e., an average of 2.16), imposes stress on their partners (i.e., an average of 2.25) and limits their socialisation time with friends (i.e., an average of 2.07).

Given that family and friends are an important factor in the way in which individuals personally cope with stress (Sloan and Cooper, 1986), pilots are at a distinct disadvantage in relation to their commutes. Because of the time away from family and friends, pilots often have to delay the coping process or cope with stress differently.

Hypothesis III; that is, commuting pilots experience more stress due to their commute, was supported by the data to be correct. The statistical analysis with the Mann-Whitney U-Tests showed a significant difference between the sample's commuting and non-commuting pilots and testing supported the hypothesis.

5 Discussion

The majority of European airline pilots (56.4 per cent) commute more than 45 minutes one-way to their designated home base. Stutzer and Frey (2007) stated that the average European commute one-way as 23 minutes. Accordingly, pilots spend longer commuting than other average European workers.

Pilot commuting is different in many aspects, the main being that it does not involve a daily commute. The analysis has shown that commuting is quite challenging in terms of time, but also in terms of stress. In fact, commuting adds another stressor to an airline pilot's already highly demanding role.

In analysing the commute situation of European airline pilots, it is important to understand the underlying trend and motivation for a pilot's commute. Drawing an empirical picture of a commute through empirical research is preferable to an "analysis of home-to-domicile distances, calculated from zip codes" (National Research Council, 2011, p. 2), which was the method used by the National Research Council in their study "The Effects of Commuting on Pilot Fatigue" (2011).

Calculating "the straightline distance from the center of the home zip code to the center of the domicile zip code" (National Research Council, 2011, p. 64) creates a significant gap in understanding as it fails to take into account commuting variables, such as mode of transport, intermediate housing facilities, frequency of commute and motivations for commuting.

On average, European pilots commute almost five times per month (4.99) between their home base and place of residency. Indeed, the results showed that 43.1 per cent of pilots commute more than five times a month and 15.9 per cent of pilots commute more than nine times a month. Thus, the data has provided a very interesting picture in relation to the frequency of commuting.

Reasons for the frequency of commutes, included intrinsic factors, such as family issues or life quality (which the study analysed) and extrinsic factors, such as commercial pressures, roster scheduling and airline duty plan optimisations or the type of operations. Leaving the

pilot to check out on the designated homebase is an advantage for the company to save on night stop, layover costs and daily allowances. Checking pilots out at homebase is easy to plan in short and mid-haul operations. However, scheduling pilots on day trips and requiring them to check in and out on the designated home base and leaving the costs for overnight accommodation to cockpit crew members is problematic, particularly when pilots could be scheduled on consecutive night stop rotations where hotel accommodation is organised by the airlines. This practice potentially aggravates the commuting situations of mid and short-haul pilots, who are at a distinct disadvantage in comparison to long haul operations.

The results of this study indicated that 70.3 per cent of pilots work in mid and short-haul environments, while 23.7 per cent are engaged in long-haul operations. Long-haul operations have different challenges, but the nature of these operations requires less frequent commuting to home base.

Surprising to the author was the results of the study in relation to the first hypothesis. Indeed, the presence of dependent children in a pilot's household was expected to be an important factor in the commuting of pilots. Roberts et al., (2011 p. 1066) conducted a gender-related commuting study and stated that "in relation to family circumstances and gender roles, we would expect these factors to be important largely for those individuals who are living as a couple, and particularly for those with children".

Commuting pilots with dependent children state with 39.5 per cent that the strongest reason for commuting home was their family situation. Objectively, pilots with dependent children do not commute significantly more often to their place of residency than pilots without dependent children.

Over a third of all pilots surveyed (i.e., 33.9 per cent) indicated that they commuted because of their family situation. However, a higher percentage of pilots (37.2 per cent) indicated that they commuted to their places of residency for a better quality of life. In the "other" answer option to this question, a majority of pilots (70.8 per cent) stated that a combination of life quality and family situation were key commuting issues.

This study shows an interesting trend in relation to its “better quality of life” and “work hours obligation reduction” hypothesis. It is almost inevitable that a decrease in work hours would result in lower incomes, thus, it is implied that pilots are weighing the value of work time and compensation levels against the stress of commuting.

It was found that significantly more European pilots (i.e., 17.6 per cent of commuting pilots) who commute from their place of residency to their home base “buy” the value of their off time through the reduction of work obligation, compared to 8.3 per cent of non-commuting pilots. A pilot’s choice of their place of residence and the quality of life at the place of residence, were considered to be the most important factors by 37.2 per cent of commuting pilots. Further, 85.5 per cent of commuting pilots indicated that they had thought about a reduction in work hours or had already reduced their work hours.

Sexton et al., (2000, p. 1) undertook a medicine and aviation cross-sectional survey about error and stress and found that “pilots were least likely to deny the effects of fatigue on performance”. They also found that: “Attitudes regarding the recognition of stressor effects indicate the degree to which individuals will place themselves in error inducing conditions” (Sexton et al., 2000, p. 3).

The author suggests that the highest objective of any pilot is to avoid making errors and, should any mistakes occur, to mitigate the consequences. Accordingly, “in aviation, perceptions of fatigue, stress, and error continue to be topics of training and targets for improvement.” (Sexton et al., 2000, p. 8)

It is evident from this study, that pilots experience stress in relation to commuting. Indeed, 71.2 per cent of pilots surveyed stated that they felt stressed by commutes and their related circumstances. In relation to pilots’ personal lives and partnerships, 68.5 per cent of pilots surveyed “totally agreed” or “agreed” with the statement commuting imposes stress on their partners. Pilots’ wives or partners play a key role in stress coping strategies and the “determinants of mental well-being” (Sloan and Cooper, 1986, p. 158), as do stable relationships.

Commuting appears to add additional friction to relationships and 47.5 per cent of participating European pilots stated that commuting issues led to discussions with their partners, endangering valuable rest time at home.

Sloan and Cooper (1986 p. 156) discussed the stressful experiences of the wives of pilots and pointed to the wives having an "overload experienced in their domestic role, which is a direct consequence of their husband´s job" (p.156). Similarly, in this study 75.8 per cent of pilots stated that commuting limits socialisation time with their friends which conforms with the Sloan and Coopers pilots wives picture that "close community ties cannot develop due to adverse effects of irregular working schedule on family plans and social engagements with friends and relatives"(p. 156).

Almost two thirds of European airline pilots (62.6 per cent) felt that commuting influences their overall life happiness and more than half (53.95 per cent) considered the safety issues connected to their commute and 42.5 per cent indicated that commuting influences the quality of their colleagues' work.

European airline pilots who commute to work are significantly more stressed than their colleagues that live within 45 minute of their home base.

Drawing the European pilot commute picture is important in understanding the potential threats that commuting imposes on the aviation system.

A National Transportation and Safety Board (NTSB) Report (NTSB/AAR-10/01 PB2010-910401, NTSB, 2010) used the word "commuting" 64 times and the word "commute" 42 times in an air accident report of 285 pages; that is, it contained 106 references to commuting, which amounts to a reference to commute or commuting on nearly every second page of the report.

Improving safety is key and a fundamental desire to the aviation system. "The aviation approach is to deal with errors non-punitively and proactively, and this approach defines behavioural strategies" (Sexton et al., 2000, p. 12). As Sexton et al., (2000, p.12) stated "to avoid error whenever possible, to trap errors when they do occur, and to mitigate the

consequences of error before they escalate into undesirable states" is the mission, which also applies to pilot commuting.

Interestingly, commercial pressures are an important issue in the well performing worldwide aviation safety system. New European harmonised rules to avoid flight crew fatigue are in the legislative process and should be "fully implemented by the end of 2015". (EASA, 2014)

It is also worth noting that the majority of stakeholders approached to contribute to this study via the distribution of the survey to their pilots, were quite reserved and only a few agreed to distribute the survey to increase participation by pilots.

The FRMS implementation guide for operators, published by ICAO describes the FRMS as a "data-driven means of continuously monitoring and managing fatigue-related safety risks" (ICAO, 2011, p. 4). The European Airline Pilot Commute Study appears to be the first study where data about the European pilot commute situation has been gathered and analysed. The ICAO (2011, p. 6) outlined a "Fatigue Hazard" as being an "Extended commute prior to scheduled flight duty period" and recommended mitigation take place at a personal-pilot level, such that pilots "arrive at duty location with sufficient time to allow adequate sleep, ensuring fitness for duty" (ICAO, 2011, p.6). This is the only reference to commuting by the ICAO and this reference was restricted to comments about the period prior to duty, thus, leaving the responsibility of commuting at a micro/personal pilot level.

Gander et al., (2011, pp. 582) broadens this perspective and emphasises that "extended driving to and from work also poses hazards to both the commuter and other road users" and further points out the importance of educating awareness "on the use of appropriate fatigue mitigation strategies, including strategies to assist individuals to arrive at work in the best possible (least fatigued) condition, and strategies to help maintain a safe level of functioning at work and commuting home". (2011, p.583)

As the United States report on "The Effects of Commuting on Pilot Fatigue" (2011) explained some operators as stakeholders in the aviation safety system are actively engaged in the management of the pilot commute and make it possible to plan and book jump seats, or rest facilities at the pilots' home bases and also include the commute time in the overall duty

time calculations. Such operators are putting an effort into and taking responsibility for the aviation safety system.

A joint effort from aviation industry and airline pilot associations, governing on the one hand the pilot commute and on the other hand, the duty and rest requirements will balance the interests and costs of various groups in respect of not over restricting the freedom of choice where pilots live.

The voluntary reduction of work commitments and careful deliberation about commuting and its connected stressors by cockpit crew members is a mature behaviour and a means of implementing a defence (Reason, 1997). However, individual pilots at a micro-level are covering for an overall un-governed commuting situation that is a latent factor that imposes danger to the aviation system worldwide.

Rules that govern an airline pilot's commute at both the micro (pilots') level and the macro (legislative or operators') level will foster safety in the European sky.

6 CONCLUSION AND RECOMMENDATION

6.1 Conclusion

Commuting is an important issue in most pilot careers. As the first of its kind, the European Airline Pilot Commute Study revealed that the majority of pilots surveyed were considering decreasing their work commitments to compensate for negative effects of commuting.

To date, only vague attempts have been made (in the form of aviation legislation) to deal with and include commuting as part of an overall safety management system. As this study showed, commuting is a significant stressor for pilots and the combination of pre-conditioned stress and the time taken up by commuting is an additional burden on European pilots.

The objective of this thesis was met and the statistical acceptance or rejection of the hypotheses of this work revealed important factors in the pilot commute situation in Europe, including motivation for commutes in relation to children, a propensity towards a reduction in work commitments and the stress experience by pilots as a result of commutes.

Interest from participants in the European Airline Pilot Commute Study was very strong, particularly from individual crew members who commute constantly. From the airlines and bodies who officially represent European pilots, interest was weighted against the possible negative results that might have arisen from the study. Considering the sensitivity of the topic and industry and regulatory interests, a joint engagement on the topic for future progress would be desirable.

The results of the unregulated exposure of the aviation industry to the pilot commuting situation has been seen and addressed already in one aviation accident. Pilot commuting as a source of stress and fatigue is a precondition in a potential organisational or even industry error situation.

Regulating, managing or mitigating the exposure risk of a pilot's commute has obviously not yet reached critical levels. Indeed, it appears that no steps are presently being taken to regulate pilots' commuting.

6.2 Recommendation

The aviation industry has historically been a leader in operational safety developments. The ongoing development of the aviation safety system must continue and expand as new, or previously neglected aspects, arise within the system, including latent conditions.

Encouraging commuting through the offer of discounted or free airline travel tickets (an industry standard connected to airline basing policies) and then leaving it to cockpit crew members to individually handle the commute to work, responsibly and professionally, is disconcerting and an abuse to a safety system in which operators encourage and tolerate pilot commuting.

All stakeholders in the aviation industry should aspire to expand and implement a safety system that regulates and mitigates the possible dangers present in pilot commutes.

6.3 Further Research

In this thesis, out of the high amount of data derived from the European Airline Pilot Commute Study, only few aspects could be considered. Further research and analysis should be conducted to investigate the various modes of transport used and the average duration and distance of pilot commutes in Europe. Pilots' self-perceived performance on commuting days should be analysed as well as the factors that influence their wellbeing and the stress that commutes generate. An optimum-commuting model, in relation to mode, form, distance and benefits or restraints, should be designed and developed.

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APPENDICES

Appendix A

European Airline Pilot Commute Study - Questionnaire

Introduction

Dear Colleagues,

Commuting has been aviation industry standard for pilots for many years.

At one time or another, every pilot will have to make career decisions related to commuting.

Very little is known about how European Airline Pilots commute to work.

At this time no scientific study has been conducted on this topic. There is a lack of knowledge on how the European Airline Pilot Corps comes to work.

This is the basis for this very comprehensive survey. To gather information on how, why a how often you commute to your home base, not to forget how the commute is affecting your very personal private & work life.

Even when you are living on or near your home base, you can add scientifically relevant details about your way to work to this study.

The study is conducted under the academic supervision of Dr Matthew Greaves, Cranfield University, UK.

It is important to mention that your answers will be 100 per cent with no traceable name as well as confidential and used for research only.

With your answers you will contribute significantly to understanding the European Airline Pilot commuting situation.

Many thanks for your participation & for adding safety to our skies,

Capt. Thomas M. Friesacher

Cranfield UNIVERSITY

General / Biographical Part

1 Sex: (Compulsory)

- Female
- Male

2 Age: (Compulsory)

in years

3 Personal status: (Compulsory)

Please select

4 Have you been divorced before: (Compulsory)

Yes No

5 Number of own Children: (Compulsory)

Please select

6 Dependent children living in household: (Compulsory)

Please select

7 Age of youngest Child in household (Compulsory)

in years Please select

8 Country of residency: (Compulsory)

Please select

9 Form of Housing at Place of Residence: (Compulsory)

- House
- Apartment
- Shared Housing
- Other:

10 Mode of Housing: (Compulsory)

- Ownership
- Rent
- Other:

11 Country of Operator:

Please select

12 Country of Crew base:

Please select

13 Airline:

TWO LETTER ICAO CODE

14 Type of Airline: (Compulsory)

Please select

15 Operation Schedule:

Please select

16 Personal Type of Operation: (Compulsory)

Please select

17 Job Position:

Please select

18 Total Time of Pilot Employment in years: (Compulsory)

19 Number of previous pilot Jobs:

Please select

20 Years with current employer:

21 Approximate Total Flight Time: (Compulsory)

in total hours

Dividing Question Commuter – NON Commuter

22 Are you commuting to your pilot base from outside a travel radius of 45 minutes? (Compulsory)

Pilot Base is the place where you are based according to your employment contract. The place where you start and end your work obligation.

Please select

COMMUTER PART

23 I would change my type of aircraft to be based closer to my place of residency?

strongly agree	somewhat agree	neutral/no opinion	somewhat disagree	strongly disagree
○	○	○	○	○

24 I would change my position (First Officer/Captain or vice versa) to be based closer to my place of residency?

e.g. Upgrading to commuter – Downgrading to Homebase

strongly agree	somewhat agree	neutral/no opinion	somewhat disagree	strongly disagree
○	○	○	○	○

25 I would change my employer to be based closer to my place of residency?

strongly agree	somewhat agree	neutral/no opinion	somewhat disagree	strongly disagree
○	○	○	○	○

26 Would you like to reduce your work hours/days (part time employment) to accommodate your commuting? (Compulsory)

I think about permanent reduce	I think about temporarily reduce	I reduced the work hours in the past	I have reduced it	Maybe in future	No, I'm not interested in reducing it
○	○	○	○	○	○

27 To what percentage did you reduce your working obligation/month?

Please enter percent (%) in full numbers

28 Does your employer offer different cockpit crew bases? (Compulsory)

Yes No

29 Does your employer offer commuting benefits?

Yes No

30 Which benefits are these?

(Multiple answers are possible)

Discounted travel tickets | Free travel Tickets | Preferred rostering | Rostering bidding System | Commuting contract | Other | None

31 Did you change your employer because of residential issues:

Please select

32 How important is the residential issue for changing the employer?

Very important | Somewhat important | Neither important nor unimportant | Somewhat unimportant | Very unimportant

33 Are you on a waiting list to be based on base closer to your place of residence?

Yes No

34 Do you have a commuting history in your past pilot career?

Yes No

35 How far is your residence from your pilot base (in KM): (Compulsory)

Please enter full number of KM

36 How far is your residence from your pilot base in travel time: (Compulsory)

Time in hh:mm

37 Are you using multiple forms of transport to commute to your pilot base (Car, Train, Bus, Aircraft, etc.)? (Compulsory)

On a regular commute to your pilot base from your place of residence which form of transport do you use active or passive and what is the approximate time spent on each mode of transport

Active means as a driver of a car for example;

Passive means as a passenger of a bus for example

Please enter time in format hh:mm

	Active (Time)	Passive (Time)
Car		
Bus / Tram / Metro		
Aircraft		
Train		
Bike		
Other		

38 Does your employer offer resting facilities at your home base?

Yes No Not Sure

39 What best describes the form of these resting facilities?

(Multiple answers are possible)

Crew lounge | Flat beds | separate Sleeping chairs | Resting rooms | Hotel room | Shared room at crew base

Other

40 Are these resting facilities free of charge?

Yes No Not Sure

41 Are these resting facilities permissible for overnight stay?

Yes No Not Sure

42 How often per month, in an average duty schedule do you commute to your place of residence?

0 1 2 3 4 5 6 7 8 9

If >9, how often:

43 Do you plan your commute on a long term schedule?

Never Sometimes Often Almost Always Always

44 How often do you experience problems in your commute?

(Delays, Flight Cancelations, No Seat available, etc.)

Never Sometimes Often Almost Always Always

45 How often do you have to cancel/change your commute due to external factors?

Never Sometimes Often Almost Always Always

46 Does Your Employer provide you with free commuting tickets?

Yes No Not Sure

47 Approximately how much money do you spend per month on commuting?

Please specify amount in EUROS

0- 50 50-100 100-150 150-200 200-250 250-300 300-400 400-500 500-600 600-700

if > 700, please specify amount:

48 Do you use an intermediate housing facility at your homebase?

An intermediate housing facility is a place in your use where you regularly stay at your homebase. (eg. room or shared apartment at your homebase)

Yes Sprung -> "What form of interme..." | No Sprung -> "Does your employer h..." | I did in the past Sprung -> "Does your employer h..."

49 What form of intermediate housing do you use?

Flat Shared Apartment Hotel room Shared Room

50 Are you sharing the intermediate housing facilities with other people?

Yes No

51 With how many other persons are you sharing?

0 1 2 3 4 5 6 7 8 9

If >9, please specify:

52 How often do you stay there per month?

0 1 2 3 4 5 6 7 8 9

If >9, please specify:

53 Do you have to pay for the use of intermediate housing at your homebase?

Yes No

54 Approximately how much is the cost of your intermediate housing facilities per month?

Please specify in Euros

0-50 50-100 100-150 150-200 200-300 300-400 400-500 500-600 600-700 700-800

If >800, please specify:

55 How far is your intermediate housing facilities from your pilot base? (in KM) (Compulsory)

Please enter full KM

56 How far is your intermediate housing from your pilot base in travel time? (Compulsory)

Please enter hh:mm

57 Are you using multiple forms of transport to commute to your pilot base? (Car, Train, Bus, Aircraft, etc.) (Compulsory)

On a regular commute to your pilot base from your intermediate housing which form of transport do you use active or passive and what is the approximate time spent on each mode of transport
Active means as a driver of a car for example;

Passive means as a passenger of a bus for example

Please enter time in format hh:mm

	Active (Time)	Passive (Time)
Car		
Bus / Tram / Metro		
Aircraft		
Train		
Bike		
Other		

58 Does your employer have procedures / protocols in their operation manual in place surrounding the employee commuting issue? (Compulsory)

Yes No Not sure

59 Does your employer / rostering department know that you are commuting to work? (Compulsory)

Yes No Not sure

60 Does your employer specify a radius in km and /or travel time around your crew base, where you have to have your place of permanent residence? (Compulsory)

Yes No Not sure

If yes, please specify KM or hh:mm

61 Does your employer have a rostering systems incorporating crew commuting? (Compulsory)

Yes No Not sure

62 How do you feel about your commute? (Compulsory)

	Totally Agree	Agree	Neither agree / nor disagree	Disagree	Totally disagree
Commuting impose stress on my life					
Commuting imposes stress on my partner					
Commuting leads to discussions in my relationship					
Commuting limits the socialisation time with my friends					
Friends turned away from me because of my commuting/time issues					
Commuting makes me think about the safety					

issues connected to my commuting					
I think that commuting influences the quality of my colleagues work	○	○	○	○	○
Commuting influences my overall life happiness	○	○	○	○	○

63 How satisfied are you with your life, all things considered? (Compulsory)

completely dissatisfied	○	○	○	○	○	○	○	○	○	○	○	completely satisfied

64 Your reasons for commuting? (Compulsory)

	Totally Agree	Agree	Neither agree / nor disagree	Disagree	Totally disagree
My housing situation / cost of housing influence the decision to commute	○	○	○	○	○
My family situation influences the decision to commute	○	○	○	○	○

65 What is your main reason for commuting? (Compulsory)

- ○ Higher income
- ○ Cheaper housing at place of residency
- ○ Social bands at place of residency
- ○ Better life quality at place of residency
- ○ Family situation
- ○ Other:

66 Do you consider relocating to your crew base? (Compulsory)

○ Yes ○ No

67 Relocation considerations? (Compulsory)

	Never	For Sure
Do you consider relocating closer to your crew base		
Will you be relocating closer to your crew base in the future		

68 Pilot Self Assessment (Compulsory)

Think about your last few flights recently on days where you commuted to work.

1. Consider how well or badly you performed.
2. Examine the list of elements below; they are different ways of assessing performance.
3. Please rate yourself on the scales by marking your answer.

Remember, we are relying on you to make this as accurate of a scientific measure as possible.

The answers are 100% anonymous and confidential

Being ahead of the game:

	2	1	0	1	2	
Ahead for 100% of flight						Behind for 100% of flight

69 Excess mental capacity: (Compulsory)

	2	1	0	1	2	
No excess capacity during flights						Plenty of excess capacity during flights

70 Coping with things that go wrong: (Compulsory)

	2	1	0	1	2	
Coped very satisfactorily						Coped very unsatisfactorily

71 Attaining self-set levels of performance: (Compulsory)

2 1 0 1 2

Did not attain self-set of performance for flights

Attained self-set levels of performance for flights

72 Smoothness and accuracy of approaches: (Compulsory)

2 1 0 1 2

Very smooth & accurate approaches

Very unsmooth & inaccurate approaches

73 Smoothness and accuracy of landings: (Compulsory)

2 1 0 1 2

Very unsmooth & inaccurate landings

Very smooth & accurate landings

74 Degree of basic airmanship exhibited: (Compulsory)

2 1 0 1 2

Very high degree of basic airmanship

Very low degree of basic airmanship

75 Overall smoothness of flights: (Compulsory)

2 1 0 1 2

Very unsmooth

Very smooth

76 Quality of interpersonal relations with aircrew: (Compulsory)

2 1 0 1 2

High and Satisfactory Quality — Low and unsatisfactory Quality

77 Degree of mental and physical coordination: (Compulsory)

2 1 0 1 2

Very low degree of coordination — Very high degree of coordination

78 Number of errors made: (Compulsory)

2 1 0 1 2

Relatively high number — Relatively low number

79 Extent of errors made: (Compulsory)

2 1 0 1 2

Relatively high importance — Relatively low importance

80 Satisfaction with flights generally: (Compulsory)

2 1 0 1 2

Very high degree of satisfaction — Very low degree of satisfaction

81 Ability to divide attention: (Compulsory)

2 1 0 1 2

Very low ability — Very high ability

82 Many pilots when asked to assess the quality of their performance reply that it is "just a feeling" -can you assess yourself on a scale in this way? (Compulsory)

2 1 0 1 2

Very good — Very poor

NON COMMUTER PART

83 Did you change your employer in the past to be based closer to your place of residency?

Yes No

84 I would change my type of aircraft to be based closer to my place of residency? (Compulsory)

strongly agree somewhat agree neutral/no opinion somewhat disagree strongly disagree

85 I would change my position (First Officer/Captain or vice versa) to be based closer to my place of residency?

e.g. Upgrading to commuter – Downgrading to Homebase

strongly agree somewhat agree neutral/no opinion somewhat disagree strongly disagree

86 I would change my employer to be based closer to my place of residency?

strongly agree somewhat agree neutral/no opinion somewhat disagree strongly disagree

87 Would you like to reduce your work hours/days (part time employment) to accommodate your commuting?

I think about permanent | I think about temporarily | I reduced the work hours in | I have reduced it | Maybe in future | No, I'm not interested in

reduce ○ reduce ○ the past ○ ○ reducing it ○

88 To what percentage did you reduce your working obligation/month?

Please enter percent (%) in full numbers

89 Does your employer offer different cockpit crew bases?

Yes ○ No ○

90 Does your employer offer commuting benefits? (Compulsory)

Yes ○ No ○

91 Which benefits are these?

Discounted travel tickets ○ Free travel Tickets ○ Preferred rostering ○ Rostering bidding System ○ Commuting contract ○

Other ○ None ○

92 Did you change your employer because of residential issues?

Yes ○ No but I think about it ○ No there is no need for a change ○

93 How important is the residential issue for changing the employer?

Very important ○ Somewhat important ○ Neither important nor unimportant ○ Somewhat unimportant ○ Very unimportant ○

94 How far is Residence from your pilot base? (in KM): (Compulsory)

Please enter full amount of KM

95 How far is your residence from your pilot base in travel time: (Compulsory)

Time in hh:mm

96 Are you using multiple forms of transport to commute to your pilot base? (Car, Train, Bus, Aircraft, etc.) (Compulsory)

On a regular commute to your pilot base from your place of residence approximate time spent on each mode of transport

Active means as a driver of a car for example;
Passive means as a passenger of a bus for example
Please enter time in format hh:mm

	Active (Time)	Passive (Time)
Car		
Bus / Tram / Metro		
Aircraft		
Train		
Bike		
Others		

97 Does your employer have procedures / protocols in their operation manual in place surrounding the employee commuting issue? (Compulsory)

Yes No Not sure

98 Does your employer specify a radius in km and /or travel time around your crew base, where you have to have your place of permanent residence?

Yes No Not sure

If yes, please specify KM or hh:mm

99 Does your employer have a rostering systems incorporating crew commuting?

Yes	No	Not sure
○	○	○

100 How do you feel about your commute?

	Totally Agree	Agree	Neither agree / nor disagree	Disagree	Totally disagree
Commuting impose stress on my life	○	○	○	○	○
Commuting imposes stress on my partner	○	○	○	○	○
Commuting leads to discussions in my relationship	○	○	○	○	○
Commuting limits the socialisation time with my friends	○	○	○	○	○
Friends turned away from me because of my commuting/time issues	○	○	○	○	○
Commuting makes me think about the safety issues connected to my commuting	○	○	○	○	○
I think that commuting influences the quality of my colleagues work	○	○	○	○	○
Commuting influences my overall life happiness	○	○	○	○	○

101 How satisfied are you with your life, all things considered? (Compulsory)

completely dissatisfied	○	○	○	○	○	○	○	○	○	○	○ completely satisfied

102 Pilot Self Assessment Questions (Compulsory)

Think about your last few flights recently.

1. Consider how well or badly you performed.
2. Examine the list of elements below; they are different ways of assessing performance.
3. Please rate yourself on the scales by marking your answer.

Remember, we are relying on you to make this as accurate as a scientific measure as possible.

The answers are 100% anonymous and confidential

Being ahead of the game:

2 1 0 1 2

Ahead for 100% of flight — Behind for100% of flight

103 Excess mental capacity: (Compulsory)

2 1 0 1 2

No excess capacity during flights — Plenty of excess capacity during flights

104 Coping with things that go wrong: (Compulsory)

2 1 0 1 2

Coped very satisfactorily — Coped very unsatisfactorily

105 Attaining self-set levels of performance: (Compulsory)

2 1 0 1 2

Did not attain self-set of performance for flights — Attained self-set levels of performance for flights

106 Smoothness and accuracy of approaches: (Compulsory)

2 1 0 1 2

Very smooth & accurate approaches — Very unsmooth & inaccurate approaches

107 Smoothness and accuracy of landings: (Compulsory)

2 1 0 1 2

Very unsmooth & inaccurate landings — Very smooth & accurate landings

108 Degree of basic airmanship exhibited: (Compulsory)

2 1 0 1 2

Very high degree of basic airmanship — Very low degree of basic airmanship

109 Overall smoothness of flights: (Compulsory)

2 1 0 1 2

Very unsmooth — Very smooth

110 Quality of interpersonal relations with aircrew: (Compulsory)

2 1 0 1 2

High and Satisfactory Quality — Low and unsatisfactory Quality

111 Degree of mental and physical coordination: (Compulsory)

2 1 0 1 2

Very low degree of coordination — Very high degree of coordination

112 Number of errors made: (Compulsory)

2 1 0 1 2

Relatively high number — Relatively low number

113 Extent of errors made (Compulsory)

2 1 0 1 2

Relatively high importance — Relatively low importance

114 Satisfaction with flights generally: (Compulsory)

2 1 0 1 2

Very high degree of satisfaction — Very low degree of satisfaction

115 Ability to divide attention: (Compulsory)

2 1 0 1 2

Very low ability — Very high ability

116 Many pilots when asked to assess the quality of their performance reply that it is "just a feeling" -can you assess yourself on a scale in this way? (Compulsory)

2 1 0 1 2

Very good — Very poor

Send Off

We thank you for your participation!

&

For adding valuable information to our scientific research regarding European pilot commuting habits.

Thanks you for adding safety to our sky! Please commute responsibly!

Yours sincerely,

Capt. Thomas M. Friesacher,

Cranfield University, UK

Appendix B

Cranfield UNIVERSITY

Dear appreciated colleague,

Commuting has been an issue in most pilot careers.

To gain further insight Cranfield University, UK is conducting the

EUROPEAN AIRLINE PILOT COMMUTE STUDY

-

It closes an important scientifical gap.

The scientific university study is looking into the modes, time spent, housing issues, etc. the way to flight duty generates.

The Study is conducted anonymously and confidentially, for scientific research only.

Please join our Study and invest a short time in aviation safety research.

We would appreciate a response to all questions so as to generate maximum benefit from the research.

To add your valuable information & to participate in the study

Click on:

European Airline Pilot Commute Study

Thanks you for adding safety to the sky!

With collegial greetings,
Thomas M. Friesacher

Thomas M. Friesacher
Cranfield University

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Appendix C

Cranfield UNIVERSITY

Dear appreciated colleague,

Commuting has been an issue in most pilot careers.

To gain further insight Cranfield University, UK is conducting the

EUROPEAN AIRLINE PILOT COMMUTE STUDY

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To add your valuable information & to participate in the study

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European Airline Pilot Commute Study

Thanks you for adding safety to the sky!

With collegial greetings,

Thomas M. Friesacher

_____

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