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Do Economics Matter in the Flight Deck?

A Statistical Analysis

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Foreword

This thesis marks an end to a long journey through the academic environment that is a Master’s degree in Aviation Science at the University of Tromsø, Norway. Taking this course part-time while working full-time has been challenging, while also being very instructive. First, I want to thank my supervisor for this thesis, Robert Schenk, for his guidance in producing this paper. You have been of tremendous help, and this thesis would not exist without all the time you have offered for your assistance. Furthermore, I would like to thank Jens Andreas Terum for his initial guidance in putting me on the right track and Elinor Ytterstad for her invaluable insight and assistance with the statistical part of the paper. Lastly, I would like to thank my friends, colleagues, and family for their support and for listening to me complain about having too much to do all the time. Writing a thesis of this scope seemed daunting, bordering on impossible, but with the help, support, and guidance of everyone mentioned here, the final product you are now reading came to fruition.

Livet er et lære, man må alltid lære.

Tord Nedrebø

Abstract

The aviation industry operates within a dynamic framework influenced by economic factors, safety concerns, and operational considerations. It is an industry easily influenced by global events and geopolitics, making airlines straddle a fine line between profitability and financial ruin. The purpose of this paper is to explore the importance of financial factors in the decision-making processes of flight crews. It aims to establish under what conditions these factors are considered essential and to what degree they influence the final decisions made in the flight deck.

Using literature on human factors, decision-making, and crew interaction and cooperation, this paper aims to understand the presence of economic factors in the flight deck. It also explored the relationship between safety and economy to dissect the intricate relationship these economic considerations have with safety and any implications. Furthermore, a questionnaire was sent to several organisations in the Scandinavian aviation industry, resulting in a sample of N = 38. The questionnaire measured several factors: the type of flight activity, experience in flight hours, performance and skill maintenance, financial factors, and job satisfaction. These variables were measured against two dependent variables: the importance of financial considerations and to what degree these considerations were the deciding factor in flight crews' decisions. This was analysed statistically using Spearman rank correlation, independent sample t-test testing several hypotheses, and multiple regression analysis.

Results show that financial factors are important considerations among flight crew engaged in commercial flight activity. Furthermore, the degree of importance of these factors is influenced by the flight crew's experience, their perception of financial struggle in the companies they work for, and any financial restrictions that come with this. Pilots with high job satisfaction put less emphasis on economic considerations, while those looking to switch jobs do the opposite. Economic factors are shown to have a presence in the flight deck, as pilots report that they both evaluate and often place great importance on them, which may lead to safety concerns. However, the findings in this study suggest that when safety issues are present, economic concerns are no longer prioritised.

Acronyms and Abbreviations

Acronym/Abbreviation	**Explanation**
CAT	Commercial Air Transport
CRM	Crew Resource Management
EASA	European Union Aviation Safety Agency
GA	General Aviation
HFACS	Human Factors Analysis Classification System
HRA	Human Reliability Analysis/Assessment
NCO	Non-Commercial Operations
RPD	Recognition-Primed Decision-making
SD	Standard Deviation
SPSS Statistics	Statistical Product and Service Solutions, a statistics analysis software from IBM
TEM	Threat and Error Management
VIF	Variance Inflation Factor

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1 Introduction

Aviation has always been highly volatile and massively affected by global events. Most recently, the world saw the effects of COVID-19 on the global economy, with aviation being hit especially hard. Over 60% (Michelmann et al., 2022) of global flights were cancelled, and most aircraft were grounded and aircrew put on hold. As the pandemic went on, many airlines that struggled before it went bankrupt and several others downsized and sold off assets to lessen the economic burden placed upon them (Michelmann et al., 2022). This resulted in many personnel losing their jobs and being without work for the better part of two years before the industry started to recover. As big of an impact the COVID-19 pandemic had on the aviation industry, it was not the first time the industry was hit hard by a global crisis. During the 2008 financial crisis, many airlines went bust as the demand for air travel took a nosedive, and those who survived exited the crisis in a severely weakened economic state (Macário & Van de Voorde, 2009). This also caused many people to lose their jobs. Another crisis which had a tremendous impact on the aviation industry, especially in the United States, was the September 11 terrorist attacks. Airlines filed for bankruptcy, while many other large carriers engaged in dramatic cost-cutting programs. The prospects for a lack of recovery in passenger demand impacted the industry for several years after the attacks (Ito & Lee, 2005).

Crises like these underscore the importance of financial stability for the industry and the people within. Even though pilots may not be directly responsible for the airlines' financial success, these events might make them more aware of their roles in the larger organisation. It is essential to acknowledge that aviation is one of many high-risk industries worldwide. With high risk comes great responsibility, and the industry takes safety seriously. Aviation has gone from being relatively prone to accidents to one of the safest transportation methods, as fatalities have decreased by 95% in the past 20 years alone (FAA, 2018). Safety comprises many different aspects, all working together to ensure passengers and cargo remain safe.

1.1 Relevancy

The concern arises when safety and economic goals or considerations clash. What happens when pilots are put in an impossible situation and must choose between severe financial consequences or violating safety precautions? An example could be choosing between diverting or not due to weather and safety concerns, which would be a significant cost to the airline to arrange accommodations for 200 passengers and crew. Research on this topic is sparse, but there have been several studies on pilots and their attitudes to weather minimums. In an article by Winter et al. (2020), it was found that in a simulated environment, over 95% of pilots breached their previously stated personal minimums, while over 80% descended below published legal minimums. A simulated financial incentive was provided, but this did not show any statistically significant correlation with the results. On behalf of the United States government, a study by Knecht et al. (2005) investigated what makes General Aviation (GA) pilots take off in marginal weather conditions. This study tested many personality traits; however, none gave any statistically significant answers, whereas financial incentives were the only reliable predictor for predicting a take-off in marginal conditions. These incentives ranged from setting aside time to do a flight to having appointments that must be attended and missing them resulting in financial loss (Knecht et al., 2005). In a follow-up study, these findings were further supported as GA pilots may take more risk when facing "social [and] economic pressures" (Knecht, 2008, p. i). Furthermore, a study of risk and decision-making by Causse et al. (2011) found that pilots may take more risk when facing financial incentives. The study concluded that risky decision-making may result from "economic constraints and uncertainty" (Causse et al., 2011, p. 231). However, no studies have examined how prevalent these economic pressures or incentives are in flight crews' decision-making processes and how pilots account for them in their daily operations.

1.2 Objective

Studies have shown in other high-risk industries that economic concerns do not necessarily negatively impact safety. This study aims to gauge what the case is for aviation. Moreover, the objective of this paper is threefold. The primary objective is to explore the importance pilots place on the financial consequences of their actions and to what extent they consider the economic ramifications of their decisions. Secondly, the study aims to understand to what extent these financial considerations are the deciding factor in the decisions pilots make daily. Lastly, the possible impact of these financial considerations on aviation safety is discussed.

1.3 Scope and Layout of the Study

The world of human psychology is vast and complex and under constant change through discoveries and research as experts continue to deepen their understanding of the human mind. This study is limited to the decision-making processes among flight crews and will touch upon human factors, safety, and economics. As such, to focus the scope of the study, the following is included in this study:

- Chapter 1: Introduction
    - In the introduction, this study is justified, focusing on the relevance for the aviation industry and an overview of similar research on the topic. Furthermore, the objective and scope of the study are presented.

- Chapter 2: Literature
    - The chapter presents the overarching literature to establish context and theories to discuss the results. The elements of the literature chapter are human factors, decision-making, crew resource management (CRM), threat and error management (TEM), and the relationship between safety and economics.

- Chapter 3: Methodology
    - The methodology chapter includes an overview of the methodology used in this paper and further elaborates on the variables chosen for statistical analysis. A survey was conducted to gather the data used for the analysis. Respondents were probed in five areas: general, experience, performance, financial, and job satisfaction. This provided the foundation for the statistical analysis in this paper.

- Chapter 4: Results
    - In the results chapter, the results from the survey are presented, together with the results from the statistical analysis, correlation and hypotheses testing. The multiple regression models are also presented in this chapter.

- Chapter 5: Discussion
    - Here, the findings in the results chapter are discussed. The significance of the different variables is discussed, and thoughts on decisions, safety, and economics are offered in the flight deck. The chapter ends with some discussion on the topic of responsibility and accountability.

- Chapter 6: Conclusion
    - A final summary of the findings and essential points from the discussion is found in the conclusion, including a presentation of the limitations of the thesis and suggestions for future research.

2 Literature

This chapter includes literature in two main categories: human factors and the relationship between safety and economics. The literature on human factors is introduced to understand what influences humans in high-risk operational environments and how experts understand the decision-making processes, while the literature on safety and economics is presented to establish context and to explain current theories on the issues that this study is exploring, which will be used in the discussion part of this thesis.

2.1 Human Factors

Safety research in the aviation industry focuses on many different factors. Typically, there is a focus on the advanced technology employed in the sector, and examinations of technical causes of accidents are commonplace. These causes have been analysed in academic papers, including communication and misunderstandings (Hazrati, 2015), loss of control over the aircraft (Ancel et al., 2015), and runway incursions and excursions (Monro & McLean, 2004; Wagner & Barker, 2014). Underlying all of these cases is the growing belief that human factors are the main component contributing to aviation accidents (Strauch, 2017). Early in aviation's history, it was believed that the leading causes of accidents were technical failures (Gong et al., 2014). Through research, experts can now attribute around 70-80% of all accidents to causes involving human factors (Strauch, 2017). Furthermore, Munene (2016) found that the largest categories of human error were skill-based errors, which were present in 56,4% of the cases studied, the environment or hardware-liveware interaction, present in 36,4%, and violations, present in 20%. Additionally, decision errors were present in 18,2% of cases, and perceptual errors were present in 10,9%. This study was conducted in Kenya, Nigeria, and South Africa. These countries were commonly considered “third world” (Tomlinson, 2003); however, most accidents cannot be attributed to poor or outdated equipment and technology.

2.1.1 Human Factors Analysis Classification System (HFACS)

Experts usually employ Human Reliability Analysis or Assessment (HRA) systems when assessing human factors. HRAs are a systematic approach to identifying human failures and describing the human contribution to events (Guglielmi et al., 2022). There are several studies showcasing a variety of different types of HRAs focusing on many different high-risk industries. An excerpt of these methods was highlighted by the National Aeronautics and Space Administration (NASA) in a 2006 assessment of space applications, including the Technique for Human Error Rate Prediction (THERP), Nuclear Actions Reliability Assessment (NARA), Cognitive Reliability and Error Analysis Method (CREAM), and Standardized Plant Analysis Risk HRA (SPAR-H) (Chandler et al., 2006). These are all applicable tools for human factor analysis, but the main framework used in aviation is the Human Factors Analysis Classification System (HFACS; Wiegmann & Shappell, 2003). This methodology has been used in many different industries, such as oil and gas (Nwankwo et al., 2022), healthcare (Cohen et al., 2018), rail (Zhan et al., 2017), maritime (Kaptan et al., 2021) and aviation (Li & Harris, 2006). HFACS is a human error framework based on the "Swiss Cheese" model by James Reason (1990). It integrates principles from human factors psychology, cognitive psychology, and organisational psychology to understand human performance in complex systems and environments comprehensively (Ergai et al., 2016). The framework divides human factors into a hierarchy of four levels defining 19 subcategories (see Figure 1).

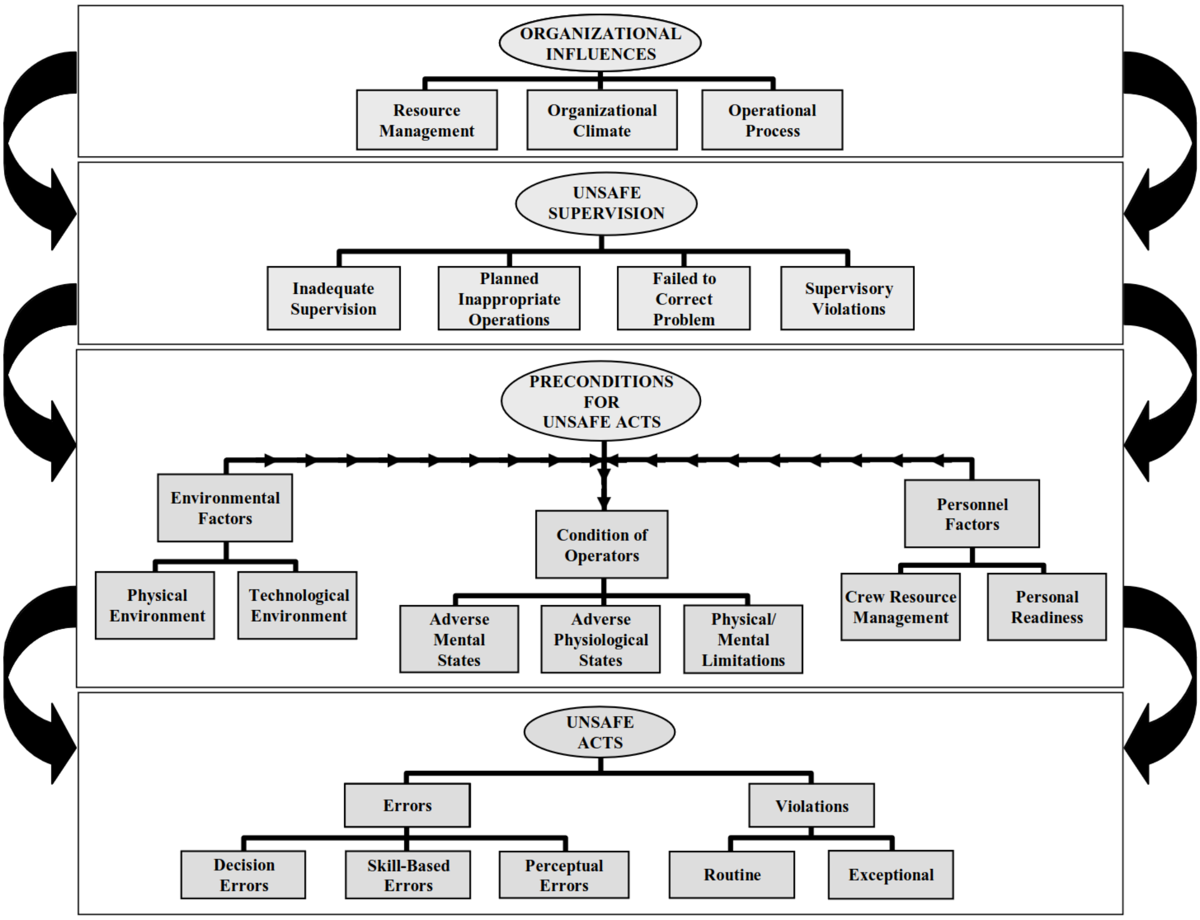

Figure 1: The HFACS framework (Shappell et al., 2007)

These four main categories are organisational influences, unsafe supervision, preconditions for unsafe acts, and unsafe acts. The interaction between these tiers is based on a progression from unsafe acts to organisational influences, from active to latent conditions moving up the hierarchy (Ergai et al., 2016). In other words, it describes that unsafe acts made by sharp-end personnel are usually rooted in deeper causes within the environment and the broader organisation, such as a lack of oversight or mismanagement of organisational resources.

What most of the HRAs have in common is that they are analysis tools made to be used after an accident or incident has occurred. It is used to examine the sequence of events leading up to and following an occurrence, which can then be analysed and dissected according to the appropriate model's methodology. They are not usually tools used in a preventive manner (Alexander, 2019) but rather to analyse and prevent similar events in the future.

2.1.2 Decision-making

In high-risk industries with intricate operational environments and significant potential for adverse outcomes, effective decision-making is pivotal in ensuring operational efficiency, safety, and resilience. In such environments, the margin for error is usually slim, and the consequences of decisions can be profound, highlighting the need to understand the decision-making processes. From aviation to healthcare or nuclear to fossil energy sectors, professionals in these industries are tasked with making critical choices under uncertainty, complexity, and often extreme pressure.

There are many studies on the topic of decision-making in high-risk environments. In an article by Reale et al. (2023), four overarching categories of decision-making strategies are highlighted: Recognition-primed decision-making (RPD), analytical, rule-based, and creative or innovative. RPD is a model for naturalistic decision-making introduced by Gary Klein (1989), described as "the intuitive, pattern-based situational decision-making" (Reale et al., 2023, p. 189) experts use in different situations. In other words, it is the type of decision made mainly through instinct and without much thought or debate, instead recognising patterns and applying previously learned methods and knowledge. Analytical decision-making is collecting and analysing information to develop the best path forward (Kahneman & Klein, 2009). Rule-based decision-making involves making decisions based on learned procedures to respond to events (Rasmussen, 1983). Creative or innovative decision-making applies when standard procedures or approaches are unavailable or not of interest. This type of decision-making is adaptive by nature and is used in unusual situations requiring creativity or innovation to deal with present events (Kaempf et al., 1996).

According to Reale et al. (2023), these four decision-making methods are not distinct, as rule-based decision-making is often classified as part of RPD. A pilot may recognise a situation as routine and choose his actions according to applicable procedures outlined in the company's operating manuals. In another case, one may recognise that these standardised procedures do not apply and develop a creative approach as part of RPD. A literature review found that RPD was the most frequently used decision-making strategy among healthcare professionals, naval officers and emergency personnel such as firefighters (Reale et al., 2023). Analytical approaches were primarily used in non-critical situations because of the extra time allotted to making a decision. The difference from RPD was unclear when it came to rule-based decision-making, and the apparent use of rule-based decision-making strategies was rare. This was mainly due to the studies not differentiating RPD from rule-based strategies (Reale et al., 2023). This indicates that RPD and rule-based strategies might be used in parallel, making differentiating them difficult. Very few cases were identified when it came to innovative or creative approaches. Although rare, innovative or creative decision-making processes occur in high-risk environments (Reale et al., 2023).

Furthermore, Reale et al. (2023) found two additional themes surrounding decision-making methods: time pressure and stress. Time management is one of the most important considerations a decision-maker must be able to deal with effectively. This primarily determines the type of decision-making strategy employed by experts in the field. Studies suggest that when time pressure is interpreted as low, more systematic approaches can be implemented (Weinger et al., 1994), and when time pressure is high, decision-making becomes more automatic (Cohen, 2008). In addition, poor estimation of time availability has been identified as the cause of erroneous decisions (Orasanu et al., 1993). When time is short, pilots were found to make satisfactory decisions rather than optimal ones (Mosier et al., 2007). Introducing stress into the situation can have two outcomes: a person might become overwhelmed, panicking and unable to think clearly (Tallentire et al., 2011), or it may increase alertness and focus (Wetzel et al., 2006). However, most studies find stress to negatively impact the decision-making process (Reale et al., 2023).

Lastly, it was found that experience played an essential role in effective situation assessments. Experienced emergency personnel were found to be able to stick to initial plans while avoiding delays for re-evaluations (Reale et al., 2023)—those less experienced required additional information to evaluate the situations before deciding on a revised action plan. An example of this can be seen in a study by Kale et al. (2023), where it was discovered that less experienced pilots need four times more time to make decisions in a landing or go-around situation. The ability to detect problems seems to relate to experience, where a decrease in time needed was seen in conjunction with increased experience in the field (DeAnda & Gaba, 1991). Experience significantly aided decision-makers regarding time pressure, stress, and uncertainty (Reale et al., 2023).

2.1.3 Crew Resource Management (CRM)

It is important to understand that decisions made in the cockpit are rarely a product of individuals but rather a product of team effort. In much of commercial aviation, two pilots are required on the flight deck, but in cases where there is only one crew member on an aircraft, they still have the support of services like air traffic control. It is rarely the case that a crew member is all alone, mostly in flights through remote regions where radar and communication coverage is limited. With aviation heavily dependent on cooperation and plagued by terrible accidents, Crew Resource Management (CRM) was introduced in the 1970s and widely adopted by the global industry in the 1990s (Helmreich et al., 1999). With technological improvements, the human element shows the most significant potential for safety gains (Brennan et al., 2020). CRM has gone through many iterations, and many differing definitions exist. The European Union Aviation Safety Agency (EASA) (2015) defines CRM as “the effective utilisation of all available resources to achieve safe and efficient operation.” In essence, CRM is a “team training strategy focused on improving crew coordination and performance” (Salas et al., 2006, p. 392) by focusing on communication, teamwork, situational awareness, stress management, decision-making, and leadership and followership, as well as conflict resolution and cultural factors (Flin et al., 2002; Kaps et al., 1999; Thorogood & Crichton, 2014). By enhancing flight crews’ abilities to perform effectively in high-pressure situations and through fostering a culture of open communication and mutual respect, where crew members feel empowered to voice concerns and collaborate on solutions, CRM has managed to mitigate the ever-increasing issue of human errors in aviation (Brennan et al., 2020). Furthermore, CRM has also contributed to increased awareness of human factors in aviation safety. This heightened understanding has prompted the development of comprehensive training programs and policies to address potential vulnerabilities in crew performance, furthering the positive safety effects of CRM training (Salas et al., 2006).

2.1.4 Threat and Error Management (TEM)

Threat and Error Management (TEM) is used in aviation safety to enhance decision-making and mitigate risks during flight operations. It involves identifying potential threats, errors, and undesired aircraft states and effectively managing them to maintain safety (Thorogood & Crichton, 2014). Threats are external factors that can challenge the safety of a flight. They can include adverse weather conditions, air traffic congestion, technical malfunctions, or even human factors such as fatigue or stress. Identifying threats allows pilots to anticipate potential problems and prepare appropriate responses (Brennan et al., 2020). Meanwhile, errors are human actions or inactions that can lead to deviations from the intended flight path or compromise safety. They can be further categorised into skill-based errors (e.g. slips, lapses), decision errors (e.g. misjudgements, violations of procedures), and perceptual errors (e.g. misinterpretation of information) as seen in the unsafe acts section of the HFACS framework (Shappell et al., 2007). TEM is a continuation of the development of non-technical skills among flight crews by increasing their ability to recognise and manage dangers to themselves and others (Thorogood & Crichton, 2014) and has shown to be a vital part of multi-crew operations (Taber & Taber, 2020).

2.2 Economics and Safety

While human factors are increasingly well understood, they are only part of the bigger picture. Safety in aviation is non-negotiable, underpinned by strict standards, robust regulations, and continuous technological and human advancements. However, the pursuit of safety does not exist in isolation but intersects with the economic realities that govern the industry. Airlines, manufacturers, and other stakeholders must navigate a system of financial considerations, aiming for profitability while upholding safety standards. Decisions regarding fleet management, maintenance schedules, route optimisation, and even staffing levels are influenced by economic factors and should not compromise safety. Like many other industries, aviation's economic landscape is shaped by many variables, such as fuel prices and personnel costs. For airlines, investing in state-of-the-art safety technology and training programs incurs significant costs, yet it is essential for maintaining safety and, thus, public trust. Moreover, economic pressures can sometimes create tensions with safety imperatives. Cost-cutting measures, such as deferred maintenance or reduced crew training, may appear financially attractive in the short term but can compromise safety in the long run. The interplay between safety and economics is a dynamic and intricate relationship that has shaped the aviation industry. While safety remains paramount, economic considerations exert significant influence on daily operational decisions across the globe.

2.2.1 Relationship Between Economics and Safety

To understand the impact that economic worries can have on safety, it is important to establish the relationship between safety and economics. In an article by Asche and Aven (2004), the relationship between economics and safety was explored. It found a significant relationship between what a company is projected to earn and the risk consumers experience when consuming a product. When people experience personal health-related risks, their aversion dramatically increases when they expose themselves to any product a company may offer. For this reason, companies need to deal with and plan for uncertainties through precautionary actions (Asche & Aven, 2004). The paper concludes that companies have economic incentives to invest in safety, but only to a certain extent, as not all levels of investment will result in positive safety coverage. Furthermore, as investments into safety are investments against low probability events, it may lead to companies under-investing. However, this can be mitigated as organisations that operate with significant risk often focus more on the correct organisational culture, whether it is safety-related or otherwise (Asche & Aven, 2004). Moreover, the article highlights the importance of public opinion, which industries like aviation heavily rely on, and the economic consequences of not managing risk in the public eye.

The link between profitability and safety in aviation has been studied in several papers, often finding opposing results. Rose (1990) found a positive link, while other studies (Dionne et al., 1997; Fardnia et al., 2021; Raghavan & Rhoades, 2005) found an inverse relationship between profitability and safety. Lastly, Golbe (1986) found that there was no statistically significant relationship between the two. A study by Kalemba and Campa-Planas (2019) attempted to tackle the issue using data from airlines across the globe in the 21st century. In addition to studying profitability, they also studied the relationship between safety and airline revenue, which they found previous literature lacking or obsolete. Their results agreed with Golbe (1986), as they found neither a positive nor negative link between safety and profitability in the airlines they studied. However, they found a statistically significant relationship between revenue and safety. Even though the link between profitability and safety is contested, Madsen (2013) found that airlines that are close to achieving their profitability goals record a higher number of accidents than those who are far below or above their targets, suggesting they take an increased amount of risk trying to achieve their financial goals when they are close.

2.2.2 Safety Impact of Economic Worries

Adding to this is the impact on safety performance due to economic pressures. An article by Stamolampros (2022) looked at the impact of rising costs and economic volatility on safety in the aviation industry. Earlier studies have suggested that in the face of economic pressures, companies may trade product quality to achieve short-term financial targets (Maksimovic & Titman, 1991; Dionne et al., 1997). For newer examples, consumers saw a decrease in product quality and a reduction in quantity in many industries during the post-COVID-19 pandemic economic recession (Jung & Hayes, 2023; Smialek, 2024). Stamolampros (2022) tested three variables impacting airline accidents: fuel prices, interest rates, and stock market volatility. All factors had a statistically significant negative impact on safety statistics.

The impacts of economic pressures can also be felt by the individuals in an organisation. In a study on the recession in the Norwegian hydrocarbon sector, Sætrevik et al. (2020) investigated the impact on job security and safety in the industry. The study gives insight into the evolution of perceptions and impacts of safety during an economic recession, as samples were collected before, during and after the recession had passed. Inconclusive evidence of any reduction in safety climate perceptions was seen, indicating no difference in perception before, during and after the recession (Sætrevik et al., 2020). However, perceptions of job security declined during the recession and attitudes to safety and reporting declined at the beginning of the recession but increased by the end. As there was no significant impact on safety, the conclusion was that companies managed to mitigate any impact the recession had on safety (Sætrevik et al., 2020).

An industry plagued by economic instability is the farming industry (Trompiz & De La Hamaide, 2024). A study of farms in Canada studied the impact such economic pressure had on farm workers (Hagel et al., 2013) and any safety implications that followed. Farms experiencing financial pressures experienced deterioration of building maintenance and an absence of safety measures, suggesting that economic pressures led farm operators to reduce investments into safety barriers, which may lead to increased accident rates and higher occupational hazard for workers (Hagel et al., 2013). Educating people on the economic advantages of safety investments was one of the solutions proposed.

2.3 Summary of the Literature

HFACS and other HRAs have become commonplace to understand the impact humans may have on a situation. Focusing on decision errors and understanding pilots' decision-making processes is essential. This paper highlights four main categories of decisions, the most applicable for flight crew being RPD and analytical approaches. Furthermore, CRM and TEM have been introduced as specific training regimes to aid flight crews in making better decisions to promote safety.

The other focus of this study is the consequences the decisions may have on safety and economics. These elements are closely connected, as one often impacts the other. There are economic incentives for safety investments, as accidents cost money. While the link between profitability and financial success is unclear, studies show that airlines close to achieving their financial goals suffer an increased number of accidents and incidents. Facing economic worries, companies and employees have shown tendencies to lower product quality and safety standards to maintain economic viability.

3 Methodology

The choice of an overall research approach was not straightforward. Quantitative and qualitative research approaches have advantages and disadvantages and are not necessarily opposites. Quantitative research is an empirical approach to investigating phenomena through collecting and analysing numerical data (Masters et al., 2006). It is a methodological framework employed across various disciplines, including social sciences, natural sciences, and business, to uncover patterns, relationships, or trends within a specific population or sample. This methodology relies on statistical techniques to draw objective and reliable conclusions, making it useful for researchers seeking to quantify and measure different variables. Qualitative research, on the other hand, is a methodological approach used to explore and understand phenomena in depth (Fossey et al., 2002). Unlike quantitative research, qualitative research emphasises gathering rich, descriptive data to uncover meanings, patterns, or insights. This approach allows researchers to examine the complexities of human experiences, behaviours, and social contexts. In qualitative research, data is typically collected through interviews, focus groups, observations, or document analysis (Fossey et al., 2002).

With the research question in mind and the relatively sparse amount of previous studies on the topic, the choice of research approach was a quantitative study. By employing structured data collection methods, such as a survey, quantitative researchers systematically gather data that can be subjected to statistical analysis (Czaja & Blair, 2005). Surveys enable the collection of vast amounts of data from a diverse sample through standardised questionnaires, while experiments allow for the manipulation of variables to establish cause-and-effect relationships (Czaja & Blair, 2005). The research design in this study involves formulating hypotheses, identifying variables, and using standardised statistical tools to examine patterns, relationships, and significance within the data.

One of the strengths of quantitative research is the ability to produce generalisable results (Masters et al., 2006). Through random sampling techniques and statistical analysis, researchers can draw conclusions about a broader population based on findings from a relatively small but representative sample. This generalisability enhances the study's external validity and contributes to the broader applicability of the research findings (Masters et al., 2006). Another advantage of quantitative methodology is the relatively simple approach to data gathering. Gathering data through a questionnaire is less time-consuming than in-person interviews, especially using modern technology such as web-based surveys (Couper, 2008), making data gathering quicker and easier. While quantitative research offers valuable insights and contributes to evidence-based decision-making, it is essential to acknowledge its limitations. This methodology may not capture the complexity and nuances of human behaviour or fully explore the context of a phenomenon. Therefore, researchers must complement quantitative studies with qualitative approaches to understand the research topic comprehensively (Allwood, 2012).

3.1 Questionnaire Design

Due to the small amount of previous data to rely on, the questionnaire was designed to be generalised and not make assumptions about the issue. To make responding to the survey as easy for participants as possible, it was important to make the survey short enough to keep respondents' attention but long enough to gather meaningful data. Too many question categories can overwhelm respondents and lead to survey fatigue, resulting in incomplete or biased responses (O'Reilly-Shah, 2017). The survey was designed to collect data in five categories: (1) flight activity, (2) experience, (3) performance, (4) economic factors, and (5) job satisfaction. The questions were either structured with fixed answers or rating questions using the Likert scale, with some questions needing input of numbers by the user, such as age or flight hours. Before final distribution, the questionnaire underwent many revisions as feedback was considered. None of the people who helped in the design process were invited to partake in the final survey. The final questionnaire revision is attached to this paper as Appendix 1.

3.1.1 Question Design

To simplify data analysis, all ranking questions used a Likert scale from one to six to force participants to pick a side. Having six options is a good middle ground between achieving easy-to-comprehend and reliable questions, as studies suggest that having more options on a Likert scale increases the reliability of the data gathered (Lozano et al., 2008). This decision was also made to avoid having a middle option, categorising responses into distinct groups and making it easier to interpret and form conclusions from the collected data. By eliminating a middle option, ambiguity is reduced or eliminated, possibly leading to more precise data, as research has shown that when respondents are presented with a neutral option, they tend to select it instead of giving their actual opinions (Johns, 2005). An advantage of doing this is that it pushes people who might be on the fence toward one side or another, providing more precise insights into their opinions or preferences on the topic. It also encourages participants to think critically about their stance on the issue, promoting active engagement with the survey questions rather than allowing for neutral or indecisive responses (Johns, 2005). However, without a middle option, respondents might feel compelled to choose a side even if they hold a more nuanced or moderate viewpoint. This can result in oversimplification of responses and potentially inaccurate representation of people’s opinions. Furthermore, forcing respondents to choose between two extremes might introduce bias, especially if the options are presented as leading or unbalanced, influencing participants to choose one side over the other (Johns, 2005). Also, respondents who genuinely feel undecided or neutral about any particular issue may become frustrated or feel alienated by the lack of a middle option, leading to lower survey completion rates or less honest responses (Rattray & Jones, 2007). Lastly, by not providing a middle option, the survey may miss out on capturing valuable insights from respondents who genuinely hold neutral or ambivalent views on the topic, which could provide a more comprehensive understanding of the issue (Johns, 2005). Moreover, only the endpoints of the Likert scale were labelled, but research is divided on whether this introduces bias among respondents (Weijters et al., 2010).

Question complexity is also a consideration in the design of any survey or questionnaire, as it directly impacts respondents' ability to comprehend and provide accurate answers (Rattray & Jones, 2007). Using other methods, such as interviews, this is often avoided as participants can ask for clarification from the interviewers (Graesser et al., 2006). Complex questions often contain convoluted language, ambiguous terms, or multi-part structures, confusing participants and leading to inconsistent or erroneous responses (Lenzner, 2014). Therefore, writing clear, concise, and easily understandable questions for the target audience is important. Simplifying language, breaking down complex concepts into smaller components, and utilising straightforward language and formats such as multiple-choice or Likert scales will often enhance question clarity and minimise respondent burden and measurement error (Graesser et al., 2006). To address this, the survey was checked by industry professionals and people with limited aviation knowledge to ensure the questions were as easy to understand as possible. Participants also had the opportunity to send an email to ask for any clarification if needed.

3.2 Identification of Important Factors

To reduce the amount of data points and variables in the dataset for analysis, the choice was made to focus on a few key factors in the following question categories: (1) flight activity, (2) experience, (3) performance, (4) financial factors, and (5) job satisfaction. The reasons for focusing on the selected factors are discussed in the following paragraphs. One null and alternative hypothesis is constructed for each variable, corresponding to a single question in the questionnaire due to the results from the reliability tests in chapter 3.6.2.

3.2.1 Flight Activity

Three questions were presented in the general category: age, sex, and type of flight activity. Regarding gender, it is estimated that roughly five per cent of the world's flight crews are women (Silk, 2023). In this study, around 16% of the respondents were women, but the overall turnout was too small to use these figures for any statistical analysis. Gender was, therefore, not a factor included in any of the hypotheses. Age was also not included to reduce the scope of the statistical analysis. Nonetheless, the most important factor to measure here is the type of flight activity. Participants had one of three choices to answer this question: commercial, non-commercial, or others. Commercial aviation is any activity where an airline earns money by transporting passengers or freight. EASA defines commercial aviation as any flying activity compensated by "remuneration or other valuable consideration" (EASA, 2019), while non-commercial is an activity that is not rewarded by such compensation. An example of this would be flight clubs. Many flight clubs take payment from their members, but they are not supposed to make a profit from such remuneration. This is because they do not operate as a commercial air transport (CAT) organisation and are therefore not subject to the CAT regulations; instead, they follow the non-commercial operations (NCO) regulations (EASA, 2023). For anything else, the other category should be selected. An example is military flight activity. The goal of including this question was to test the hypothesis that economic considerations are present to a greater extent in commercial activity than in non-commercial or other activities, such as flight schools or military activities.

> Hypothesis 1: There is no difference in the importance of economic factors between different flight activities.

> Hypothesis 1A: Economic factors are more important for considerations in commercial flight activity.

3.2.2 Experience

Experience has been established as one of the most important factors influencing decision-making processes for personnel in high-risk industries (Reale et al., 2023). The more experienced an individual is, the more likely their decisions are based on instinct rather than analytical or rule-based (Reale et al., 2023). Studies sometimes use pilot salary as a variable influencing accidents and incidents because it is used as a proxy of experience, something easily measured and can say a lot about the experience level of an employee (Low & Yang, 2019). It is unclear how the experience would affect someone's tendency to consider the economic impacts of their decisions or if it has any impact. Common sense says that an experienced crew would make better decisions. While this may be true, studies show that experienced crew make faster decisions, often based on pattern recognition and instinct (Reale et al., 2023). To consciously consider the economic side of things, one must stop and analyse the situation rather than act on intuition alone. This thought process has led to the following hypothesis for how experience impacts economic considerations in decision-making:

> Hypothesis 2: There is no difference in the importance of economic factors between experience levels.
>
> Hypothesis 2A: Economic factors were more important at high experience levels.

3.2.3 Performance

The performance section was divided into two parts. Three questions focused on the participants' perceived self-performance, while the last two focused on how they felt their employers took care of their skills and knowledge. Performance is somewhat related to experience, as studies have shown that increased job tenure can lead to reduced performance at work due to factors such as loss of motivation or boredom (Ng & Feldman, 2013). This can seem counterintuitive, as one would expect experienced people with long job tenure to care more about their work and be more motivated to perform well. However, one can also think of new hires as people who want to show what they are capable of and that they are valued members of the workforce. Furthermore, studies have shown a statistically significant relationship between motivation and job performance (Kumari et al., 2021). Because of this link, performance can be used as a proxy for motivation or vice versa. Motivation is also somewhat covered in the job satisfaction sector, where respondents were asked how much they enjoy their flying activities and to what degree they are looking to switch careers.

The second part of this category is how employees feel they are cared for by their employers, concerning their skills and knowledge being preserved and expanded. All active pilots must perform regular proficiency checks to keep their licenses valid (EASA, 2023). It can be argued that companies who struggle financially or are financially pressed in any way may skimp on the recurrent training of their employees, only performing the minimum required skill maintenance. This leads to two pairs of hypotheses:

> Hypothesis 3.1: No difference in the importance of economic factors between performance levels.
>
> Hypothesis 3.1A: Economic factors were more important at high levels of performance.
>
> Hypothesis 3.2: No difference in the importance of economic factors between levels of skill maintenance.
>
> Hypothesis 3.2A: Economic factors were more important at low levels of skill maintenance.

3.2.4 Financial Considerations

The main goal of this study was to gauge the importance of financial factors in decision-making. Naturally, this was one of the variables in the survey. The 1978 Airline Deregulation Act in the United States marked a pivotal shift in the global airline industry, unleashing competitive forces that reshaped the landscape. By removing government control over routes, fares, and market entry, the act spurred innovation, lowered ticket prices, and expanded consumer choices (National Air and Space Museum, 2021). This inspired other countries to follow suit, leading to a more competitive aviation market. However, with increased competition came financial struggles for many airlines. Over the years, factors such as volatile fuel prices, economic downturns, terrorist attacks, and, most recently, the COVID-19 pandemic have compounded these challenges. Airlines have had to navigate through bankruptcies, mergers, and restructurings to survive, highlighting the precarious nature of the industry's financial health. One of the first major victims of the deregulation-inspired influx of new actors and innovations was Pan American World Airways (Pan Am), which filed for bankruptcy in 1991 after years of financial struggle due to high fuel prices, increased competition, and geopolitical events such as the Lockerbie bombings (Singh et al., 2023). This was soon followed by the closure of Trans World Airlines (TWA) in 2001 when they were bought by American Airlines (Finlay, 2023). Modern examples include the closure of the German airline Air Berlin in 2017 (Tennant, 2017) and the British airline Monarch Airlines in 2017 (Bray, 2017). During the COVID-19 pandemic, major national carriers, such as Aeroméxico and Scandinavian Airlines, filed for bankruptcy (Daly, 2023; Madry & Hilaire, 2022). With the recent pandemic hitting the global airline industry as hard as it did, it seemed like an excellent opportunity to gauge how mindful flight crews are regarding the financial consequences of their decisions. Even though it is ultimately not the flight crew's responsibility that the company remains economically profitable, do they still feel any pressure to make sure their decisions are financially viable? This leads to the following hypotheses:

> Hypothesis 4.1: No difference in the importance of economic factors with or without a perception of financial struggle.

> Hypothesis 4.1A: Economic factors were more important with a perception of financial struggle.

> Hypothesis 4.2: There is no difference in the importance of economic factors at any level of belief that financial restrictions impact safety negatively.

> Hypothesis 4.2A: Economic factors were more important at high levels of belief that financial restrictions impact safety negatively.

> Hypothesis 4.3: No difference in the importance of economic factors between degrees of financial restrictions.

> Hypothesis 4.3A: Economic factors were more important with a high degree of financial restrictions.

3.2.5 Job Satisfaction

The last variable looked at was the participants' job satisfaction. This was included to check whether people who do not care for their work also do not emphasise the importance of financial success within the company or vice versa. Another theory is that people who struggle with their finances may also let this influence their job satisfaction and place a higher importance on fiscal responsibility at work. As the cost of living increases and salaries stagnate, this increases financial anxiety among many members of society (Bennett, 2023). Therefore, people who are unhappy with their salary may let it impact their job satisfaction or desire to switch jobs, which is why they were included as variables in this survey. The following two hypotheses were constructed in this category:

> Hypothesis 5.1: No difference in the importance of economic factors between levels of job satisfaction.

Hypothesis 5.1A: Economic factors were more important with low levels of job satisfaction.

Hypothesis 5.2: No difference in the importance of economic factors between degrees of considered job switching.

Hypothesis 5.2A: Economic factors were more important when looking for new jobs.

3.3 Data Collection

In order to gather the data for this paper, a survey was distributed to various aviation organisations. The distribution strategy aimed to reach various participants and capture diverse perspectives on the subject matter. The survey was built on the website nettskjema.no to keep data collection simple. This website generated a short link that was sent primarily to respondents via email to different labour unions in Scandinavia. As such, it would be appropriate to assume that primarily participants from this region have responded to the survey. The paper author contacted some specific workplaces in person, with a short overview and a link to participate in the survey online. This personal invitation could influence the participation rate from the different groups invited, as a personal request could see better engagement than other methods, or it might be seen as annoying by the parties invited. Nonetheless, the groups invited to participate in the survey were a mix of pilots in commercial aviation, ambulance services, flight schools and clubs, and military service, with pilots for both fixed- and rotary-wing aircraft being represented. Unfortunately, as noted by Enaasen and Ørsleie (2023, p. 24), the Scandinavian aviation industry bears signs of being saturated by survey requests, making exhaustive data collection difficult. Nonetheless, the survey was open for roughly two months, depending on the date of the distributed invitations. It was advertised to take about 10 minutes to complete, measured during the survey's design process.

To encourage participation in online surveys, a popular tool is to include incentives for the respondents, such as a cash reward. A clear advantage of this approach is that it motivates individuals to take the time to complete the survey, leading to higher response rates and possibly a more representative sample (Abdelazeem, 2022). Furthermore, incentives can capture respondents' attention and encourage them to provide thoughtful and accurate responses, leading to higher quality data while possibly broadening the reach of the study, though research is not entirely clear on the extent of the impact incentives have on data quality (Stanley et al., 2020). Incentives have also been shown to increase the speed of data collection and create a positive impression about the distributor of the survey by making them seem serious and competent (Smith et al., 2019). However, a significant disadvantage is the cost of such incentives. They were considered for this study, but processing and approval times made it challenging to implement in time for the survey distribution. As such, no incentives were offered to encourage participation in this study. Moreover, incentives can harm the data collection process, as the incentives may become the primary motivation for respondents to participate in the survey rather than providing valuable insights (Abdelazeem, 2022). In the worst-case scenario, the survey may be shared with other groups who are not the targets for the study, destroying the relevancy of any data collected.

3.4 Privacy of the Participants

Ensuring privacy in research questionnaires is crucial for several reasons. Firstly, it fosters trust between researchers and participants, encouraging honest and accurate responses. Participants are more likely to provide candid feedback and information if they feel confident that their identities and personal data are protected (Kaiser, 2009; Saunders et al., 2015). Secondly, privacy safeguards uphold ethical principles, respecting participants' autonomy and right to confidentiality. Furthermore, protecting privacy helps maintain the integrity of the research process, ensuring that the data collected is reliable and unbiased (Saunders et al., 2015).

In order to safeguard the privacy of the participants, an anonymous survey was conducted. Every party involved in the study only needed the link to the online survey to be able to answer the questionnaire. If participants felt uncomfortable answering any given question, they could skip it and continue the survey. Participants also had the opportunity to exit the survey at any time if they felt so inclined. The data was collected through a survey published on the website nettskjema.no run by the University of Oslo, which is widely used in higher education research in Norway (University of Oslo, n.d.). In order to secure anonymity for the participants, the following steps were taken: (1) no personally identifiable information was collected, (2) several parties were invited to answer the survey to ensure no single participant could be singled out, (3) participants had two months to answer the survey and the time of answers were removed from the dataset, (4) there were no free text answers to ensure participants could not be identified by the way they communicate in writing, and (5) the online survey was deleted after the data had been gathered and downloaded.

3.5 Data Analysis

The dataset was exported from nettskjema.no in Excel format and imported into IBM SPSS Statistics for data analysis. The variables were coded and cleaned to ensure the resulting analyses were easy to understand. All graphs and tables were created using the dataset and the analyses from SPSS Statistics.

3.5.1 Condensing Variables

To limit the scope of the paper and reduce the amount of statistical analysis needed, much of the dataset was not used or condensed into fewer variables. None of the variables in the financial category were removed or condensed for the analysis. Analysing the experience variable started by simplifying the questions about experience into one variable to use for the data analysis. The starting point is that flight hours are a solid measurement of experience for a pilot. This view comes from the fact that it has been used in recruitment processes in the aviation industry for many years (Todd & Thomas, 2012). Therefore, the other experience factors were removed from the dataset for analysis. As for performance, the chosen focus was on personal performance and the degree of skill maintenance reported by the survey participants. Lastly, for the job satisfaction category, only the overall job satisfaction of the participants and the degree to which they were looking to switch jobs were chosen for statistical analysis. The answers to the questions not used were removed from the dataset used for data analysis, leaving the following variables:

- Dependent variables
  - Financial impact
  - Financial deciding factor

- Independent variables
  - Flight activity
  - Experience level (flight hours)
  - Performance level
  - Skill maintenance
  - Financial worry
  - Financial restriction impact on safety
  - Financial restricted
  - Job satisfaction
  - Job seeking

3.5.2 Hypotheses Testing

The initial hypothesis testing uses an independent sample t-test because all variables except experience are categorical. For every test, the groups were divided by the median value of the answers; in other words, the cut-point used in the tests was the median value for each independent variable to divide the groups into equal parts. There were a few options for dividing the respondents into two groups. One option was to use the middle answer option for the ordinal variables, which was 3.5. This option was not used because it would divide some groups unevenly. It did not consider the skew in the variables such as performance, skill maintenance, and job satisfaction, where the mean answer was close to 5. This left the choice between using the mean or the median value. Both options would be valid and give similar results; however, the decision was made to divide the respondents into equal groups using the median value of the variables for hypothesis testing. Using the mean value sometimes resulted in groups being divided unequally, and with the survey's low response rate, some groups had fewer than five members. The median values used for hypothesis grouping are shown in Table 1 below.

Table 1: Median values used for grouping in hypothesis testing.

Variable	Median value
Flight activity	N/A
Flight hours	3000
Performance	5
Skill Maintenance	5
Financial worry	3
Financial restriction safety impact	3
Financial restrictions	3
Job satisfaction	5
Job seeking	3

Regarding the alpha level or level of statistical significance, the standard used in research is often 0.05 (Tabachnick & Fidell, 2013), which will also be used in this paper. However, it is important to remember that the field of study is relatively niche, and the sample size was small. Therefore, hypothesis test results should not be outright rejected with p-values slightly larger than but still close to 0.05.

3.5.3 Multiple Regression

Multiple regression is a statistical method used to analyse the interplay between a dependent variable and two or more independent variables (Tabachnick & Fidell, 2013). It expands on the concept of linear regression by allowing for multiple predictors to be considered simultaneously. This method helps understand how changes in the independent variables are associated with changes in the dependent variable while controlling for other factors. Multiple regression is widely used in economics, social sciences, and natural sciences to model complex relationships and understand the underlying mechanisms behind phenomena of interest (Tabachnick & Fidell, 2013).

This paper employed a linear regression analysis to understand the relationship and effects of the independent variables on the dependent variables. Two models were constructed for each of the dependent variables. The models were first constructed using the highly correlated variables with the dependent variable using a correlation coefficient cut-off point of 0.6. Afterwards, the forward-stepwise model generation tool in SPSS Statistics expanded the regression model to include the optimal predictors. The models were then compared based on significance and prediction power while considering multicollinearity, autocorrelation and non-normality issues.

3.6 Objectivity, Reliability, and Validity

3.6.1 Objectivity

There is still a debate on whether science can be neutral (Føllesdal, 2020). According to Hanna (2004), science aims to measure the objective reality using objective research methods. Achieving such scientific objectivity is a complex endeavour, requiring researchers to be aware of unconscious biases, societal pressures, and external influences that may compromise the integrity of the scientific process. As such, the notion that absolute objectivity is unattainable is a viewpoint held by many scientists and philosophers of science (Føllesdal, 2020). This perspective acknowledges the complexities and nuances of the scientific process, including the unavoidable influence of subjective factors such as background beliefs, cultural context, and personal experiences. Our observations are unavoidably filtered through the theoretical frameworks and paradigms that shape our understanding of the world (Reiss & Sprenger, 2020). Consequently, even seemingly objective observations may be influenced by underlying assumptions or theoretical commitments, potentially biasing interpretations of empirical evidence. Furthermore, the social and institutional contexts in which scientific research takes place can introduce additional layers of complexity. Funding sources, peer review processes, and academic incentives may subtly influence research agendas and outcomes, potentially compromising the objectivity of scientific inquiry (Reiss & Sprenger, 2020). However, while complete objectivity may be an unattainable ideal, this does not render the pursuit of objectivity futile. By openly acknowledging the potential for bias and actively striving to mitigate its effects, scientists can uphold the integrity of their research and promote more rigorous and reliable knowledge production (Hanna, 2004; Reiss & Sprenger, 2020). With that being said, the author is a part of the aviation industry and cannot be considered a neutral third party, which might lead to certain biases, as discussed above.

3.6.2 Reliability

Reliability testing in statistics refers to assessing the consistency and stability of a measurement instrument or test over time. The goal is to ensure that the instrument yields reliable results, meaning it consistently measures what it is intended to measure. Reliability is critical to any measurement because it reflects the extent to which it is free from random error or how reproducible it may be (Bartko, 1991). Cronbach's alpha is one of the most widely used statistics for assessing the reliability of a scale or test composed of multiple items or questions (Tavakol & Dennick, 2011). It measures internal consistency, which is the extent to which all items in a test measure the same underlying construct. This method is used in this thesis, and the test results can be seen in Table 2. The four groups of questions were tested, excluding flight activity, which was in a group all alone with only two choices to answer the question: commercial or other flight activity. This was, therefore, not included in the reliability tests.

Cronbach's alpha is calculated based on the average correlation between items within a test. Using the suggested values by Tavakol & Dennick (2011), the group with the financial variables has excellent reliability, while the group with the performance variables have poor reliability. The group of questions with experience and job satisfaction have very low reliability, meaning that these questions should not be used together to test a common latent variable.

Table 2: Cronbach's alpha scores for the different groups of variables measured.

Variable group	Cronbach's alpha
Flight activity	N/A
Experience	0.1
Performance	0.5
Financial	0.9
Job satisfaction	0.1

Because some of the groups have very low reliability scores, the hypotheses in this thesis do not measure a latent variable of a group of questions but rather focus on the specific question it tests. This means that even though the internal consistency of some of the groups of questions was poor, the results from the hypothesis tests should not be discounted as they focused on the variable measured in the questions they relate to rather than a latent variable in a group of questions.

3.6.3 Validity

Statistical validity refers to the degree to which the conclusions drawn from a statistical analysis are accurate and reliable. It encompasses various aspects of validity, each addressing different potential threats and errors that can affect the results of a study. Ensuring statistical validity is important for making credible inferences and decisions based on data (García-Pérez, 2012). There are several threats to statistical validity, among them: (1) low statistical power, (2) violation of statistical assumptions, (3) reliability of measurements, and (4) sample size issues (García-Pérez, 2012). These are just excerpts of what can impact the validity of a study, but the ones presented are those mainly impacting the validity of this study. The first factor is a symptom of the last one, namely sample size. Effect and error sizes are large, while the sample size is small, impacting the validity of the thesis. Additionally, some of the statistical tests showed violations of the statistical assumptions, meaning the results should only be viewed as suggestions of a pattern rather than a fact. Lastly, the reliability of the measurements is questionable at best. The questions measuring job satisfaction and performance are of particular concern, as they show poor reliability using Cronbach's alpha coefficient. However, as mentioned in the reliability chapter, the hypotheses were not built on the latent variables in the groups of questions because of this lack of internal consistency.

4 Results

4.1 Descriptive Data Presentation

The sample size of the survey was N = 38. All respondents answered all the questions in the survey, even though every question was optional to encourage engagement. The average age of the respondents was just over 37.18 (SD=10.17), and the years active as pilots were, on average, 13.08 years (SD=9.33). The average number of flight hours was 5076.32 hours (SD=4556.81) with a median of 3000 hours, indicating that the experience level skewed towards less experienced pilots. There were respondents with well over 10.000 hours, the highest being 18.000 hours. When it came to aircraft types flown, it ranged from only two to at most 20. An average of 4.16 (SD=3.18) indicates that most respondents had a relatively low number of aircraft under their belts, with a couple of outliers, as seen in Figure 2.

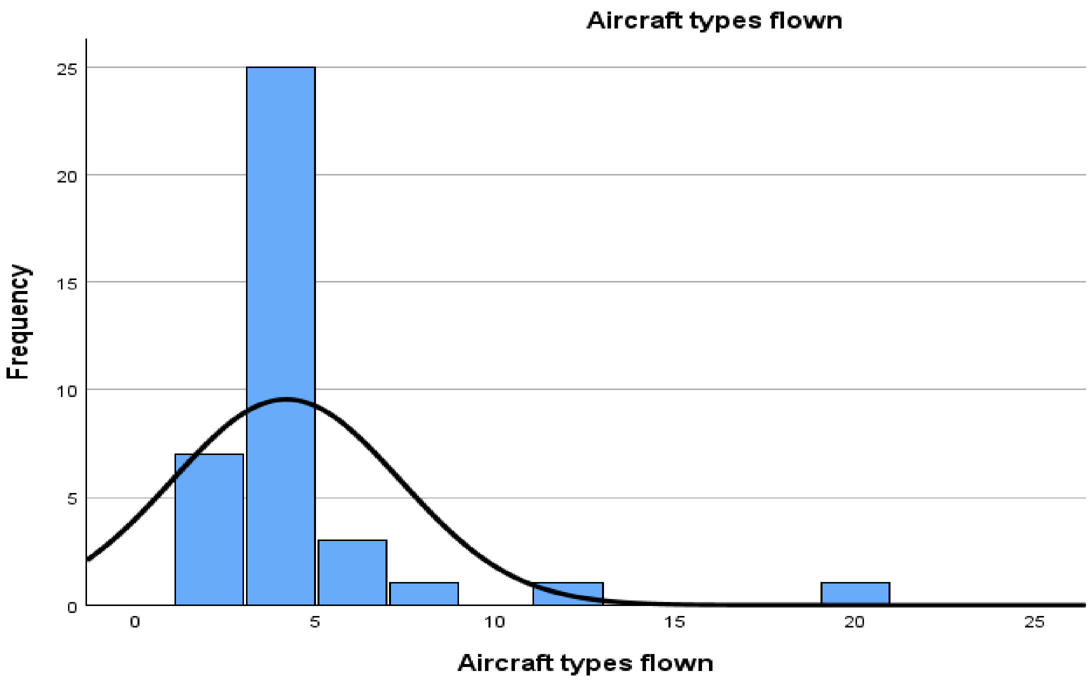

Figure 2: Histogram of aircraft types flown. Mean = 4.16, SD = 3.18, N = 38.

The last factor indicates that some respondents might have misunderstood the question, as the lowest answer to the question of how many companies respondents had worked or operated for was zero. On average, however, this number was 3.24 (SD=1.68). Respondents were instructed to include any flight schools or flight clubs, so an answer of three might indicate a pilot starting out casually in a flight club before enrolling in a flight school and ending up working for an airline. In hindsight, this question should have probably been restricted to employers, as the maximum answer of seven may indicate anything from a long career to someone moving around a lot and joining different flight clubs.

Table 3: Demographic statistics for the data sample. N = 38.

	Age	**Flight years**	**Flight hours**	**Aircraft types flown**	**Companies worked**
Mean	37.18	13.08	5076.32	4.16	3.24
Median	36.50	11.50	3000.00	4.00	3.00
Standard Deviation	10.17	9.33	4556.81	3.18	1.68
Minimum	23.00	2.00	200.00	2.00	0.00
Maximum	61.00	40.00	18000	20.00	7.00

Furthermore, the distribution among genders and flight activity can be seen in Table 4. The gender distribution is more equal than the world average (Silk, 2023), but the number of female respondents was still too small to make any significant statistical analysis. Nonetheless, the most notable factor in the general category is the type of flight activity the respondents were engaged in. The distribution in this survey shows that the number of respondents in commercial aviation was 25 (65.8%), while 13 (34.2%) were engaged in other flight activities.

Table 4: Distribution of gender and flight activity. N = 38.

	Gender			**Flight activity**	
	N	**%**		**N**	**%**
Male	32	84.2	**Commercial**	25	65.8
Female	6	15.8	**Other**	13	34.2

4.2 Spearman Rank Correlation

In statistics, correlation is used to examine the relationships or to check for an association between different variables. For this paper, Spearman rank correlation is used because most of the data is ordinal, as many questions were based on the use of the Likert scale (Schober et al., 2018). Correlations are ranked from -1 to 1, but there is no definite answer to what constitutes a weak or a strong correlation. An example from Schober et al. (2018) marks anything below a correlation coefficient of 0.4 as a weak correlation and anything above 0.7 as a strong correlation.

Table 5: Spearman rank correlation between the independent and dependent variables. ** signifies a p-value of less than 0.01.

Independent \ Dependent	Financial impact of decisions	Financial deciding factor
Flight activity	-0.69**	-0.59**
Flight hours	0.46**	0.24
Performance level	0.25	-0.050
Skill maintenance	0.020	0.22
Financial worry about company	0.66**	0.76**
Financial restriction impacts safety	0.70**	0.69**
Financially restricted	0.74**	0.76**
Job satisfaction	-0.43**	-0.48**
Job seeking	0.21	0.29

Table 5 presents the Spearman rank correlations between the independent and dependent variables. Flight activity has a moderate negative correlation between both dependent variables. It is a negative correlation since commercial flight activity was coded as the lowest value. As for experience, or flight hours, this has a moderate correlation with how strongly pilots consider the financial impacts of their decision, with a weak correlation to whether such considerations are a deciding factor. Performance level, however, borders on no correlation with both dependent variables and the same can be said for the degree of skill maintenance perceived by the respondents. Nonetheless, the degree of financial worry has the strongest correlation to financial considerations of any of the independent variables, meaning that the higher the perception of a financially struggling employer, the more important financial factors become in the decision-making processes among flight crews. Another two variables with a strong correlation to both dependent variables are the perceptions of financial restrictions imposed on the respondents and to what extent these restrictions are perceived to impact safety. Furthermore, job satisfaction also seems to have a moderate correlation with the dependent variables, only this time having a negative one. Lastly is the degree the respondents were looking to switch jobs. This question did not ask specifically if the respondents wanted to switch careers (for example, from pilot to teacher) or if they wanted a better employer in aviation specifically. Regardless, the correlation between job-seeking and financial factors was weak.

4.3 Hypotheses Tests

4.3.1 Financial Impact

The first round of testing is testing against the first dependent variable. This variable is the degree to which pilots consider the financial consequences of their decisions, the results of which can be seen in Table 6. The first test considered whether there was a statistically significant relationship between such considerations and the type of flight activity. The test showed this was the case with a p-value of less than 0.001. The null hypothesis is therefore rejected, meaning financial considerations were more important for pilots engaged in commercial flight activity than those engaged in non-commercial or other activities. The next test considered the experience levels of the respondents and showed a statistically significant relationship between flight hours and financial considerations. With a p-value of less than 0.001, the null hypothesis is rejected, meaning economic considerations were more important at higher experience levels or among pilots with greater flight hours. However, the hypothesis test for the performance variable resulted in the null hypothesis being accepted due to the p-value being 0.090. There does not seem to be any statistically significant relationship between the performance level of the respondents and the financial considerations in their decision-making process. The same result was concluded for skill maintenance, with a p-value of 0.92, strongly suggesting the relationship with financial considerations is non-existent.

Table 6: Results from hypothesis tests for the dependent variable "financial impact of decision." ** signifies a p-value of less than 0.01.

Variable	t-value	Result
Flight activity	6.57**	H1 Rejected
Experience	3.84**	H2 Rejected
Performance	1.81	H3.1 Accepted
Skill maintenance	-0.096	H3.2 Accepted
Financial worry	4.20**	H4.1 Rejected
Financial restriction and safety	6.44**	H4.2 Rejected
Financial restriction	7.34**	H4.3 Rejected
Job satisfaction	-3.11**	H5.1 Rejected
Job seeking	1.46	H5.2 Accepted

Nevertheless, hypothesis testing revealed a statistically significant relationship with $p < 0.001$ for the degree of financial worry. The null hypothesis is rejected, meaning financial considerations were more important for respondents with a high perception of financial struggle in their employment. Furthermore, both null hypotheses were rejected regarding financial restriction, with both cases having $p < 0.001$. This suggests a statistically significant relationship between financially restricted employment and the importance of financial impacts on the decisions among flight crews. The null hypotheses are rejected, meaning that financial considerations were more important, with a higher perception of financial restrictions and the impact of the restrictions on safety. Lastly is the category of job satisfaction. Hypothesis testing reveals a statistically significant relationship between job satisfaction and financial consideration, with a p-value of 0.004. The null hypothesis is rejected, meaning that financial considerations were more important when job satisfaction was low. As for job seeking, the hypothesis testing resulted in a non-significant result with p-value=0.16. As such, this indicates no statistically significant relationship between flight crew looking to switch jobs and the degree of financial considerations in their decision-making processes.

4.3.2 Financial Deciding Factor

The second round of testing is against the second dependent variable: how often financial or economic considerations are the deciding factor in their decisions. Table 7 shows that the null hypothesis for flight activity is rejected, suggesting that financial considerations are deciding factors more often in commercial aviation activities. The test for experience also rejected the null hypothesis, with increased flight hours meaning financial factors were more often the deciding factor.

Table 7: Results from hypothesis tests for the dependent variable "financial deciding factor." ** signifies a p-value of less than 0.01, * signifies a p-value of less than 0.05.

Variable	**t-value**	**Result**
Flight activity	5.31**	H1 Rejected
Experience	2.59*	H2 Rejected
Performance	0.61	H3.1 Accepted
Skill maintenance	-1.14	H3.2 Accepted
Financial worry	4.86**	H4.1 Rejected
Financial restriction and safety	5.86**	H4.2 Rejected
Financial restriction	5.68**	H4.3 Rejected
Job satisfaction	-3.60**	H5.1 Rejected
Job seeking	2.36*	H5.2 Rejected

There was no statistically significant relationship with performance ($p = 0.547$), and neither for skill maintenance ($p = 0.261$). The null hypothesis for financial worry was rejected with a p-value less than 0.001, meaning that financial factors were a deciding factor more often with a high perception of financial struggle. The same was true for financial restrictions, with both cases rejecting their respective null hypotheses. Job satisfaction also resulted in the null hypothesis being rejected with $p=0.001$. In contrast to the first dependent variable, the hypothesis test for job seeking was also rejected with p=0.024, meaning financial considerations were the deciding factor more often when respondents were looking to switch jobs.

4.4 Multiple Regression

Using SPSS Statistics and assuming the dependent variables were continuous, forward-stepwise modelling was used to build a linear regression model. Two sets of models were created, one for each dependent variable.

4.4.1 Financial Impact

Creating a linear regression model started by selecting the variables with the highest degree of correlation with the first dependent variable: financial impact. The variables with a correlation over 0.6 (Table 5) selected for the initial model were (1) flight activity, (2) financial worry, (3) financial restrictions safety impact, and (4) financial restrictions. This model aims to explain the degree to which flight crew consider the financial impact of their decisions. The model is statistically significant with a p-value of less than 0.001 and has acceptable R^2 and adjusted R^2 of 0.682 and 0.643, respectively. The assumption of multicollinearity seems to be rejected as the collinearity tolerance of all predictors is larger than 0.2, and the variance inflation factor (VIF) values are all greater than one, which might indicate multicollinearity issues (Urban & Mayerl, 2011, p. 232).

Table 8: Dependent variable 1 (financial impact of decision), model 1-I.

	Unstandardised Coefficients		**Standardised Coefficients**	**Significance**		**Collinearity Statistics**	
	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
(Constant)	3.75	0.87		4.32	<0.001		
Flight activity	-1.45	0.41	-0.42	-3.54	0.001	0.70	1.43
Financial worry about company	0.23	0.16	0.24	1.50	0.14	0.39	2.59
Financial restriction impact safety	0.13	0.26	0.098	0.50	0.62	0.25	3.98
Financially restricted	0.38	0.30	0.25	1.26	0.22	0.25	4.058

Furthermore, the Durbin-Watson test statistic is used to check for autocorrelation, which in this case is 2.062, indicating that the residuals are uncorrelated as the value is close to two

(Janssen & Laatz, 2013, p. 414). Checking the residual plots in Appendix 2 indicates that issues of non-normality are small, and homoscedasticity is likely. Table 8 shows that flight activity exhibits a negative relationship with the dependent variable, meaning that pilots in commercial aviation pay more mind to the financial consequences of their decisions than those engaged in other flight activities. Financial worry has a positive relationship in this model, indicating that those who perceive financial struggles in their workplace exhibit a greater tendency to consider the economic impacts of their decisions. When it comes to financial restrictions, whether they impact safety has a weak relationship with financial considerations, but when financial restrictions are perceived, pilots increase their focus on these considerations.

Model 1-I is expanded using SPSS Statistics' forward-stepwise model generation, which in this case adds the following predictors to the new model: flight hours and job satisfaction. This model is also statistically significant, with a p-value less than 0.001, slightly higher R^2, and adjusted R^2 of 0.725 and 0.671, respectively. This model has similar issues with multicollinearity; however, they are still small. Furthermore, checking for autocorrelation indicates a small negative correlation of the residuals, but it is still very slight. The residual plots for this model are similar to the first one, indicating small non-normality issues, with homoscedasticity being likely (Appendix 3).

Table 9: Dependent variable 1 (financial impact of decision), model 1-II.

	Unstandardised Coefficients		**Standardised Coefficients**	**Significance**		**Collinearity Statistics**	
	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
(Constant)	1.92	1.46		1.31	0.20		
Flight activity	-1.39	0.40	-0.40	-3.52	0.001	0.69	1.45
Financial worry about company	0.29	0.16	0.29	1.79	0.084	0.34	2.96
Financial restriction impact safety	0.22	0.25	0.16	0.85	0.40	0.25	4.084
Financially restricted	0.30	0.29	0.20	1.018	0.32	0.24	4.15
Flight hours	0.043	0.00	0.18	1.76	0.088	0.90	1.11
Job satisfaction	0.27	0.21	0.15	1.28	0.21	0.61	1.64

Building on the first model, flight activity is still negatively associated with financial considerations, while financial worry and restrictions exhibit a positive relationship. The addition of flight hours having a positive relationship indicates that more experienced pilots exhibit greater consideration for financial factors, with the same behaviour seen with job satisfaction. An overview of the two models can be seen in Table 10. An increase in R^2 of 0.043 represents an increase of 4.3% in the prediction accuracy of model 1-II over 1-I.

Table 10: Overview of the two models for the first dependent variable. ** signifies a p-value of less than 0.01.

Model	R square	Increase in R square	F-value
1-I	0.682	-	17.667**
1-II	0.725	0.043	13.590**

4.4.2 Financial Deciding Factor

The three variables with a correlation above 0.6 with the second dependent variable from Table 5 are (1) financial worry, (2) financial restrictions safety impact, and (3) financial restriction. This model intends to explain the likelihood of financial decisions being the deciding factor in the decision-making processes of flight crews. As with the first dependent variable, this first model is statistically significant with a p-value of less than 0.001. Furthermore, the model has satisfactory, albeit lower than the earlier models, R^2 and adjusted R^2 of 0.673 and 0.644, respectively. The assumption of multicollinearity also seems to be rejected here, as the collinearity tolerance of the predictors is all larger than 0.2. Furthermore, as with the previous models, the VIF values are still above one, suggesting slight multicollinearity issues. Checking for autocorrelation using the Durbin-Watson test statistic reveals a slight negative correlation among the residuals, though this issue is minor. Moreover, the issues of non-normality are more extensive than for the first dependent variable, but not hugely so, while homoscedasticity is still likely in this model (Appendix 4).

As seen in Table 11, it does not include the type of flight activity like the model for the financial importance did. Financial worry is still included and shows a positive relationship in this model as well, further indicating that an increase in financial worry in their workplace increases the importance of financial considerations in the decisions made by flight crews. In this case, financial factors are often the deciding factor when the perception of financial worry is higher. Interestingly, the impact financial restrictions have on safety is negatively correlated, with financial factors being the deciding factor, albeit slightly. However, like the first two models, the degree of financial restriction is still positively linked to financial factors being the deciding factor in this model.

Table 11: Dependent variable 2 (financial deciding factor), model 2-I.

	Unstandardised Coefficients		**Standardised Coefficients**	**Significance**		**Collinearity Statistics**	
	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
(Constant)	0.36	0.37		0.97	0.34		
Financial worry about company	0.41	0.15	0.44	2.79	0.009	0.39	2.57
Financial restriction impact safety	-0.21	0.24	-0.17	-0.87	0.39	0.26	3.89
Financially restricted	0.84	0.26	0.59	3.27	0.002	0.29	3.42

Table 12: Dependent variable 2 (financial deciding factor), model 2-II.

	Unstandardised Coefficients		**Standardised Coefficients**	**Significance**		**Collinearity Statistics**	
	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
(Constant)	0.53	1.35		0.39	0.70		
Financial worry about company	0.44	0.15	0.48	2.97	0.006	0.34	2.94
Financial restriction impact safety	-0.10	0.23	-0.082	-0.44	0.66	0.25	4.042
Financially restricted	0.62	0.27	0.44	2.32	0.027	0.25	4.059
Flight activity	-0.77	0.37	-0.24	-2.098	0.044	0.70	1.43
Job satisfaction	0.22	0.20	0.13	1.12	0.27	0.61	1.63

More predictors are added to the first model via the forward-stepwise model generation in SPSS Statistics, resulting in the addition of flight activity and job satisfaction predictors. Like model 2-I, model 2-II is statistically significant with a p-value less than 0.001, a higher R^2, and an adjusted R^2 of 0.721 and 0.677, respectively. The issues with multicollinearity are still present, however, the newly added predictors exhibit better performance than those already present. In contrast to the first model, however, autocorrelation testing reveals that this model now has slight positive correlation issues among the residuals. Moreover, the residual plots for this model are similar to the previous one, exhibiting the same non-normality issues, while homoscedasticity is still likely (Appendix 5).

Table 13: Overview of the two models for the second dependent variable. ** signifies a p-value of less than 0.01.

Model	R square	Increase in R square	F-value
2-I	0.673	-	23.329**
2-II	0.721	0.048	16.513**

As with model 2-I, it exhibits the same relationships with financial worry and financial restriction and a similar but smaller one with financial restrictions and safety impact. Adding flight activity, it shows a similar relationship as model 1-II, showing that pilots in commercial aviation more often have financial factors as the deciding factor than pilots engaged in other operations. Lastly, job satisfaction is shown to have a slight positive relationship with the dependent variable.

Looking at the overview of the two models in Table 13, an increase in R^2 of 0.048 represents an increase of 4.8% in the prediction accuracy of model 2-II over 2-I.

5 Discussion

The discussion is structured to discuss the five independent variables separately, followed by the multiple regression models. Afterwards, the literature is used to discuss the findings in this paper, followed by an overarching discussion of the possible financial and safety implications. Lastly, a word on responsibility and accountability is offered, as the author felt it would be appropriate to end the thesis with a discussion about who is ultimately responsible for a company's financial success in a high-risk environment such as aviation.

5.1 Discussion of the Independent Variables

5.1.1 Flight Activity

This study aimed to investigate the extent to which pilots consider the economic consequences of their actions, focusing on two financial variables: the importance flight crew place on economic consequences and the extent to which these economic considerations are the deciding factor in their decisions. Many factors impacted these variables, one being the type of flight activity in which the respondents were engaged. This was one of the strongest predictors in this study, proving statistically significant in hypothesis testing and regression analysis. At face value, this seems logical, as one of the main reasons to operate a commercial business is to generate revenue, which often entails maximising profits and minimising waste. The fact that flight crew report a higher degree of financial considerations in commercial aviation is entirely understandable, as they operate in an environment dependent on financial viability. Pilots who fly for other operators such as defence agencies or ambulance services may not have this financial burden lurking over them as these are government institutions, at least in most of Europe, therefore not needing to worry about actions having dire financial consequences for their employer. The aviation industry has shown itself to be volatile and easily impressionable by local or global geopolitical events, examples of which have been the 1990 Gulf War (Bonné, 2003), the 2001 New York City terrorist attacks (Clark et al., 2009, p. 75), and the 2008 financial crisis (Franke & John, 2011). Most of these events led to either increased costs or reduced demands, resulting in trying times for the whole industry. Many pilots probably also have some degree of understanding of the margins that they operate with, especially after the advent of budget airlines such as Ryanair established their footholds in the European market, providing fares well below what was the norm for the market at the time (Malighetti et al., 2009). Most recently, with the COVID-19 pandemic having hit the industry as hard as it did, this understanding may lead pilots to alter their behaviour so as not to exercise unnecessary economic burdens on their employers.

5.1.2 Experience

Another predictor was the experience level of the respondents or the number of flight hours they had. With a higher number of flight hours, there is a medium correlation, and model 1-II shows an increase in the importance of the financial factors. Even though experience has been shown to be an important factor in decision-making processes (Reale et al., 2023), this study did not find experience to have as large of an impact as the literature suggests. This may be because, in commercial aviation, there are often two pilots in the flight deck, and with the increased focus on CRM training, this may make any experience held by the individuals a shared resource for everyone to employ. As pilots work in a team, they learn to use the skills and experience of their colleagues, making decisions in the flight deck a product of team effort and cooperation rather than individuals having to rely on their personal knowledge. When there is an experienced captain and a less experienced first officer, it does not seem to matter what experience level the individual has, as working as a team leads to having a bigger shared experience pool to use when making important decisions. Through CRM and TEM training, flight crews grow more interconnected and have greater resources at their disposal than they would have if they were working alone.

5.1.3 Performance

The only group of factors that was widely absolved of any statistical significance in this study was performance. The lack of statistical significance may result from the study's measuring method, as respondents self-reported all the data collected. This means that none of the data was objective, and evaluating one's performance may have been a product of overconfidence in their abilities. The same was seen for skill maintenance, as there was no difference in crew reporting low or high degrees of such maintenance and their focus on financial factors.

5.1.4 Financial

As for the financial factors, they were all deemed statistically significant, suggesting that flight crew understand the financial environments they work in. Crews who reported a high degree of financial worry also exhibited an increased focus on financial considerations and consequences linked to their actions. This can be due to them simply being more aware of the financial realities facing the industry they work in and, therefore, trying to become more aware of the implications for their own actions in this wider system. People facing financial problems in the industries they work have shown tendencies of reduced focus on the attitudes towards safety (Sætrevik et al., 2020), and it would be naive to assume otherwise regarding the aviation industry. Financial considerations seem to have the ability to displace individuals' focus on safety, which could lead to serious safety concerns should this focus skew too much away from safety in the face of economic pressure.

Moreover, the perception of financial restrictions and any safety impacts were also statistically significant factors impacting the importance of financial considerations among the respondents. However, in the regression models, these predictors were not statistically significant. These findings should, therefore, be taken as indications of a relationship rather than as pure facts. Nonetheless, pilots who feel the impact of financial restrictions may increase their focus on the financial consequences of their own actions. Exposing people to such effects will increase their awareness and is what marketing is all about. It makes people aware of the problems present and sells them a solution; only in this case, it is the flight crews themselves who may make adjustments to their priorities to mitigate the problems they are facing. As seen in the models for the second dependent variable, models 2-I and 2-II, the impact financial restrictions have on safety is negatively correlated, with financial factors being the deciding factor. This suggests that in situations where financial restrictions have the possibility to impact safety in a negative way, flight crews may emphasise safety factors rather than any financial considerations. Interestingly, this can mean flight crews regularly consider financial factors but put those aside when a potential safety threat is present. The cause for this behaviour is not entirely clear, but it might indicate an increased use of analytical decision-making when faced with financial restrictions and safety concerns simultaneously. This also suggests that safety training is so ingrained into pilots' behaviour that they have become well-versed in detecting threats and taking mitigating action, which is what TEM training aims to achieve.

5.1.5 Job Satisfaction

Job satisfaction showed an inverse relationship with both financial importance and deciding factors is the correlation table (Table 5). This does seem to make sense as someone with high job satisfaction would be happy and engaged in their work and probably less worried overall about their job safety, which might indicate that they work for a financially robust company. However, when put together with several factors, job satisfaction exhibited a positive relationship with the dependent variables, so any findings should only be taken as indications of a relationship. One reason is that the multiple regression analysis might be controlling for other variables not accounted for in the initial tests. These variables could influence the relationship between job satisfaction and the importance of financial considerations among the respondents. Furthermore, the relationship may not be strictly linear. There may be a nonlinear relationship that was not captured in the initial analysis but is accounted for in the regression model. Lastly, the sample size in this study might have been too small to detect more nuanced relationships accurately. The multiple regression analysis with a larger sample size might provide a more reliable estimate of the true relationship. When it came to respondents stating they were seeking alternative employment, this exhibited a positive relationship with financial importance. However, none of the findings were statistically significant, except for the hypothesis regarding financial considerations being the deciding factor. This may indicate that some form of job dissatisfaction can lead to an increased awareness of financial consequences and considerations, but with the exclusion of this variable from any regression models, this is only speculation.

5.2 Regression Models

Looking at the differences between models 1-I and 1-II, there is an increase of 4.3% in the prediction accuracy. This is such a small increase, and model 1-I can already explain 68.2% of the variance in the data. The biggest benefit of model 1-II is the addition of flight hours, which is close to significance. Moreover, all the financial variables slope in the same direction, in both 1-I and 1-II, with high VIF values, suggesting redundancy in including all of them. From this, it seems a sufficient model for predicting the financial impact of decisions may only hinge on the inclusion of flight activity, financial worry, and flight hours.

Similarly, the difference in R^2 between models 2-I and 2-II is small, as model 2-I already has an R^2 of 67.3%. These models exhibit the same collinearity issues as models 1-I and 1-II, where the inclusion of only one financial factor may be sufficient to explain the degree of financial considerations being the deciding factor. This is also reflected in the significance of the variables, together with flight activity in model 2-II. An increased sample size would have ultimately been preferred as the results from this survey are inconclusive.

5.3 Decisions in the Flight Deck

It is difficult to say what the nature of the decisions made in the flight deck is. Many common tasks are most likely of the RPD nature, where pilots use their experience to recognise patterns, quickly react, and make decisions without extensive deliberation. Examples of this can be weather avoidance, where a certain type of weather phenomenon is recognised from past experience, and without thinking about it, a decision is made to ignore it or to begin planning a route around it. However, to consciously consider the economic implications of their actions, an RPD approach is not likely to be used. There could possibly be some instances where this is the case, but in the majority of cases, such considerations would be a result of team effort and collaboration, and having an equal RPD response to an event among both members of the flight crew is unlikely. With this in mind, pilots must employ other decision-making methods to consider the financial consequences of their actions. To be able to make such considerations, it is necessary to have the time to do so. This is where analytical decision-making comes into play, and it is likely what pilots use when discussing courses of action during a flight. Analytical decision-making involves systematically gathering relevant data. For pilots, this means looking at various sources of information such as weather reports, aircraft performance metrics, fuel consumption rates, or maintenance records. This approach allows pilots to break down complex problems into manageable parts, analysing each component individually and in context, which is crucial for understanding the full scope of any financial implications. Using a structured, analytical approach, pilots can identify potential risks and evaluate their likelihood and impact, making it easier to manage financial risks, such as the costs associated with delays, diversions, or emergency landings. For instance, they can choose flight paths that minimise fuel consumption or identify maintenance schedules that reduce downtime and repair costs. Pilots often need to balance these financial considerations with safety and operational efficiency. An analytical approach helps them weigh these factors appropriately, ensuring that cost-saving measures do not compromise safety or performance. Furthermore, this is also what is taught and encouraged through CRM and TEM training, where pilots learn to take a step back, assess the current situations for threats and errors, and cooperate to find an appropriate solution.

Rule-based decision-making is common in aviation, as checklists and procedures are commonplace. Creative decision-making, however, is rarely needed because of the relatively low rate of abnormal occurrences in the aviation industry. Most flights go as planned, but sometimes pilots must deviate from these plans, often following already established procedures for such deviations. Creative decision-making only seems to come into play when flight crews face abnormalities outside of their manuals' scope. A protruding case of this was seen in aviation when an Air Canada Boeing 767 ran out of fuel on its way from Calgary to Edmonton, resulting in the pilots using their experience to come up with an innovative approach called a *sideslip* to land the plane on an abandoned airstrip (Government of Canada, 1983). The main motivator behind this decision was safety, and the financial benefit of not losing the airframe or any passengers came only as a byproduct. This might seem like an obvious shift in the priorities of the flight crew, and it is also seen in the results of this paper, where it seems that when the flight crew senses danger or has safety concerns, the financial considerations get thrown out the window in order to focus more on the safety of the flight and its occupants.

5.4 Safety and Economic Success

It is understandable that companies will chase every cost-cutting opportunity they can in the fiercely competitive aviation industry with the small margins that may exist. Furthermore, it is difficult to discern the safety impact of sharp-end personnel's heightened awareness of economic considerations. On the one hand, there is a clear relationship between safety and economic success, suggesting that an increased focus on the financial side of the equation might have a negative impact on the safety aspect. On the contrary, aviation is a mature industry, having undergone countless changes in regulations following numerous serious accidents and events leading to economic losses, not to mention major loss of life. Throughout the years, safety barriers have been put in place, one by one, to safeguard the industry from future accidents. Since early on in aviation, its Swiss cheese model of Reason (1990) has filled many holes, and the industry is safer now than ever. Unfortunately, accidents are still happening, and some are rooted in a desire for profit. In 2019, after the introduction of its new aircraft model, the 737 MAX, Boeing faced two mysterious crashes of the airliner. The root cause of these crashes was a faulty sensor that pushed the aeroplanes into a steep, unrecoverable dive (NTSB, 2019). It was further uncovered that the flight crews had not been given sufficient training on the new model and were unfamiliar with the system, which had led to the accidents. The reason for this lack of training, and the system being implemented in the first place, was Boeing's desire to circumvent the requirement for different training for flight crews, making the Boeing 737 MAX an easier pill to swallow by lessening the required investments needed for the airlines who purchased it (Last Week Tonight, 2024). This is, unfortunately not the only example of cost-cutting measures having direct impacts on safety, and they were not the end for Boeing’s increasing safety concerns, as the 737 MAX models, as well as the 787 Dreamliner, have been plagued with quality control issues leading to aircrafts losing doors mid-flight (Shepardson, 2024) and a significant number of whistleblowers raising concerns about the state of the company (Koenig, 2024).

The hunt for profitability and ever-growing numbers seems like the biggest threat to the aviation industry today. This paper shows evidence of economic and financial obsession permeating the flight deck itself, where some pilots may feel the burden of limiting the financial impacts of their decisions on their employer’s behalf. For now, safety concerns seem to outweigh economic considerations, but there is still cause for concern as flying might become more dangerous. With the advent of global warming, the weather is becoming increasingly unpredictable and dangerous. Reports have been steadily popping up during the last decade about upper atmosphere turbulence becoming more severe (Prosser et al., 2023) due to the increased temperature. While the industry has good technology and advanced systems to deal with any adverse weather phenomenon, if an airline's economic situation or culture influences pilots to take shortcuts through such environments, this may lead to dangerous situations.

Furthermore, financial worry may impact a person’s psyche, promoting psychological problems, which might lead to safety concerns. Issues like stress, anxiety and depression may lead to cognitive impairments, which may impact decision-making skills, as well as attention span and memorisation skills (Haslam et al., 2005). With this, an increase in the number of unsafe acts, as seen in the HFACS framework, may be a consequence that might have severe impacts on safety. For pilots, maintaining mental health is important not only for their own well-being but also for the safety of their passengers and the overall integrity of the aviation system. Addressing financial stress and providing adequate support systems for pilots in this situation can help mitigate these risks, ensuring safer skies for everyone.

The biggest danger may be the hunt for the last piece of the puzzle, as Madsen (2013) discovered that airlines close to achieving monetary goals suffered the most regarding safety. In other words, airlines that are close to achieving their monetary goals may compromise safety in pursuit of financial performance, which might pose several significant dangers to aviation safety. Maintenance shortcuts, fuel savings, staff and compensation reductions, extended working hours, performance pressure, reduced training budgets and safety programs are all possible paths to eliminating those last few percentages on a spreadsheet, but any one of them may have severe consequences should the cost-cutting be taken a little too far. The findings in this study suggest pilots still prioritise safety, but in a world where every cent matters, it may just be a question of time before this changes for the worse.

5.5 Responsibility and Accountability

Responsibility and accountability are paramount in the aviation industry, particularly for pilots whose decisions directly impact the safety and well-being of passengers and crew. While safety is the foremost priority, financial considerations and implications also play a critical role in a pilot's professional conduct. Pilots should maintain a balance, ensuring operational efficiency does not compromise safety standards. Responsibility refers to the duty to perform a task or role, encompassing its obligations and expectations. On the other hand, accountability is acknowledging and accepting the outcomes of those tasks, including the obligation to report, explain, and be answerable for the results (Bivins, 2006). While responsibility is about the duties one is expected to carry out, accountability is about being held answerable for the fulfilment and consequences of those duties.

Pilots are primarily responsible for the safe operation of flights, encompassing pre-flight planning, adherence to flight protocols, and real-time decision-making during flights. They are accountable for ensuring the safety and comfort of passengers and crew, managing the aircraft's systems, and responding effectively to emergencies. This accountability extends to maintaining proficiency through regular training and staying updated on regulatory changes and best practices. Financially, pilots are also responsible for efficient fuel management, optimal flight routing, and timely reporting of maintenance issues to prevent costly delays and repairs. These responsibilities must be balanced with their primary duty of ensuring safety and demonstrating a comprehensive understanding of their role's operational and financial facets.

In contrast, airline management is responsible for setting the overarching policies and procedures that guide the airline's operations. This includes strategic planning, financial management, regulatory compliance, and maintaining operational infrastructure. Management is accountable for creating a safe, efficient, profitable operational environment. They must ensure that pilots have the necessary resources, including well-maintained aircraft, up-to-date training, and clear communication channels. Furthermore, management is responsible for fostering a culture prioritising safety while encouraging operational efficiency and cost-effectiveness.

The interplay between pilots and management is crucial: pilots rely on management to provide a stable and well-resourced operational framework, while management depends on pilots to execute their responsibilities with precision and professionalism. Both parties must communicate effectively to align their efforts towards safety, efficiency, and profitability goals. Through mutual accountability and a shared commitment to excellence, pilots and management together uphold the integrity and success of the aviation industry.

6 Conclusion

This study explored how much emphasis pilots put on economic considerations and to what extent they are the deciding factor in their decision-making processes. With a sample size of N = 38, the biggest correlations were seen with the type of flight activity, the degree of financial worry, perceived financial restriction, and if these restrictions are perceived to impact safety. Statistical tests revealed that flight activity, experience, financial worry, financial restriction, financial restriction and safety, and job satisfaction as statistically significant factors for both pilots considering the financial impact of their decisions, and financial considerations being the deciding factor, while job seeking was only significant for the latter. Further statistical analysis using linear regression modelling highlighted the type of flight activity and degree of financial worry as significant predictors for both dependent variables, while flight hours were significant for predicting the degree of financial importance consideration, and financial restriction was a statistically significant predictor for predicting when pilots use financial considerations as the deciding factor.

One nuance of the results is that when pilots experience safety as the biggest issue threatening a flight, the findings in this study suggest that they prioritise the safety aspect and put any economic considerations on hold. Through training regimes like CRM and TEM, they learn to analyse situations and cooperate with each other to make optimal decisions.

However, the results indicate that pilots are fully aware of their actions' financial impact and often consider these economic consequences as the most important factor. There may be cause for concern, as Madsen's (2013) findings show that airlines close to reaching their economic goals might compromise safety in the chase for financial success. Pilots may feel incentivised to take the safest option economically instead of focusing purely on safety if this culture permeates the flight deck. Of course, there is no air travel without profitability and economic sustainability. A balance is required to maintain economic viability while providing an operational environment fostering safe decision-making opportunities for flight crews free from blame and managerial burdens. This can only be achieved by management maintaining a safety culture and highlighting clear guidelines for what a pilot is and is not responsible and accountable for to make sure the flight crew feel comfortable making the best decisions for the safety of the flight.

6.1 Limitations

One limitation of this study is the number of participants who participated. Due to the fact that participation was voluntary, individuals who chose to participate might be more interested in the study because they had some form of bias. This can be because they experience a greater effect of economic restrictions at their workplace and want this to be known. Those who did not participate might have chosen to ignore the survey because they felt it was irrelevant to their situation. This is to say that individuals who chose to participate would be more likely to answer that they experience economic restrictions and let it affect their decision-making processes, skewing the study's results towards this conclusion.

Another limitation is the method of measurement. All data was gathered through a survey where all participants would voice their subjective opinions. This means they can only convey what they are consciously aware of, and the question is to what degree flight crew are aware of what influences their decisions. This might be a part of the subconsciousness for many of them, and asking them to answer a survey in a completely different environment than what they are used to operationally might produce incomplete or skewed results. Self-reporting means people can only report what they are aware of, and if they cannot remember how they act in challenging situations, the data they convey may not be the whole truth.

Furthermore, the departure from measuring a latent variable from a group of questions to focusing on a single variable from only one question may introduce an increased amount of erroneous data, such as false positives (type I error) and false negatives (type II error). Moreover, with this approach, some selective choices had to be made, and not all questions were included for further analysis to reduce the scope of the thesis. This is a consequence of the low sample size, as a bigger sample size might have limited such errors.

This also impacts the generalisability of the study. A low sample size from a small part of the aviation industry results in data with narrow applicability. The culture and safety standards are similar among Scandinavian countries, but applying the results from this study to the larger EASA community, the Americas, or Asia may not be viable. A longer timescale for the study might have resulted in a more refined questionnaire being constructed, possibly heightening the reliability scores and ironing out any kinks in the methodology.

6.2 Suggestions for Future Research

Stress, time management, and motivation should have been factors included in the survey, as these would have broadened the insight into the topic studied in this paper. Measuring them, however, is another matter, as subjective responses in a calm environment may not produce any relevant data. A more in-depth study on these factors can be recommended to see how flight crew implement financial considerations in stressful or time limited situations. Furthermore, a look at the differences between captains and first officers could be of interest, and among flight instructors and students for a paid versus sponsored flight school.

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Appendix 1 - Questionnaire

Questionnaire

Introduction
Dear participants,

We are conducting a research study as part of a master's thesis focusing on how economic factors might impact decision-making within the aviation industry. We invite you to participate by answering a short questionnaire as part of this study. Your valuable insights as a pilot are integral to our research, and we hope you are able to take the time to answer the questionnaire.

Objective:
This study aims to explore how economic factors influence the decision-making processes among flight crews and to understand the potential impacts on safety.

Confidentiality:
Your responses will be treated with confidentiality, and your identity will remain anonymous throughout the study. All participants receive the same link, and there is no way for anyone to link your answers to you personally. The information collected will only be used for academic purposes and will not be shared with any third parties.

Categories Measured:

- General
- Experience
- Performance
- Economic factors
- Job Satisfaction

Instructions:
Please answer each question thoughtfully and to the best of your ability. The questions in the general and experience category have mostly scaled or textbox answers. The remaining categories will ask you to rank a statement or a question on a scale from 1 to 6, based on how you feel it applies to you or your work. Your honest and open responses are crucial for the success of this study. Your participation is voluntary, and you may withdraw from the study at any point without consequences. All questions are optional, and you may skip questions you are not comfortable answering. Completing this questionnaire is estimated to take approximately 10 minutes of your time.

Thank you for your time and contribution to this research. Your insights will contribute to the advancement of knowledge in aviation safety. Please contact us if you have any questions regarding the questionnaire or the study.

Sincerely,
Tord Nedrebø
tne030@uit.no

General (three questions)
What is your gender?
Male, female, other.

What is your age?
Textbox.

What type of flying are you engaged in?
Commercial (ex. airlines), Other(ex military)

Experience (four questions)
How many years have you been flying (professionally) in total?
Textbox that participants can choose amount of years.

How many flight hours do you have? (Round to nearest 100 or 1000)
Textbox that participants can type amount of years.

How many different types of aircraft have you flown?
Textbox that participants can type amount of a/c types.

How many different companies have you flown for?
Textbox that participants can type amount of companies.

Performance (five questions)
How would you rate your flying performance?
1-very poor, 6-very good

To what degree do you feel you have the resources (i.e. time, freedom etc) available to you to be able to perform optimally?
1-not at all, 6-to a very high degree

To what degree do you feel your knowledge and skills are being maintained at your workplace (examples being study time, simulator sessions, courses)?
1-not maintained, 6-very well maintained

How often do you catch yourself missing checklists or check items?
1-never, 6-often

Please rate the accuracy of the following statement: During your flights you get corrected more than you would like to.
1-strongly disagree, 6-strongly agree

Economic considerations (five questions)
How often do you think or worry about your company's economic situation?
1-never, 6-every day

How often do you consider the economic impact of your operational decision?
1-never, 6-always

How often has the economic impact been a deciding factor in your decisions?
1-never, 6-often

To what degree do you feel economic restrictions affect safety in a negative way at your workplace?
1-not at all, 6-to a very high degree

To what extent do you feel restricted by your company's economic policies?
1-not at all, 6-to a very high degree

Job satisfaction (five questions)
How would you rate your overall job satisfaction?
1-very unsatisfied, 6-very satisfied

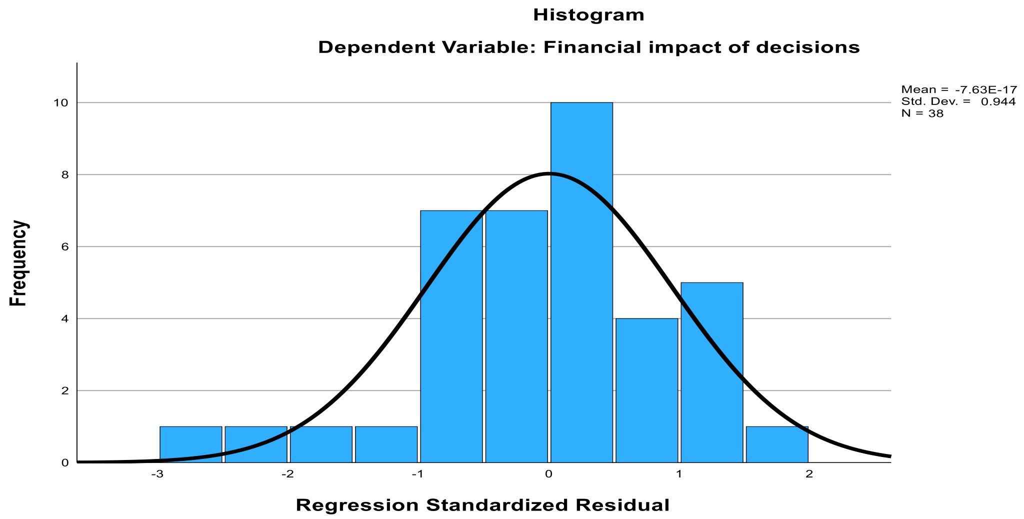
How satisfied are you with your compensations (salary and other benefits)?
1-very unsatisfied, 6-very satisfied

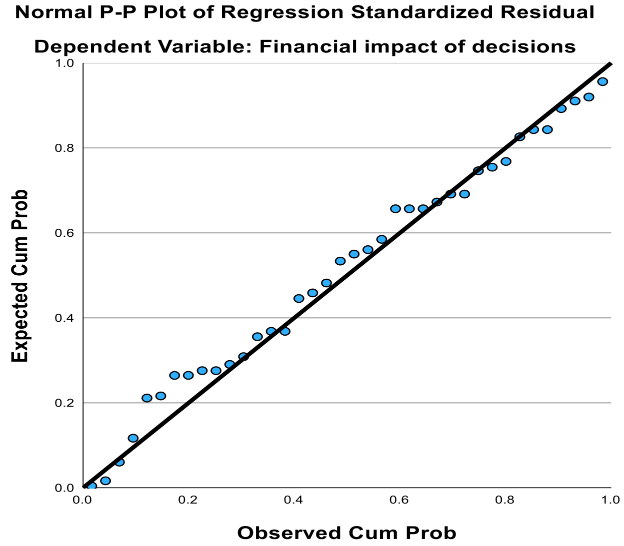
How satisfied are you with the workplace culture at your work?
1-very unsatisfied, 6-very satisfied

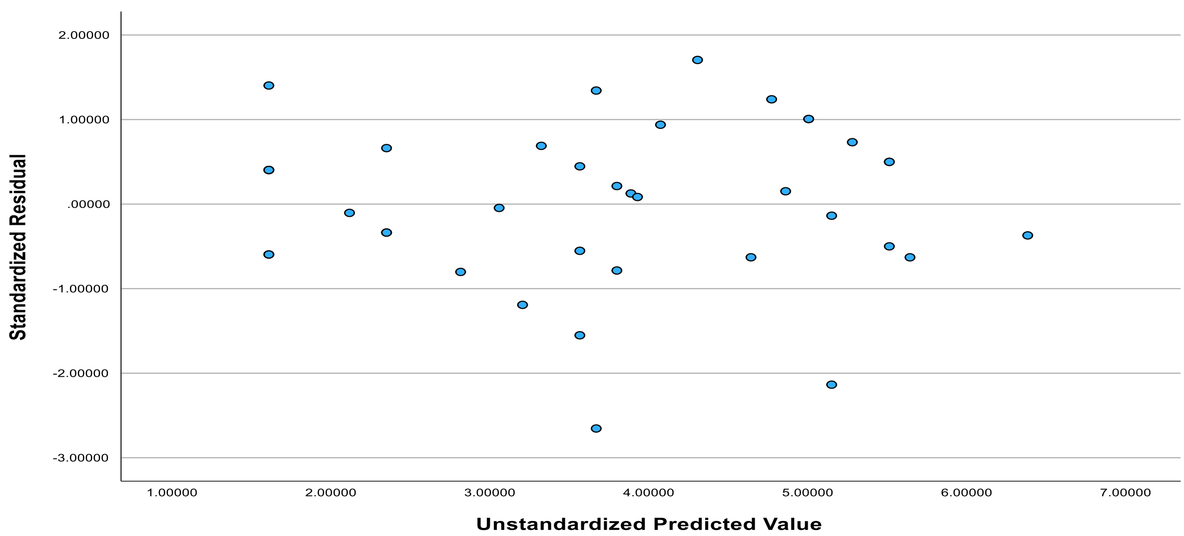
How often do you think about moving to another company or job?
1-not often, 6-very often

How much do you enjoy your current flying activities?
1-not much, 6-very much

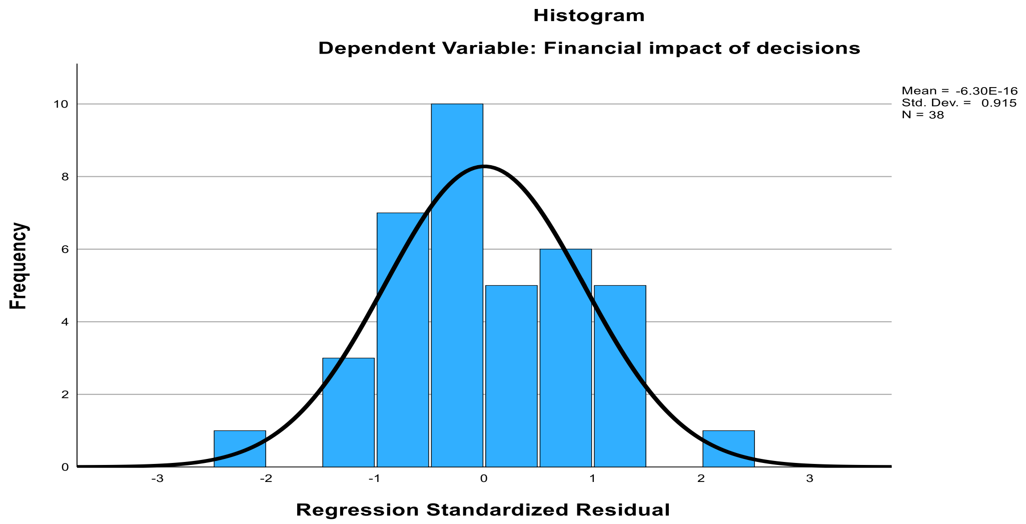
Appendix 2 – Model 1-I Residual Plots

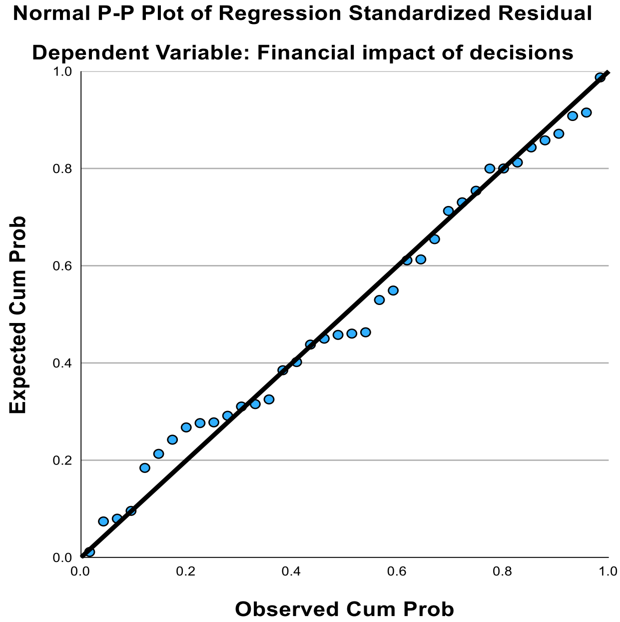


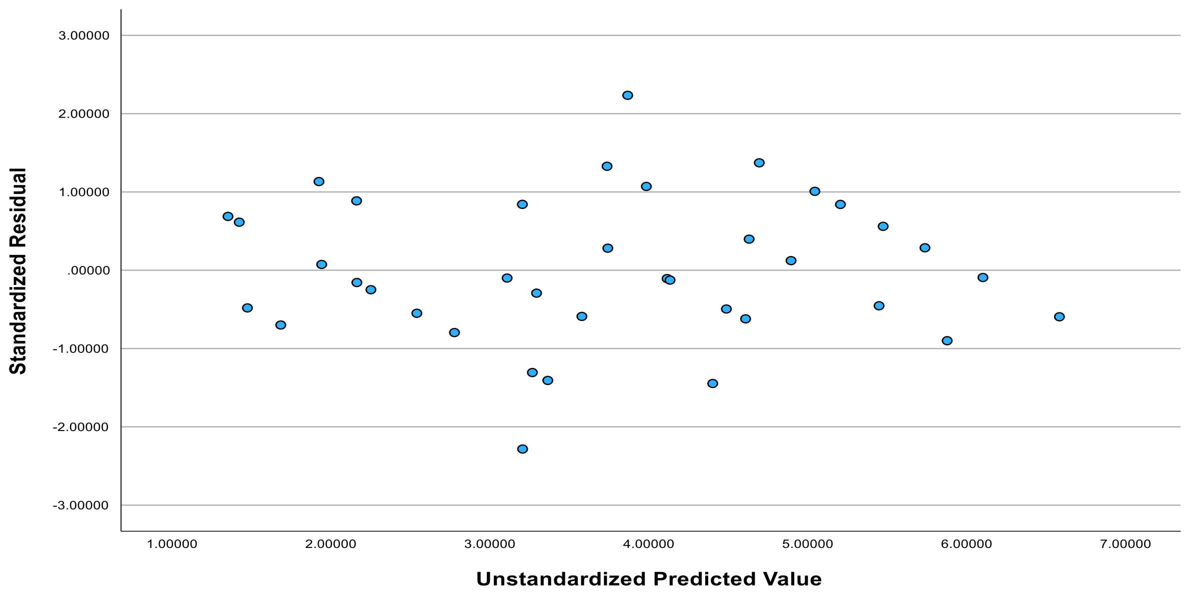




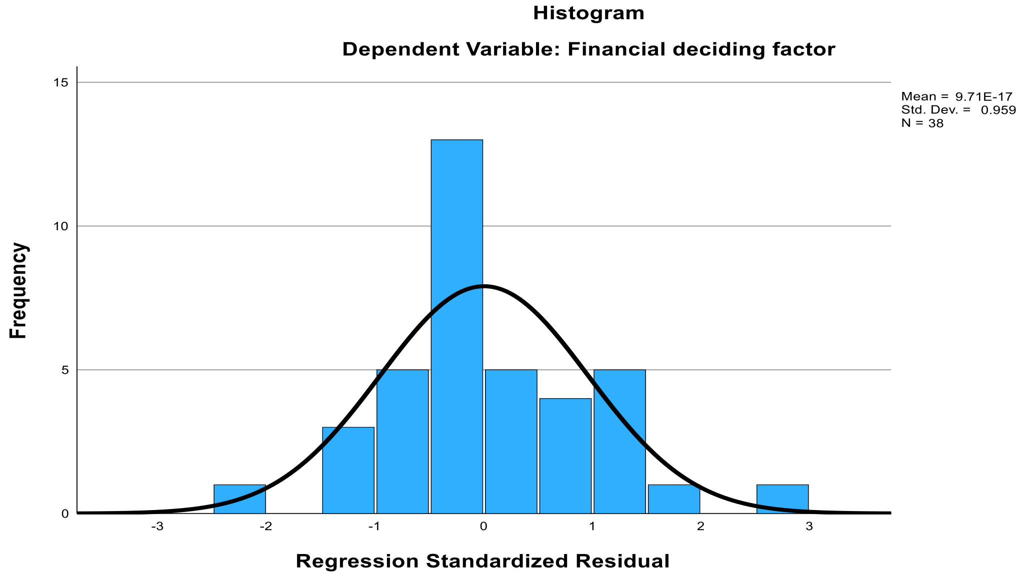
Appendix 3 – Model 1-II Residual Plots

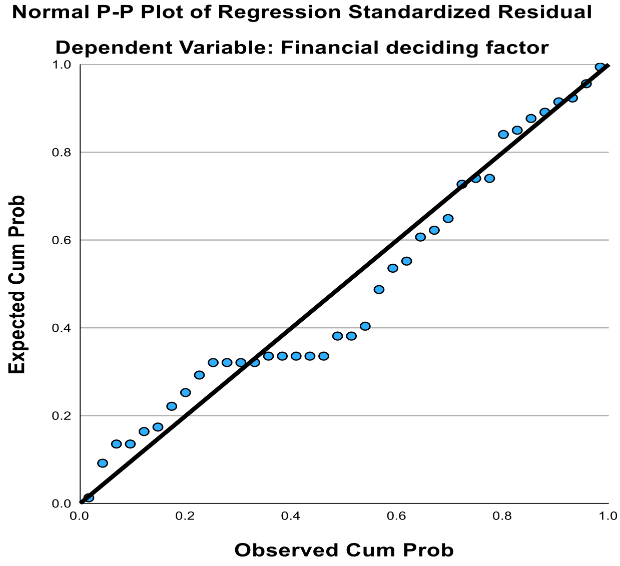


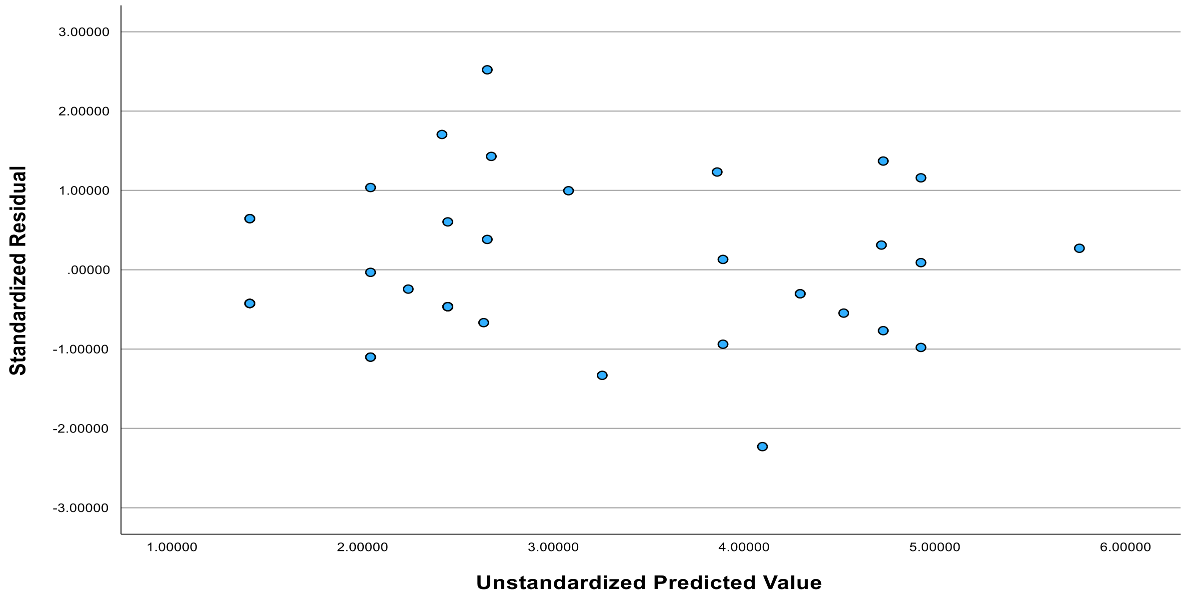




Appendix 4 – Model 2-I Residual Plots







Appendix 5 – Model 2-II Residual Plots