SAINT LOUIS UNIVERSITY.

Program-Level Assessment: Annual Report

Program Name (no acronyms): Ph.D. in Aviation	Department: Oliver L. Parks Department of Aviation Science
Degree or Certificate Level: Doctor of Philosophy	College/School: School of Science and Engineering
Date (Month/Year): June 2023	Assessment Contact: Stephen G. Magoc
In what year was the data upon which this report is based collected? AY Fall 2022 – Spring 2023	
In what year was the program's assessment plan most recently reviewed/updated? June 2022	
Is this program accredited by an external program/disciplinary/specialized accrediting organization? No	

1. Student Learning Outcomes

Which of the program's student learning outcomes were assessed in this annual assessment cycle? (Please list the full, complete learning outcome statements and not just numbers, e.g., Outcomes 1 and 2.)

Student Learning Outcome # 2 - Apply the major practices, theories, or research methodologies in the field(s) of study.

2. Assessment Methods: Artifacts of Student Learning

Which artifacts of student learning were used to determine if students achieved the outcome(s)? Please describe the artifacts in detail and identify the course(s) in which they were collected. Clarify if any such courses were offered
a) online, b) at the Madrid campus, or c) at any other off-campus location.

Evidence from courses includes, but is not limited to, assignments, quizzes, papers, and student surveys are collected by the department. All courses were taught in an online modality. The courses from which evidence was collected are:
ASCI 5010 Introduction to Aviation Research
Methods ASCI 5020 Analysis of Aviation Safety
Data
ASCI 5030 Aviation Security
Management ASCI 5220 Aviation
Safety Programs
ASCI 5470 Quantitative Data Analysis
ASCI 6010 Federal and International Regulations

3. Assessment Methods: Evaluation Process

What process was used to evaluate the artifacts of student learning, and by whom? Please identify the tools(s) (e.g., a rubric) used in the process and **include them in/with this report document** (please do not just refer to the assessment plan).

The faculty of the Department of Aviation Science met to assess the student learning outcome. Performance indicator rubrics prepared by the faculty were used to determine if graduates were able to meet the requirements of the student learning outcome being assessed. The rubric used to determine if graduates met the student learning outcome, and the course performance indicator rubrics used in this assessment are found in Appendix A of this assessment report.

4. Data/Results

What were the results of the assessment of the learning outcome(s)? Please be specific. Does achievement differ by teaching modality (e.g., online vs. face-to-face) or on-ground location (e.g., STL campus, Madrid campus, other off- campus site)?

The result of the assessment of the student learning outcome is that the graduates do meet the student learning outcome requirements. These courses were taught only in an online modality so there is no difference in achievement to note.

5. Findings: Interpretations & Conclusions

What have you learned from these results? What does the data tell you?

The data tells the faculty of the department that its graduates currently have the ability to assess relevant literature or scholarly contributions in the aviation field of study.

6. Closing the Loop: Dissemination and Use of Current Assessment Findings

A. When and how did your program faculty share and discuss these results and findings from this cycle of assessment?

All faculty in the department met on 06/23/2022 to assess the student learning outcome, therefore all faculty are aware of the results and findings of this assessment cycle.

B. How specifically have you decided to use these findings to improve teaching and learning in your program? For example, perhaps you've initiated one or more of the following:

Changes to the Curriculum or Pedagogies	• Course content • Teaching techniques • Improvements in technology • Prerequisites	• Course sequence • New courses • Deletion of courses • Changes in frequency or scheduling of course offerings
Changes to the Assessment Plan	• Student learning outcomes • Artifacts of student learning • Evaluation process	• Evaluation tools (e.g., rubrics) • Data collection methods • Frequency of data collection

The faculty agreed to take certain actions/make changes to course content so as to better enable students to perform at higher level when working to achievement of the requirements of the student learning outcome. These changes are as follows:

Course	Recommended Actions	When Assessed
ASCI 5010 Introduction to Aviation Research Methods	Raise the level of rigor in the course by requiring a term paper.	Unable to assess action items due to course not being taught during the 2022-2023 assessment cycle. The next assessment of this course will be after the Fall 2023 semester.
ASCI 5020 Analysis of Aviation Safety	None.	The next assessment of this course will be

Data		after the Spring 2025 semester.
ASCI 5030 Aviation Security Management	Require students to identify a contemporary resource for assignments. Require students to post the strengths and weaknesses of the discussion board posts made by their classmates.	Unable to assess action items due to course not being taught during the 2022-2023 assessment cycle. The next assessment of this course will be after the Spring 2024 semester.
ASCI 5220 Aviation Safety Programs	None.	The next assessment of this course will be after the Fall 2023 semester.
ASCI 5470 Quantitative Data Analysis	Improve learner-to-learner interactions.	Unable to assess action items due to course not being taught during the 2022-2023 assessment cycle. The next assessment of this course will be after the Spring 2024semester.
ASCI 6010 Federal and International Regulations	None.	Unable to assess action items due to course not being taught during the 2022-2023 assessment cycle. The next assessment of this course will be after the Spring 2024 semester.

Please describe the actions you are taking as a result of these findings.

The department will implement the recommendations actions when the affected courses are next offered.

7. Closing the Loop: Review of Previous Assessment Findings and Changes

A. What is at least one change your program has implemented in recent years as a result of assessment data?

- In the ASCI 5010 Introduction to Aviation Research Methods course, the faculty agreed to require a more comprehensive methodologies section in the required mini proposal.
- In the ASCI 5470 Quantitative Data Analysis course, the faculty agreed to provide structured examples of the required analysis of statistical data used to find and interpret published research data used in the course assignments.

B. How has this change/have these changes been assessed?

The changes were implanted into the courses and assessed by the faculty immediately after the courses were taught to determine if the purpose of the required changes were met.

C. What were the findings of the assessment?

The faculty of the department determined that the changes implemented did assist the students in meeting the Student Learning Outcome #2, applying the major practices, theories, or research methodologies in the field(s) of study.

D. How do you plan to (continue to) use this information moving forward?

The department faculty will continue to monitor the discussion boards in the courses to ensure that the students understand and follow the more-explicit instructions provided.

IMPORTANT: Please submit any assessment tools (e.g., artifact prompts, rubrics) with this report as separate attachments or copied and pasted into this Word document. Please do not just refer to the

assessment plan; the report should serve as a stand-alone document.

Ph.D. in Aviation Student Learning Outcome Assessment Rubric

Student Learning Outcome #2: Apply the major practices, theories, or research methodologies in the field(s) of study.

Date of this assessment: 05-24-2023

The following assessment is based on coursework of students and surveys of graduates.

Performance Indicator Assesses	Do not Meet	Meet
Students and graduates possess different skills needed to carry out research in Aviation, e.g., quantitative data analysis, numerical modeling, and computational competence.		X
Students and graduates possess different skills needed to carry out research in Aviation, e.g., qualitative data analysis and field work.		X

List any prior change(s) made to the curriculum to aid students and graduates in meeting this student learning outcome:

- In the ASCI 5010 Introduction to Aviation Research Methods course, the faculty agreed to require a more comprehensive methodologies section in the required mini proposal.
- In the ASCI 5470 Quantitative Data Analysis course, the faculty agreed to provide structured examples of the required analysis of statistical data used to find and interpret published research data used in the course assignments.

Describe the effect of any change(s) made to the curriculum:

- The changes made in the ASCI 5010 course allowed the students and graduates to be better able to apply the research methodologies to the major practices, theories, or research methodologies in the field of aviation.
- The change made in the ACI 5470 course allowed the students and graduates to find and interpret published research data so as to be better prepared to use the the major practices, theories, or research methodologies in the field of aviation.

List recommendation(s) for changes to be made to the curriculum as a result of this assessment:

- In the ASCI 5010 Introduction to Aviation Research Methods course, it is recommended to raise the level of rigor in the course by requiring a term paper.
- In the ASCI 5030 Aviation Security Management course, it is recommended to require students to identify a contemporary resource for assignments, and to require students to post the strengths and weaknesses of the discussion board posts made by their classmates.
- In the ASCI 5470 Quantitative Data Analysis course, it is recommended to work towards improving the learner-to-learner interactions.

Department of Aviation Science

Ph.D. in Aviation Graduate Program Assessment

Continuous Improvement Items

05-24-2023

Course	Action Item
ASCI 5010 Introduction to Aviation Research Methods	Raise level of rigor by requiring a term paper
ASCI 5470 Quantitative Data Analysis	Improve learner-to-learner interaction.

SAINT LOUIS UNIVERSITY

OLIVER L. PARKS DEPARTMENT OF AVIATION SCIENCE

Appendix A

Ph.D. in Aviation Program

Course Evidence

Graduate Course Performance Indicator Rubric

Assess Student Learning Outcomes

Course: ASCI 5010 Introduction to Aviation Research Methods Course Instructor: Terrence Kelly

Semester Taught: Fall 2021 Number of Students in Course: 3

Student Learning Outcome Assessed	**Assessment Results: (Indicate what % of class achieved a minimum score of 80%)**	**Benchmark achieved? (Benchmark: 80% of students will score a minimum of 80% = "B")**
SLO 1: Assess relevant literature or scholarly contributions to the aviation field of study.	Precis Average Scores Precis LM2: 91.0% Precis LM4: 95.6% Precis LM6: 89.3% Precis LM8: 90.0%	Yes, 3 of 3 – 100%
SLO 2: Apply the major practices, theories, or research methodologies in the aviation field of study.	Assignment Average Scores Thesis Statement: 95% Problem Statement: 92% Source List: 100% Mini-Lit Review: 90% Research Questions: 93%	Yes, 3 of 3 – 100%

Course Assessment (Intended Use of Results)
The following will be used for recommendations to improve the quality of course delivery based on assessment results. These recommendations may include prerequisite change; changing course outline and adding more topics; adding a third assessment; changing the course sequence, etc.

SLO 1 was evaluated using precis assignments that required students to assess the literature surrounding an assignment-specific research topic and prepare an overview/critique (precis). Four precis assignments were given over the Fall 2021 semester. The average for precis LM2 was 91%; the average for precis LM4 was 95%; the average for precis LM6 was 89% and the average for precis LM8 was 90%. I do not anticipate a need for any significant changes to achieve SLO 1.

SLO 2 was evaluated using a synthesis of assignments aimed at providing the student a better understanding of how to engage in research methodologies surrounding the field of aviation. Throughout the semester, students were required to assemble a) a thesis statement; b) a problem statement; c) a source list; d) a mini literature review with a focus on methodology, and e) research questions in the students' research interest area. Overall, the scores on the assignments were quite strong and suggested the students were developing the research skills necessary for an introductory-research level course. Scores for the aggregate assignments were a) thesis statement 95%, b) problem statement 92%, c) source list 100%, d) mini literature review (methodology argument) 90%, and, d) research questions 93%. While I am pleased with the grades, I do question my own grading. I plan to raise the level of rigor associated with these assignments and will consider adding a more comprehensive writing assignment toward the end of the course that synthesizes all of these skills into a single effort (paper).

Examples SLO 1

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Precis LM6

Introduction

This article presents the ethical considerations and their applications to research, emphasizing the importance of ethical research. This paper was prepared by S. Akaranga & B. Makau from university of Nairobi. In the paper, they describe the definition of ethics and research ethics.
Akaranga & Makau narrates the origin of research ethics based on biomedical research, which evolved from the need to use human people in research, and the origin can be traced back to before the eighteenth century (Akaranga & Makau, 2016). The significant improvement in the research ethics was when an American tribunal launched criminal prosecutions against 23 top German doctors and officials who committed war crimes against humanity in 1946 (Akaranga & Makau, 2016). They were accused of conducting medical tests on hundreds of people held hostage in concentration camps during World War II without their consent (Akaranga & Makau, 2016). Unfortunately, many of

the victims died due to the experiments, while others were severely disabled. Because human beings were being exploited in numerous circumstances, the Nuremberg Code was established in 1948 as a result of the trial's findings (Akaranga & Makau, 2016). The Authors present two types of research ethics theories: the bad apple theory and the stressful or imperfect environment theory. They narrate the ethical research issues & ethical issues related to research. Akaranga & Makau list several unethical issues that damage the study's ultimate goals, such as fabrication, falsification, fraud, financial matters, sponsorship issues, plagiarism, writing, and publishing ethics (Akaranga & Makau, 2016). In addition to ethical issues related to research subjects, anonymity, confidentiality, privacy, beneficence, deception, non-maleficence, voluntary issues, informed consent, vulnerable groups issues, and research process issues (Akaranga & Makau, 2016). The authors conclude the paper with recommendations emphasizing the importance of ethics in research to enhance ethical research.

Background Summary

The authors cite the ethical considerations and their applications to research. They describe the meaning of ethics and research ethics as a discipline of philosophy that deals with human conduct and directs people's norms or standards of behavior and interpersonal relationships, while they describe research ethics as a branch of applied ethics with well-defined principles and guidelines that define how research should be conducted morally and honestly (Akaranga & Makau, 2016). Akaranga & Makau point out that while conducting research, a researcher must observe suitable values at all phases, and it is possible that if this is not observed, scientific misconduct will occur (Akaranga & Makau, 2016).

The authors highlighted some ethical considerations:

1. Fabrication and falsification or fraud: Fabrication entails creating, inventing, or making up false data or results that are then recorded or reported, whereas falsification or fraud entails manipulating materials, equipment, or processes to change outcomes or omit some data or findings so that the research is not well-represented or recorded (Akaranga & Makau, 2016).
2. Financial & sponsorship issues: The research findings could be jeopardized if the funding organization does not entirely support the research financially and instead focuses on cost-cutting, lowering the study's quality (Akaranga & Makau, 2016).
3. Plagiarism: is most common in the initial pages, such as the introduction and literature review; this can be attributed to laziness, ignorance, or cultural diversity, which may compromise the researcher's honesty (Akaranga & Makau, 2016).
4. Writing & publication ethics: It is unethical to submit the same paper to two distinct journals or

publish research findings twice without alerting the editors of the other publication (Akaranga & Makau, 2016).

5. Ethical issues related to research subjects: Human subjects are involved in the majority of research studies, which is why careful consideration must be given to how to interact with and relate to them in this noble endeavor (Akaranga & Makau, 2016).
6. Anonymity, confidentiality, and privacy: During the study, a researcher must protect the respondent's confidential information, but if any information must be shared, the respondent's consent must be obtained; this improves the research subject's honesty by shielding them from bodily and psychological harm (Akaranga & Makau, 2016).
7. Deception: Researchers should be honest with their participants, but if they are only told part of the truth or if the fact is wholly denied or compromised, this can lead to deception (Akaranga & Makau, 2016).
8. Non-maleficence: is a notion that focuses on avoiding harm; it emphasizes the need to prevent any intentional injury or minimize any aspect of potential harm to the respondent by refraining from damaging them physically or psychologically (Akaranga & Makau, 2016).
9. Voluntary and informed consent: is one of the most important ethical dilemmas in research, implying that "a person gives his or her consent willingly, voluntarily, intelligently, and clearly and manifestly (Akaranga & Makau, 2016). A researcher should describe the study's goal in detail, and if there are any dangers associated, they should be explained, and the researcher should not expose the respondent's identity (Akaranga & Makau, 2016).
10. Ethical issues related to the research process: researchers should adhere to guidelines associated with authorship, copyright and patenting policies, data sharing policies, and confidentiality rules in peer review (Akaranga & Makau, 2016).

The authors concluded their paper with several reasons why research ethics are important:
First, they promote the research's main aims, including the acquisition of knowledge, promoting the truth in research by avoiding errors that could arise due to providing false information, fabricating or misrepresenting information (Akaranga & Makau, 2016). Second, it is critical that researchers and consumers trust one another, accept their opinions, and treat one another appropriately. There are guidelines created in this regard to maintain the copyright and patenting policies of their products. However, this can only be accomplished if relevant standards for enhancing confidentiality are followed (Akaranga & Makau, 2016). Third, any research that researchers are involved in and any work that is published must be read by the general public, who appreciate the researcher's efforts

(Akaranga & Makau, 2016). Fourth**,** if public funds are being used to fund the research, it must be properly accounted for because it must be encouraged to improve its quality and integrity (Akaranga & Makau, 2016). Finally, research ethics is concerned with societal values; as a result, researchers should promote social responsibility, uphold human values, and safeguard the welfare of study participants and animals in accordance with international law and safety regulations (Akaranga & Makau, 2016).

Evaluation

This paper is easy to read and understand since they discuss the common ethical issues related to research in the academic field. In addition to the purely academic ethical issues such as writing and publishing, they addressed the welfare study of the participants, either humankind or animals. The authors do an excellent work narrating the definitions related to the ethics and ethical issues related to the research so the reader can understand the terms. Also, they do a great effort to provide the origin of the research ethics, giving the reader the perfect background. The authors report ethical research issues in this paper include the most common ethical research issues, especially when they included the negative impact of each one. The only drawback that they narrate one of the reasons for the paper is to promote the ranking of their university.

I believe that avoiding ethical research issues is noble work, and ethical research issues must be avoided, not just for college ranking purposes. Overall, this was a well-written paper, especially in the latter section of the paper when the authors concluded their article with several reasons explaining why research ethics are important.

References

Akaranga, S. I., & Makau, B. K. (2016). *Journal of Educational Policy and Entrepreneurial Research*. Retrieved from https://www.semanticscholar.org/paper/Ethical-considerations- and-their-applications-to-a-Akaranga Makau/0aa01e9f5bf5cea523daf16693cfb9dde7096802.

Precis LM8

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Introduction

While it seems fairly intuitive that ethical research seems like the best way to accomplish research, exactly how this is accomplished, to what degree, and against what standard it is measured is not quite as clear. This précis reviews an article that is published in an attempt to help standardize the ethical guidelines used to conduct research in Europe, as the authors form part of the European Network for Academic Integrity (ENAI), the "first European consortium established to assist academic integrity" (Sivasubramaniam et. al., 2021, p. 2).

Background Literature

The article starts with high impact verbiage to describe ethics and ethical behavior, such as fundamental pillars, precedence, transform, indispensable. These descriptions immediately catch the readers attention and remind them of the importance ascribed to holding up an ethical standard in research. The authors' stated premise for the paper is an inconsistency in how ethical standards were being applied and taught (Sivasubramaniam et al., 2021). The literature review conducted focused on looking at responsible research practice (RPP), which they defined as an all-encompassing approach to integrity in research beyond just the operational parts (Israel and Drenth, 2016).

Several of the key RRP enhancements discussed from The Singapore Statement on Research Integrity were transparency, truthful representation, respecting contributions, truthful reporting, encouraging integrity through education, among many others (2020). The authors discuss the possibility that researchers can self-govern when it comes to ethical research, with the hope that they internalize this ethical approach as an integrated behavior, not just an exercise on paper. This self-governance can and should result in high quality research. An example is then discussed regarding early human vaccination trials in the 1700s, where the test subjects were immediate family members, which according to the moral justification of that time period was acceptable (Fox, 2017). The authors then state that currently this would not be ethically acceptable, but don't elaborate any further. This is the only weak point noted in this paper, as the authors could have elaborated why and how this practice doesn't stand up to modern ethical research.

Ethical advisory committee (EAC)

The paper adequately covers a big picture history of ethical governance by giving a brief overview of the Nuremberg code, followed by the Helsinki Declaration, and then the Institutional Review Board (IRB). Many of the different governing entities and their basic structures are discussed along with what areas they cover. These ethical advisory committees are either at a national or a regional level and are responsible for reviewing study proposals and issuing ethical guidance (Council of Europe, 2014).

Ethics vs morals

The highlight of the article is the discussion on the differences between ethics and morals. The authors state that although these terms are sometimes used interchangeably, that is incorrect as they have separate meanings. Ethics is related to rules from an external source such as a workplace code of conduct (Kuyare et al., 2014). On the other hand, morals are about an individual's own principles in regards to right and wrong (Quinn, 2011). They continue by discussing how there are not much scholarly research in this field that distinguishes ethics from morals, and conclude that in research and academia the term ethics should be used instead of morals (Sivasubramaniam et al., 2021).

Conclusion

After a great introduction, a solid discussion on EAC, and distinguishing between ethics and morals, the authors conclude their article by discussing what they view is their mission in ENAI as an ethical working group. The main points discussed are that they exist to render advice, act as a guide in ethical standards, collaborate and provide support and training in this field. They go a step further and start laying out the process for how to setup an institutional ethical committee (EC), what the approval process looks like for this committee once it is setup, and how this EC should provide education to further ethical culture.

References

Shivadas, S., Dlabolová, D. H., Veronika, K., & Khan, Z. R. (2021). Assisting you to advance with ethics in research: an introduction to ethical governance and application procedures. International Journal for Educational Integrity, 17(1) http://dx.doi.org/10.1007/s40979-021-00078-6

Israel, M., & Drenth, P. (2016). *Research integrity: perspectives from Australia and Netherlands.* In T. Bretag (Ed.), Handbook of academic integrity (pp. 789–808). Springer, Singapore. https://doi.org/10.1007/978-981-287-098-8_64

Singapore statement on research integrity (2010). 3rd World Conference on Research Integrity. https://wcrif.org/guidance/singapore-statement

Fox G (2017). History and ethical principles. *The University of Miami and the Collaborative Institutional Training Initiative (CITI).* https://silo.tips/download/chapter-1-history-and-ethical-principles#

Kuyare, MS., Taur, SR., Thatte, U. (2014). Establishing institutional ethics committees: challenges and solutions–a review of the literature. *Indian J Med Ethics*. https://doi.org/10.20529/IJME.2014.047

Quinn, M. (2011). *Introduction to Ethics*. Ethics for an Information Age. 4th Ed. Ch 2. 53–108. Pearson. UK

Texts of the Council of Europe on bioethical matters - coe.int. (n.d.). Retrieved December 11, 2021, from https://www.coe.int/t/dg3/healthbioethic/texts_and_documents/INF_2014_5_vol_II_textes_%20CoE_%20bio%C3%A9thique_E%20(2).pdf

Examples SLO 2

Thesis Statement Example 1

Using the guidance provided in LM 3 (Videos and Purdue Owl), upload an example Thesis statement for a research topic related to your research interest area. This item is due no later than Friday, September 24th by 6:00pm (central time).

Aviation is an extremely expensive and complex industry with high potential for safety incidents, leading experts to continuously research ways of lowering costs, increase quality of training, and minimize risk. Visual and augmented reality in aviation training simulation has begun to fill that need experts were looking for, as there have been proven studies on its ability to immerse the pilot in a more realistic environment and help improve the flying skillset. However, as this research will show, when the complexity of the aviation task at hand increases significantly there is a point at which simulation instead of performing the task in the aircraft can in effect hamper pilot learning and proficiency. Due to this occurrence, using the new USAF Pilot Training 2.5 as the study case, the emphasis of virtual and augmented reality training should occur in the early phase of training but taper down in more advanced training, as its benefit during complex events diminishes significantly when compared to the learning that happens when flying.

*note: I used the guidance from your video that discussed thesis being 6-7 sentences, as opposed to the Purdue guidance which made is seem more like just one sentence.

Thesis Statement Example 2

Previous aircrafts' accidents and incidents investigation findings should be the lieu to commence in the proactive hazard identification and reporting process for MROs and Line Maintenance providers:
The paper that follows should:
Explain how relying of previous findings of aircrafts' accidents and incidents investigation could increase the number of proactive hazards identification and reporting for MROs and Line Maintenance for their SMS program.

Problem Statement Example 1

The advances of virtual and augmented reality in aviation simulation have allowed training quality to increase and cost to decrease exponentially in recent years. However, there is a point of diminishing return where too much simulation as a substitute for flying could have a negative outcome, potentially decreasing a pilot's situational and air awareness, and creating a less safe environment.

Problem Statement Example 2

Though SMS for 121 operators is now mandatory in the United States, others non-121 operators like MROs and line maintenance service providers that service these airlines face the challenge of clearly implementing a proactive hazards identification and reporting through their Voluntary SMS program. Numerous data of aircraft accidents and incidents imputed to MROs and line maintenance service providers do exist, therefore what effect do aircraft accident and incident investigation findings have on the proactive hazards' identification and reporting?

Sources List Example 1

Arya, S. (2020). NEW TECHNOLOGIES AND APPLICATIONS OF MOTION TRACKING IN VIRTUAL REALITY SYSTEMS. *International Journal of Advanced Research in Computer Science, 11*(5), 38-44. http://dx.doi.org.ezproxy.liberty.edu/10.26483/ijarcs.v11i5.6658

Brown, C. (2021). The Use of Augmented Reality and Virtual Reality in Ergonomic Applications for Education, Aviation, and Maintenance. *Ergonomics in Design.* https://doi.org/10.1177/10648046211003469

Carmigniani, J., Furht, B., Anisetti, M., Ceravolo, P., Damiani, E., & Ivkovic, M. (2011). Augmented reality technologies, systems and applications. *Multimedia Tools and Applications, 51*(1), 341-377. http://dx.doi.org.ezp.slu.edu/10.1007/s11042-010-0660-6

Coleman, J., & Thirtyacre, D. (2021). Remote pilot situational awareness with augmented reality glasses: An observational field study. *International Journal of Aviation, Aeronautics and Aerospace, 8*(1), 3. https://ezp.slu.edu/login?url=https://www-proquest-com.ezp.slu.edu/scholarly-journals/remote-pilot-situational-awareness-with-augmented/docview/2488140980/se-2?accountid=8065

Comerford, D., & Johnson, W. W. (2007). Potential Capabilities in a Future, Augmented Cockpit. Ergonomics in Design, 15(1), 8–13. https://doi.org/10.1177/106480460701500105

Dahlstrom, N. , Dekker, S. , van Winsen, R. & Nyce, J. (2009) Fidelity and validity of simulator training. *Theoretical Issues in Ergonomics Science*, 10:4, 305-314, DOI: 10.1080/14639220802368864

Fussell, S. G., & Truong, D. (2020). Preliminary results of a study investigating aviation Student's intentions to use virtual reality for flight training. *International Journal of Aviation, Aeronautics and Aerospace, 7*(3), 2. https://ezp.slu.edu/login?url=https://www-proquest-com.ezp.slu.edu/scholarly-journals/preliminary-results-study-investigating-aviation/docview/2428115755/se-2?accountid=8065

Fussell, S. G. (2020). *Determinants of aviation students' intentions to use virtual reality for flight training* (Order No. 28150209). Available from ProQuest Dissertations & Theses Global. (2459162236). https://ezp.slu.edu/login?url=https://www-proquest-com.ezp.slu.edu/dissertations-theses/determinants-aviation-students-intentions-use/docview/2459162236/se-2?accountid=8065

Higgins, V. (2017). Augmented & virtual reality: The future of work, not just play. *Professional Safety, 62*(6), 86-87. https://ezp.slu.edu/login?url=https://www-proquest-com.ezp.slu.edu/scholarly-journals/augmented-amp-virtual-reality-future-work-not/docview/1910288162/se-2?accountid=8065

Jones, T. (2009). Getting real about our virtual future. *Nature Materials, 8* (12), 919-21. http://dx.doi.org.ezp.slu.edu/10.1038/nmat2580

Kaplan, A. D., Cruit, J., Endsley, M., Beers, S. M., Sawyer, B. D., & Hancock, P. A. (2021). The Effects of Virtual Reality, Augmented Reality, and Mixed Reality as Training Enhancement Methods: A Meta-Analysis. Human Factors, 63(4), 706–726. https://doi.org/10.1177/0018720820904229

Mayberry, C. R. (2013). *Toward the implementation of augmented reality training* (Order No. 3591704). Available from ProQuest Dissertations & Theses Global. (1434888763). https://ezp.slu.edu/login?url=https://www-proquest-com.ezp.slu.edu/dissertations-theses/toward-implementation-augmented-reality-training/docview/1434888763/se-2?accountid=8065

Myers,Paul L., I.,II, Starr, A. W., & Mullins, K. (2018). Flight Simulator Fidelity, Training Transfer, and the Role of Instructors in Optimizing Learning. *International Journal of Aviation, Aeronautics and Aerospace, 5*(1), 6. http://dx.doi.org.ezproxy.liberty.edu/10.15394/ijaaa.2018.1203

Newman, J. (2018). The Future of Flight Training is Virtual. *Naval Aviation News, 100* (1), 22-23. http://ezproxy.liberty.edu/login?qurl=https%3A%2F%2Fwww.proquest.com%2Ftrade-journals%2Ffuture-flight-training-is-virtual%2Fdocview%2F2052770488%2Fse-2%3Faccountid%3D12085

Oberhauser, M., & Dreyer, D. (2017). A virtual reality flight simulator for human factors engineering. *Cognition, Technology & Work, 19* (2-3), 263-277. http://dx.doi.org.ezproxy.liberty.edu/10.1007/s10111-017-0421-7

Oh, C., Lee, K., & Oh, M. (2021). Integrating the first person view and the third person view using a connected VR-MR system for pilot training. *Journal of Aviation/Aerospace Education & Research, 30*(1), 21-40. http://dx.doi.org.ezp.slu.edu/10.15394/jaaer.2021.1851

Pope, H. (2018). Chapter 5. the future of virtual and augmented reality. *Library Technology Reports, 54*(6), 21-25. https://ezp.slu.edu/login?url=https://www-proquest-com.ezp.slu.edu/scholarly-journals/chapter-5-future-virtual-augmented-reality/docview/2099868508/se-2?accountid=8065

Safi, M., Chung, J., & Pradhan, P. (2019). Review of augmented reality in aerospace industry. *Aircraft Engineering and Aerospace Technology, 91*(9), 1187-1194. http://dx.doi.org.ezp.slu.edu/10.1108/AEAT-09-2018-0241

Sportillo, D., Paljic, A., Ojeda, L., (2018). Get ready for automated driving using Virtual Reality. *Accident Analysis & Prevention*, Volume 118, 2018, Pages 102-113, ISSN 0001-4575, https://doi.org/10.1016/j.aap.2018.06.003

Tiwari, A., Verma, S., Chand, T. *et al.* A comparative study on display sources for augmented reality-based technology in defense applications. *J Opt* **48,** 302–307 (2019). https://doi-org.ezproxy.liberty.edu/10.1007/s12596-019-00530-4

Vahdatikhaki, F., El Ammari, K., Kassemi, A., Langroodi, Miller, S., Hammad, A., Doree, A. (2019). Beyond data visualization: A context-realistic construction equipment training simulators. *Automation in Construction*, Volume 106, 2019, 102853, ISSN 0926-5805, https://doi.org/10.1016/j.autcon.2019.102853

Wallace, J. W., Hu, Z., & Carroll, D. A. (2020). Augmented reality for immersive and tactile flight simulation. *IEEE Aerospace and Electronic Systems Magazine, 35*(12), 6-14. http://dx.doi.org.ezp.slu.edu/10.1109/MAES.2020.3002000

Source List Example 2

Canders, M. (2016). Peer reviewed Safety Management System (SMS): Collaboration for Continuous Improvement (literature review). International Journal of Aviation, Aeronautics, and Aerospace. https://doi.org/10.15394/ijaaa.2016.1113

Castelluccio, F., Maritano, L., Amoroso, S., & Migliore, M. (2015). Cost analysis for a future helicopter for Passenger Transport. Aircraft Engineering and Aerospace Technology, 87(2), 139-146. doi:10.1108/aeat-12-2013-0240

Castelluccio, F., Maritano, L., Amoroso, S., & Migliore, M. (2016). A comparative analysis between helicopter and seaplane for Passenger Transport. Aircraft Engineering and Aerospace Technology, 88(4), 580–590. https://doi.org/10.1108/aeat-01-2015-0024

Chatzi, A. V. (2018). Safety Management Systems: An opportunity and a challenge for military aviation organisations. Aircraft Engineering and Aerospace Technology, 91(1), 190–196. https://doi.org/10.1108/aeat-05-2018-0146

Choi, W., & Hampton, S. (2020). Scenario-based strategic planning for future civil vertical take-off and Landing (VTOL) transport. Journal of Aviation/Aerospace Education & Research. doi:10.15394/jaaer.2020.1808

Goyal, R., Reiche, C., Fernando, C., & Cohen, A. (2021). Advanced air mobility: Demand analysis and market potential of the airport shuttle and Air Taxi Markets. Sustainability, 13(13), 7421. https://doi.org/10.3390/su13137421

Hinkelbein, J. (2010). Helicopter Emergency Medical Services accident rates in different International Air Rescue Systems. Open Access Emergency Medicine, 45. https://doi.org/10.2147/oaem.s9120

Mitchell, S. J., & Braithwaite, G. R. (2008). Perceptions of safety and Offshore Helicopter Travel. International Journal of Energy Sector Management, 2(4), 479–498. https://doi.org/10.1108/17506220810919036

Moon, K., & Yakovlev, A. A. (2020). A comparative statistical analysis of global trends in civil helicopter accidents in the U.S., the EU, and the CIS. IOP Conference Series: Materials Science and Engineering, 868, 012020. doi:10.1088/1757-899x/868/1/012020

Nascimento, F. A. C., Majumdar, A., & Ochieng, W. Y. (2013). Helicopter accident analysis. Journal of Navigation, 67(1), 145–161. https://doi.org/10.1017/s037346331300057x

Nystøyl, D. S., Breidablik, H. J., Røislien, J., Hunskaar, S., Østerås, Ø., & Zakariassen, E. (2018). 44 do organisational change in out-of-hour service influence on the use of Helicopter Emergency Medical Service? an observational study of a natural experiment. Abstracts. https://doi.org/10.1136/bmjopen-2018-ems.44

Peters, A. G., & Wood, D. F. (1977). Helicopter Airlines in the United States 1945–75. The Journal of Transport History, ss-4(1), 1–16. https://doi.org/10.1177/002252667700400101

Qian, F., Gribkovskaia, I., & Halskau Sr, Ø. (2011). Helicopter routing in the Norwegian Oil Industry. International Journal of Physical Distribution & Logistics Management, 41(4), 401–415. https://doi.org/10.1108/09600031111131959

Saleh, J. H., Tikayat Ray, A., Zhang, K. S., & Churchwell, J. S. (2019). Maintenance and inspection as risk factors in helicopter accidents: Analysis and recommendations. PLOS ONE, 14(2). https://doi.org/10.1371/journal.pone.0211424

Scaperdas, A., & Howson, D. (2020). CAA Research Programme – Helicopter Operations to Moving Offshore Helidecks. The Aeronautical Journal, 124(1280), 1463-1494. doi:10.1017/aer.2020.29

The European Helicopter Safety Team Releases Preliminary Analysis Results. (2009). Aircraft Engineering and Aerospace Technology, 81(5). https://doi.org/10.1108/aeat.2009.12781eab.016

Velazquez, J., & Bier, N. (2015). SMS and CRM: Parallels and opposites in their evolution. Journal of Aviation/Aerospace Education & Research. https://doi.org/10.15394/jaaer.2015.1616

V. Krivolutsky, Y. (2020). Development of a promising area of diversification in Helicopter Industry. TEM Journal, 1502–1507. https://doi.org/10.18421/tem94-24

Yamada, N., Kitagawa, Y., Yoshida, T., Nachi, S., Okada, H., & Ogura, S. (2021). Validity and risk factor analysis for helicopter emergency medical services in Japan: A pilot study. BMC Emergency Medicine, 21(1). https://doi.org/10.1186/s12873-021-00471-x

Yan, X., Lou, B., Xie, A., Chen, L., & Zhang, D. (2021). A review of advanced high-speed rotorcraft. IOP Conference Series: Materials Science and Engineering, 1102(1), 012006. https://doi.org/10.1088/1757-899x/1102/1/012006

Yeoman, K., O'Connor, M. B., Sochor, S., & Poplin, G. (2020). Characterization of fatal injuries in oil and gas industry-related helicopter accidents in the Gulf of Mexico, 2004–2014. Injury Epidemiology, 7(1). https://doi.org/10.1186/s40621-020-00288-5

Mini Lit Review (methodology argument) Example 1

Why My Research Interest Area Benefits From Quantitative Research Design

Research Problem Statement

The advances of virtual reality (VR) and augmented reality (AR) in aviation simulation have allowed training quality to increase and cost to decrease exponentially in recent years. However, there is a point of diminishing return where too much simulation as a substitute for flying could have a negative outcome, potentially decreasing a pilot's situational and air awareness, and creating a less safe environment.

Research hypothesis

Aviation is an extremely expensive and complex industry with high potential for safety incidents, leading experts to continuously research ways of lowering costs, increase quality of training, and minimize risk. VR and AR in aviation training simulation has begun to fill that need that experts were looking for, as there have been several proven studies on its ability to immerse the pilot in a more realistic environment and help improve the flying skillset. However, as this research will attempt to show, when the complexity of the aviation task at hand increases significantly there is a point at which simulation instead of performing the task in the aircraft can in effect hamper pilot learning and proficiency. Due to this occurrence, using the new USAF Pilot Training 2.5 compared to traditional Undergraduate Pilot Training as the study case, the emphasis of virtual and augmented reality training should occur in the early phase of training but taper down in more advanced training, as its benefit during complex events diminishes significantly when compared to the learning that happens when flying. An overreliance on AR/VR as a direct substitute for flying hours is a cost-savings event, but can bring increased and potentially unnecessary risks.

Background

Quantitative Impetus

As discussed in Goertzen's Quantitative article, one of the primary functions of quantitative research is to "provide evidence of success and highlight areas where unmet information needs exist" (2017, p. 3). There is not an abundance of research or seminal work on this topic of AR/VR replacing flying, creating an unmet information environment that would benefit from in-depth research attempting to show statistically significant results. The best method to show something is statistically significant is via quantitative design, which entails "manipulation of observations for the purpose of describing and explaining the phenomena that those observations reflect" (Sukamolson, 2007, p. 2).

Quantitative Design

One of the challenges for this research will be to gain permission and have access to the data required to effectively accomplish the proposed research. However, I have previously successfully completed a study comparing two classes of pilot training for a Master's level research project related to use of a GPS simulator to aid in GPS proficiency in the T-6 Texan II. During this research specific data was collected and analyzed with a quantitative design. The initial thought is to compare one class of around 25 students of UPT 2.5, which incorporates AR/VR, to another class of similar size that completes training the traditional way with no use of AR/VR. I am not sure if this will be able to produce statistically significant results with this sample size, and will need to do further research to determine this. Examples of data collected will be safety incident and accident trend information, along with specific grades and results of the different check rides accomplished throughout the training. The number of simulator and flight hours will be compared as well.

Additionally, as this research will try to uncover a given reality in comparing two pilot training methods, and will be conducted as objectively as possible, this ties into quantitative research as the ideal method (Sukamolson, 2007). Finally, as this research will be accomplished via the testing of a hypothesis which attempts to explain at what point students training via augmented and virtual reality versus flight is of reduced value, quantitative research remains the best fit to test and prove a hypothesis.

One method that will likely be utilized is surveying the instructor pilots who have experience in both traditional and 2.5 pilot training to get their professional opinions on the incorporation of AR/VR into the training. According to Creswell in Table 1.4, these surveys can be done in a manner to produce quantitative results by using closed-ended questions (2020), or use of a Likert Scale to attribute numerical value to a response.

Existing Studies

While not numerous, there are a few existing studies that research AR or VR as it relates to aviation. One paper that researches a remote pilot with AR glasses uses an observational study method (Coleman & Thirtyacre, 2021). Another study conducted at Embry-Riddle Aeronautical University concerning VR in flight training used a quantitative research method with a cross-sectional survey design (Fussell, 2020). In a different but related field, Sportillo et. al. researched automated driving using VR to study response times using experimental pretest and posttest measures (2018). All of these studies, plus a few additional one that were not mentioned, used quantitative design to conduct their research.

Conclusion

There is potentially a way to perform this research with a qualitative design, but as previously discussed, there is overwhelming support for approaching it with a quantitative design. This will allow concrete and specific data sets to be gathered and analyzed in an attempt to produce statistically significant results and show that AR/VR is beneficial as a substitute for flying in Undergraduate Pilot Training, but only up to a certain point, after which it can become detrimental.

References

Creswell, John W., Creswell, J. David, (2020). *Research Design: qualitative, quantitative, and mixed methods approaches.* SAGE Publications, Inc.

Coleman, J., & Thirtyacre, D. (2021). Remote pilot situational awareness with augmented reality glasses: An observational field study. *International Journal of Aviation, Aeronautics and Aerospace, 8*(1), 3. https://ezp.slu.edu/login?url=https://www-proquest-com.ezp.slu.edu/scholarly-journals/remote-pilot-situational-awareness-with-augmented/docview/2488140980/se-2?accountid=8065

Fussell, S. G. (2020). *Determinants of aviation students' intentions to use virtual reality for flight training* (Order No. 28150209). Available from ProQuest Dissertations & Theses Global. (2459162236). https://ezp.slu.edu/login?url=https://www-proquest-com.ezp.slu.edu/dissertations-theses/determinants-aviation-students-intentions-use/docview/2459162236/se-2?accountid=8065

Goertzen, M. J. (2017). Applying Quantitative Methods to E-book Collections. *Library TechnologyReports*, *53*(4). https://link.gale.com/apps/doc/A508425359/AONE?u=anon~47e36d85&sid=googleScholar&xid=d15e6a57

Sportillo, D., Paljic, A., Ojeda, L., (2018). Get ready for automated driving using Virtual Reality. *Accident Analysis & Prevention*, Volume 118, 2018, Pages 102-113, ISSN 0001-4575, https://doi.org/10.1016/j.aap.2018.06.003

Sukamolson, Suphat. (2007). Fundamentals of quantitative research. https://www.researchgate.net/publication/242772176_Fundamentals_of_quantitative_research

Mini Lit Review Example (methodology argument) 2

Abstract This paper discusses whether the aviation field literature is quantitative or qualitative. Also, it outlines why is quantitative research is dominant over qualitative research. For research in aviation and related subjects, it is assumed that the research question is the determining factor in the method used, and that the methodology chosen is submissive to and dependent on the answers sought (Constantin et al., 2012). However, due to the nature of aviation knowledge as empirical and experimental research, most aviation literature is quantitative. The aviation field relies on physics, mathematics, and practical sciences. In addition, most aviation research is conducted on aviation safety, which is more quantitative. While aviation qualitative field studies and observes the human relationships, communication, interaction, and activity, qualitative research still needs to fill the gaps in aviation literature, especially when studying human attitudes and behaviors in aviation.

IS AVIATION LITERATURE QUANTITATIVE OR QUALITATIVE?

Is Aviation Literature Quantitative or Qualitative?

Before we study the aviation literature, whether quantitative or qualitative, we will briefly discuss the common types of research methodology. There are three research methods are commonly used. Quantitative, qualitative, and mixed methods. The quantitative method is used to quantify or convert collected data such as behaviors, or attitudes to figures and numbers without changing the core meaning of the collected data (Creswell, 2018). The quantitative method (numbers & hypotheses) uses closed-ended questions and responses during the collection phase of the method. The qualitative method is used to explore and understand opinions, thoughts, views, and experiences of the participants so the researcher can make an interpretation of the meaning of the collected data (Creswell, 2018). The qualitative (words & interviews) uses open-ended questions and responses (Creswell, 2018). Mixed method “resides in the middle of this continuum because it incorporates elements of both qualitative and quantitative approaches" (Creswell, 2018, P. 41). In this paper, I will discuss the qualitative and the quantitative literature in the field of the aviation, then I will narrow the discussion to the dominant method, and why it is considered dominant in the aviation field. The quantitative method has more existence in the natural sciences due to its involvement in the technical fields, and the aviation is considered mostly a technical (Constantin et al., 2012). Historically, early aviation researches, experiments, studies, and topics were based on mostly physics, mathematics, engineering, chemistry and practical knowledge, and these fields are empirical in nature and based on quantitative research methodology (Constantin et al., 2012) During the early stages of aviation industry (growth stage), aviation field was mostly depending on the empirical and natural science, but after reaching the maturity stage resulted in rising other researches, studies and topics in different fields related either directly or indirectly to the field of aviation such as human factors, human factors systems, and aviation medicine (Constantin et al., 2012). However, great deal of researchers believes that using quantitative methodology in the aviation field has some drawbacks such as separation of the human element from the research (Constantin et al., 2012). Employing quantitative research in aviation field provides some benefits: objective, specific, rational analysis, simple to document, and it's useful for modeling while using qualitative research in aviation safety has some advantages, such as connecting and comparing unrelated pieces of quantitative data, evaluating the value of quantitative data, and narrowing the range of possible safety judgments (Britton, 2017). Many researchers believe that qualitative research is less rigorous than quantitative research, and it is more likely to produce common-sense results in the aviation field (Deaton, 2019). Qualitative research, or even mixed-method studies, could give new aspects to aviation research that is now being conducted (Deaton, 2019). Much of quantitative research in the field of aviation, like other disciplines, is based on participants' subjective answers, so what we consider "objective" may not be so (Deaton, 2019).

“Psychology in general has accepted the viewpoint that qualitative research is as valid as quantitative; however, I think aviation research is a bit behind in recognizing the value of qualitative data” (Deaton, 2019, para. 5). The realization of this necessity drives the increased need for qualitative research approaches in the aviation industry. Since qualitative research can study complex phenomena that are not suitable for quantitative research and can achieve the characteristics of complex behaviors and relationships, so more qualitative research methods are needed to support it (Constantin et al., 2012). The aviation researcher uses the observation of communication, interaction, and activity within a closed group of individuals in the qualitative study, and the results of this model's research present the cultural description, this concept is effective particularly in the aviation industry (Constantin et al., 2012). The human component in aviation, such as flight crews, air traffic controllers, and engineers, form independent professional teams in the aviation industry, but they must work together in a symbiotic relationship to meet operational requirements, hence the need for a qualitative study to interpret the human behavior along with the systems. (Constantin et al., 2012). Not only is the aviation world an 'evolved construct,' but the data collection tools themselves, such as performance narratives, Aviation safety reports, accident reports, etc., are usually unrestricted in format, so they are qualitative in nature (Constantin et al., 2012). Obviously, studies on human performance, particularly in aviation topics, frequently use hybrid approaches, in which the research topic is grounded in quantitative data, the research is based on quantitative method, and the results are presented in a quantifiable way; However, careful study of the data collection method raises questions about the method used, and the result is usually a numerical description of the qualitative process. This process often reduces the narrative to pure numbers (Constantin et al., 2012). Why is The Quantitative Research More Suitable for Aviation Field? The quantitative method is more suitable for aviation field research because the majority of aviation research is focused on the improvement of aviation safety. Hence, most researchers prefer to conduct their research from a positivistic standpoint due to the need for statistically driven measures by regulators and prudential authorities and a perceived requirement for findings free of subjectivity (Constantin et al., 2012). Quantitative research aims for results that are free of subjective interpretation and human influence; because of these factors, the quantitative method has become a prevalent and desirable research methodology in a wide range of disciplines, particularly when the results are meant to support organizational, governmental policy or capital investment (Constantin et al., 2012). For a long time, quantitative research has dominated fields like physics and mathematics, and its influence even has spread to the medicine, psychology, and aviation science due to its reliance on both mathematics and physics. Historically, most organizational research, especially in aviation, is considered quantifiable in nature; this is why it is mostly conducted under a positivistic methodology (Constantin et al., 2012).

Conclusion Quantitative research in aviation is the dominant due to the nature of the aviation field and its reliance on the natural and technical sciences. The research in the aviation field is typical of most disciplines, in these disciplines, the progress of research results is defined by substantial initial breakthroughs, followed by slightly insignificant improvements to existing knowledge (Wiggins & Stevens, 2016). The research question is the main factor that determines the research method that to be used for the research, and one of the most challenging tasks for a researcher is to come up with an appropriate research question (Creswell, 2018). In aviation research, quantitative data can fill the gaps in qualitative data by supporting a qualitative value assessment with quantitative facts. In addition, to determine the value of quantitative data, an expert’s qualitative opinion may be used. In the aviation field, many researchers think that qualitative research is less rigorous and more in line with common-sense results. Qualitative research, or perhaps even mixed-method studies, could add another dimension to the research as we are seeing today (Deaton, 2019). Quantitative research methodology has been, and continues to be, the preferred research methodology under which aviation research is conducted (Constantin et al., 2012).

References

Britton, T. (2017, October 18). Everything You Need to Know about Risk Analysis in Aviation SMS. SMS Pro. Retrieved from http://aviationsafetyblog.asms-pro.com/blog/everything-you-need-to-know-about-risk-analysis-in-aviation-sms-programs. Creswell, John W., Creswell, J. David, (2020). Research Design: qualitative, quantitative, and mixed methods approaches. SAGE Publications, Inc.

Deaton, J. (2019). The Future of Aviation Research. International Journal of Aviation Research, 11(01), 25-28. Ferroff, C., Mavin, T.J., Bates, P.R., & Murray, P.S. (2012). A case for social constructionism in aviation safety and human performance research.

Wigging, M., & Stevens, C. (2016). Aviation social science: Research methods in practice. Routledge.

Research Questions Example 1

Quantitative

1. In what specific phase of Pilot Training Next 2.5 at Vance AFB are Augmented and Virtual Reality assisted simulators shown to be more beneficial as compared to traditional Undergraduate Pilot Training students at the same base?

2. What change in safety trends can be noted with a decrease in flying time but increase in simulator time in the new pilot training format at Vance AFB.

3. What is the increase or decrease in student performance as denoted in the grades assigned in the four separate check rides taken when comparing Pilot Training Next 2.5 students to Undergraduate Pilot Training Students at Vance AFB?

Qualitative

1. Do instructors who have experience in both traditional and Pilot Training Next 2.5 describe a perceived benefit to increasing the amount of Augmented and Virtual Reality while simultaneously decreasing the flight hours a student pilot receives?

2. What are the main factors associated with transitioning to relying more on augmented and virtual reality than on flying during pilot training?

3. Do Pilot Training Next 2.5 students rate that adding Virtual and Augmented Reality to their training improves their learning, and if so, what reasons do they ascribe to that?

Research Questions Example 2

The purpose of my study is to examine the impact of proactive hazard identification in line and hangar maintenance on commercial aviation accident trends.

Quantitative research questions:

1- What is the impact of proactive hazard identification in line and hangar maintenance on commercial aviation accident trends?

2- What is the impact of the implementation of SMS on maintenance operations?

3- What is the contribution of previous airline accident investigations on hazard recognition?

Qualitative research questions:

1- Does an orderly disposed tool in a toolbox contributes to a safer maintenance operation in aviation?

2- Do safety posters about the dirty dozen have an impact on hangar and line maintenance operations?

3- How human factors impact safety in aviation maintenance?

Graduate Course Performance Indicator Rubric
Assess Student Learning Outcomes

Course: ASCI 5020 Aviation Safety Data Analysis

Course Instructor: Gajapriya Tamilselvan

Semester Taught: Spring 2023

Number of Students in Course: 3

Student Learning Outcome Assessed	**Assessment Results: (Indicate what % of class achieved a minimum score of 80%)**	**Benchmark achieved? (Benchmark: 80% of students will score a minimum of 80% = "B")**
SLO 1: Assess relevant literature or scholarly contributions to the aviation field of study.	Discussion Board 2 – 100%; Discussion Board 3 – 100%; Discussion Board 4 – 100%; Discussion Board 8 – 100%; Discussion Board 9 – 100%; AVG = 100%	Elements of Assessment (Discussion Boards) yielded 100%, exceeding the desired benchmark of 80%.
SLO 2: Apply the major practices, theories, or research methodologies in the aviation field of study.	Critical Analysis of Research Article – 64%; AVG = 64%	Elements of Assessment (Critical Analysis of Research Article) yielded 64% and failed to meet the desired benchmark of 80%.
SLO 4: Articulate arguments or explanations to both a disciplinary or professional aviation audience and to a general audience, in both oral and written forms.	Poster Presentation – 60%; Technical Report – 60% AVG = 60%	Elements of Assessment (Poster Presentation & Technical Report) yielded 60% and failed to meet the desired benchmark of 80%.
SLO 5: Evidence of scholarly and/or professional integrity in the field of study.	Technical Report – 60%; AVG = 60%	Elements of Assessment (Technical Report) yielded 60% and failed to meet the desired benchmark of 80%.

Course Assessment (Intended Use of Results)
The following will be used for recommendations to improve the quality of course delivery based on assessment results. These recommendations may include prerequisite change; changing course outline and adding more topics; adding a third assessment; changing the course sequence, etc.

The assessment of SLO 1 met the desired benchmark, where the students reviewed relevant literature related to the topic they chose for their technical report and discussed their progress with the class. The assessment of SLO 2 failed to meet the desired benchmark, where the students evaluated a published research article in aviation safety and presented their critique using the specified criteria in the course. The assessment of SLOs 4 and 5 failed to meet the desired benchmark, where the students designed a safety-related archival study and presented their research findings as a poster. Lack of attendance and accountability was a significant issue this semester. The same assessment tools will be used for evaluating student learning outcomes for upcoming semesters.

**Attach description of assignment used for assessment and samples of student work.*

Discussion Board 2

Post 1

Rapid Evidence Assessment (REA) is the non-systematic evidence summary I intend to utilize in critically analyzing the research article. The article I chose is the Operational Use of Flight Path Management Systems - Final Report of the Performance-based operations Aviation Rulemaking Committee/Commercial Aviation Safety Team Flight Deck Automation Working Group.

"Our method for conducting REA includes developing an explicit research question in consultation with the end-users; clear definition of the components of the research question; development of a thorough and reproducible search strategy; development of explicit evidence selection criteria; and quality assessments and transparent decisions about the level of information to be obtained from each study. In addition, the REA may also include an assessment of the quality of the total body of evidence." (Varker, 2015).

The first step REA analyzing process is the background. "The FAA Aviation Safety (AVS) promotes safety in the National Airspace by working to reduce the occurrence and impact of human error in aviation systems and improve human performance. These specialists have expertise in the design and/or evaluation of aircraft systems, maintenance, operations, procedures, pilot performance, associated FAA policy, and guidance. They develop regulations, guidance, and procedures that support the certification, production approval, and continued airworthiness of aircraft; and certification of pilots, mechanics, and others in safety-related positions." (FAA, 2013). This statement aptly summarizes the setting of these recommendations.

The second step is the question the recommendations seek to ask. What is the Working Group and it's final recommendations about. This stage also seeks to address the current and projected operational use, the safety and efficiency of modern flight deck systems for flight path management (FAA, 2013). This second step also takes into consideration PICOC, which is outlined below:

Population: Flight Crew and decision makers

Intervention: Study looking into the implementation of these recommendations, after analyzing data from differing sources

Comparison: Commercial Aviation incidents without these recommendations

Outcome: Evidence that recommendations, if adopted, would enhance commercial aviation safety

Context: All stakeholders directly influencing / impacting the operations of commercial aviation safety.

The third step: These recommendations spell out what data to include and what to leave out. The study reviewed data from 1996.

The fourth step is the search strategy utilized to achieve the recommendations. The quality of the data set and how reliable would come into play.

The fifth, sixth and seventh steps considered how the committee selected, if any, the studies to include, which data to extract and the quality of the data, contributing to the quality of the final recommendations.

The eighth step identifies the findings, whilst the ninth analyzes the finding and explains what it all means. Step ten relates to the conclusions, and its relation to the aviation safety related question posed.

Finally, even without extensively going through the last few steps, I would definitely include these FAA Working Group recommendations, in my project.

Barends, E., Rousseau, D.M. & Briner, R.B. (Eds). (2017). *CEBMa Guideline for Rapid Evidence Assessments in Management and Organizations*, Version 1.0. Center for Evidence Based Management, Amsterdam. Available from www.cebma.org/guidelines/

Design approvals. Design Approvals | Federal Aviation Administration. (n.d.). Retrieved February 3, 2023, from https://www.faa.gov/aircraft/air_cert/design_approvals

Varker T;Forbes D;Dell L;Weston A;Merlin T;Hodson S;O'Donnell M; (n.d.). *Rapid evidence assessment: Increasing the transparency of an emerging methodology*. Journal of evaluation in clinical practice. Retrieved February 2, 2023, from https://pubmed.ncbi.nlm.nih.gov/26123092/

<u>Post 2</u>

My selected article is "A review of general aviation safety (1984-2017). The article reviewed general aviation accidents from 1984 to 2017, determined safety issues noted in all the selected accidents, and addressed the following: Ways to improve safety and aircraft accident survival, human factors, and pilot health and toxicology.

The researcher started by defining general aviation and what it entails, which is all civilian aviation apart from operations involving paid passenger transport such as the airlines and charter operations. The article confirms that, historically, general aviation, mostly comprised of piston engine-powered aircraft, has accounted for the overwhelming majority (94%) of civil aviation fatalities, with 18–23% of accidents having a fatal outcome. In 2014, of 1143 general aviation accidents, 236 (20%) were fatal in the United States. In comparison, none of the 29 airline accidents in the same year were fatal. Therefore, reducing general aviation accident rates represents an important safety challenge for aviation.

The method of inquiry for the research was a literature search using the U.S. National Library of Medicine search engine or Google Scholar. To determine accident rates for domestic airlines and general aviation, the National Transportation Safety Board (NTSB) accident database was queried for accidents in the United States. Airline (domestic carriers) and general aviation fleet hours were from the Bureau of Transportation Studies.
The research results revealed that Over the past three decades, several studies had been undertaken to identify the risk factors associated with all or fatal general aviation mishaps.

In addition, the researcher discovered that geographical regions heavily influence general aviation safety in the United States. Indeed, flying over mountainous and/or high-elevation terrain poses challenges mostly relating to the weather. For example, severe, localized, gusty winds and mountain waves, which may vary from the synoptic forecast, are often associated with mountainous terrain. Also, winds blowing perpendicular to a mountain ridge can generate rotor patterns on the leeward side, potentially leading to aircraft upset by exceeding a small airplane's roll authority.

The research revealed that two complementary approaches could be proactively employed to improve general aviation safety. First is by seeking improvements in pilot performance via training and/or currency requirements aided and abetted by technological advances. The second method is to improve the probability that pilots and passengers survive and/or injuries are mitigated in an accident.

Finally, the researchers concluded that advances in technology, such as onboard weather data, automation, and a shift to scenario-based training, bode well for improvements in general aviation.

Reference

Boyd, D. D. (2017). A review of general aviation safety (1984–2017). *Aerospace medicine and human performance*, *88*(7), 657-664.

Discussion Board 3

Post 1

To assess weaknesses in the controlled randomized trial of my study, I used Table 7.8 from Chapter 7 in Evidence-Based Management: The researchers provide a table presenting the characteristics of the people who were tested. All tested pilots were men. The average age of the control group is 28 years with approximately 380 hours of flight experience, while the average age of the intervention group is 30 years with approximately 330 hours of flight experience (Dehais et al., 2013). Age and gender are similar, while there is some difference in experience. However, no statement was made as to whether the (small) differences between the groups could be statistically relevant. Furthermore, not a single participant dropped out of the experiment. The measurement methods were both subjective and objective. The pilots had to fill out a questionnaire about their impression of stress/workload. Besides that, a heart rate and oscular measurement were taken. Considering all these facts, I would classify the study as trustworthy.
Weak points could be the use of a subjective questionnaire and the lack of explanation of the statistical relevance of differences in flight experience.
In comparison to my evaluation using the guideline REA last week, I come to the same conclusion of a trustworthy study. But with the checklists from Chapter 7 in Evidence-Based Management this decision is based on a variety of smaller decisions that provide stronger support for my overall assessment.
In my opinion, the selected study has the potential to be the "best available evidence" for my topic. The examination of the study was trustworthy, as shown above, and the researchers included references from two other sources to support their conclusions. Here, Barends and Rousseau suggest to and include "evidence from four sources, not just one" (Barends & Rousseau, 2018, p. 166). I think it would also be necessary to find other studies that take into consideration the limitations of this study in order to obtain evidence from all possible perspectives.

Barends, E., & Rousseau, D. M. (2018). *Evidence-based management: How to use evidence to make better organizational decisions*. Kogan Page Limited.

Dehais, F., Causse, M., Vachon, F., Régis, N., Menant, E., & Tremblay, S. (2013). Failure to detect critical auditory alerts in the Cockpit. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *56*(4), 631–644. https://doi.org/10.1177/0018720813510735

Post 2

To determine weaknesses in the article I selected last week, I used table 7.12. The researcher's perspective was not clearly mentioned throughout the article. There was no clear statement made about their own assumptions and biases about the topic. However, according to the chapter, "a substantial number of qualitative studies fail to provide this information" (Barends & Rousseau, 165). On the other hand, the goals of the research are clearly outlined. The researcher's purpose was made in support of determining threat and error management reporting integration into the standard reporting form of aviation accidents or incidents. Furthermore, the nature of the data collection did not appear to necessarily be influenced by the researcher's perspective. The methods for data collection was clearly outlined throughout the article. A statistical analysis was observed by the researcher to determine trends in the data collection of reports to identify outliers. The conclusion for the data collection suggests the reporting behavior was nominal between the two sets of reports over a 12-month period (Harper, 134). Lastly, the quality control measures used by researcher appeared to be minimal. There was no comparison of the topic to other research articles. To support their findings, the use of Latent Semantic Analysis (LSA) was included (Harper, 158). Other quality control measures used was addressing the limitations of the results. The sensitive nature of the data collection appeared to affect the outcome of the results because of the anonymity of the reporter.

Overall, the researcher's topic does not completely support the concept of "best available" evidence. Part of the reason for my conclusion is the lack of comparison to other studies. There are few studies that are similar to this researcher's work to compare to. Limitations to information of the participants does not support the conclusion that the findings of this research would translate to other stakeholders. The results could possibly be isolated to one airline. A larger sample size and additional quality control measures would be required before this article could be used as "best evidence". This article would best serve as reference to a seminal research article to support my research question. I appreciate any feedback this group has on my conclusion.

Barends, E., & Rousseau, D. M. (2018). Evidence-based management: how to use evidence to make better organizational decisions. Kogan Page Publishers.

Harper, M.L. (2011). The aviation safety action program: assessment of the threat and error management model for improving the quantity and quality of reported information. The University of Texas at Austin.

Discussion Board 4

<u>Post 1</u>

Hi All,

For my new article, I reused table 7.12 from last week's reading to evaluate its purpose as "best evidence". I realized my article from last week did not meet all the criteria necessary to be considered best evidence. My current article explores threat and error mitigation in the Advanced Qualification Program. Through this research, it explores the use of Line Check Safety Audits (LCSAs) in different aircraft fleets as a method to improve the current model of AQP. In this research, the methods for collecting data are clearly outlined and its validity was checked. It uses a mixed methods approach to analyze the quantitative and qualitative data collected. Overall, this research article does a better job explaining the approach used to come to their results.

While my research question is still undefined, this article leads me in a direction I want to explore in relation to threat and error management.

Esser, D.A., (2005). Advanced qualification program training in threat and error mitigation: an analysis of the use of line check safety audits for validation. Proquest.

<u>Post 2</u> Hello

Class,

My chosen article for the Critical Analysis of Research Article is "The Application of Scenario Based Recurrent Training to Teach Single Pilot Resource Management (SRM) Under the FAA Industry Training Standards (FITS) Program." I did a thorough analysis of the article. However, I found a few things that the researcher should have included. First, the paper lacks research questions to address the problem discussed. Due to the lack of research questions, the result and conclusion sections lack focus. Secondly, the methodology section does not state the method used for the research. This makes it confusing to easily comprehend how the researcher conducted the research. Indeed, a full narrative of how the scenario-based approach was provided. However, using an appropriate method would have communicated the intention more clearer.

Reference:

Ayers, F. H. (2006). The application of scenario based recurrent training to teach single pilot resource management (SRM) under the FAA Industry Training Standards (FITS) Program. *Journal of Aviation/Aerospace Education & Research*, *15*(2), 8.

Discussion Board 8

Post 1

The second article I would like to include in my technical report to support my research question is the article "Multimodal analysis of eye movements and fatigue in a simulated glass cockpit environment" written by Naeeri et al., published in 2021.

The article deals with the relationship between cockpit errors due to pilot fatigue. For this purpose, depth analysis of the eye movements of twenty participating pilots was studied. The pilots (10 novices and 10 experts) were asked to fly four scenarios in a simulator while several measurements were taken without interrupting them in their activity. For this purpose, the authors first presented an extensive literature review in which they examined twenty previous studies in this field. Through this approach, they established a solid basis to justify the framework of their experiment.

I used the Rapid Evidence Assessment Guideline (REA) to assess methodological appropriateness. The exact terminology for this study is not clearly identifiable. Based on the detailed analysis of related work at the beginning of the article, it could be considered a "qualitative study" (Barends & Rousseau, 2018). Since the researchers only use this information to provide a solid background for their experiment, it could also be called a "non-randomized trial without a pretest". Non-randomized, because the authors do not mention whether the selection process of the pilots was random, and no control group or before/after measurements were taken. Since the process and the experiment are explained and conducted in such detail, I first thought about ranking the methodological appropriateness to be Level A, even if it would not fit perfectly in one of the categories. But because of the following reasons I would rather degrade the study to Level B (see Barends & Rousseau, 2018).

Reflecting on the questions mentioned in Chapter 7 of Evidence-Based Management, the questions in Table 7.12 for a "qualitative study" (Barends & Rousseau, 2018, p. 170) all fit this study because, as mentioned above, the researchers' perspective is clearly described, the methods for data collection are clearly described, and they also consider the weaknesses of their experiment. Looking at the questions for the controlled trial in Table 7.8, the first question does not fit the study (no control group), but the second and third questions about participant dropout (non) and measurement reliability and validity are reflected in the article.

In my opinion, this study has the potential to be the "best available evidence" for my topic as well. The study's research was trustworthy, as shown above, and the researchers also included all their research to show other sources and their findings to support their methodology. Since the first article I presented dealt with inattentional deafness in the cockpit, this article shows a different perspective on human error in the cockpit concerning fatigue. I would like to use this article as a second source of supporting the relevance of my research topic and to show the complexity of human errors that could occur during the flight in the cockpit.

Reference

Barends, E., & Rousseau, D. M. (2018). *Evidence-based management: How to use evidence to make better organizational decisions*. Kogan Page Limited.

CEBMa. (2017). Guideline for Rapid Evidence Assessments in Management and Organizations. Center for Evidence-Based Management, Amsterdam, The Netherlands. https://cebma.org/wp-content/uploads/CEBMa-REA-Guideline.pdf

Naeeri, S., Kang, Z., Mandal, S., & Kim, K. (2021). Multimodal analysis of eye movements and fatigue in a simulated glass cockpit environment. *Aerospace*, *8*(10), 283. https://doi.org/10.3390/aerospace8100283

Post 2

The second article I selected for my final research project researches line operation safety audits during single pilot operations. Using table 7.12, I determined the research paper is acceptable for use in my final research project. There were some weaknesses I noticed when evaluating the article but overall, the research was sound toward my research interest.

Starting with question one of table 7.12, the researcher did not explicitly mention their perspective into the topic. The nature of the study however was objective. The researcher follows the current models of threat and error management within line operation safety audits. There is no assumptions or opinions made on behalf of the researcher on the topic. Only references made to current studies regarding threat and error management and line operation safety audits were included.

The data collection process for the study was clearly outlined and described. Included in this section was quality control methods. The study recognized adjustments were required in accordance to suit single pilot operations within the threat and error management framework. Indicators of operating characteristics for a successful implementation of LOSA were acknowledged and endorsed by the International Civil Aviation Organization. These indicators were used as measurements for the study. Quality control methods took place in the form of establishing consistency within observer training. Each observer was trained to observe the operation and collect information in the same way. Standard evaluations after each operation was conducted to ensure data was collected in a uniform manner.

Overall, this research suits my research interest in threat and error management. Many articles I've looked at involved threat and error management within some form of safety program. The results of this research article supports a discussion on improvements for line operation safety audits across all aviation operators. Additionally, areas of weaknesses discovered during single pilot line operation safety audits can be used in my final research discussion.

Barends, E., & Rousseau, D. M. (2018). Evidence-based management: how to use evidence to make better organizational decisions. Kogan Page Publishers.

Earl, L., Bates, P.R., Murray, P.S., Glendon, A.I., & Creed, P.A. (2012). Developing a single-pilot line operations safety audit: An aviation pilot study. Aviation Psychology and Applied Human Factors, 2(2), 49-61.

Discussion Board 9

Post 1

The third paper I would like to include in support of my research question is from the journal Cognition, Technology & Work, titled "How to make the most of your human: design considerations for human-machine interactions", published in 2017.

The author of this paper highlights the position of the pilot in the cockpit in line with increasing automation. To this end, he lists arguments for and against a complete takeover of the cockpit by software and substantiates his statements with relevant literature. His hypothesis is that one should "work on synergizing pilot and automation so that they work better than either can alone" (Schutte, 2017). Since his paper is a "qualitative study" (CEBMA, 2017), the methodological appropriateness cannot be as high as in a controlled study for example. Nevertheless, I would like to include the paper, because it gives my research question a solid foundation. Besides that, the methodological quality can be measured as high.

That is because he sets up a small-step, highly detailed analysis of the human-machine relationship. Later in his paper, he references the "Synergistic Allocation of Flight Expertise flight deck (SAFEdeck)" (Schutte et al. 2016), to present one approach to improve the pilot-machine interaction.

When considering the tables from Barends & Rousseau's Evidence-based management, the first two questions from table 7.12 are about whether the researcher's perspective is clearly described and whether the methods he used to collect data fit to his article. Unfortunately, he does not include quality control.

Because of the detailed description of the literature review and that the author tried to give so many examples and angles to prove his hypothesis, I would rather not call it "best available evidence" but "solid evidence" to give my research question a solid foundation. His article is very well thought through and includes a huge amount of information.

Reference

Barends, E., & Rousseau, D. M. (2018). *Evidence-based management: How to use evidence to make better organizational decisions*. Kogan Page Limited.

CEBMa. (2017). Guideline for Rapid Evidence Assessments in Management and Organizations. Center for Evidence-Based Management, Amsterdam, The Netherlands. [https://cebma.org/wp-content/uploads/CEBMa-REA-Guideline.pdfLinks to an external site.](https://cebma.org/wp-content/uploads/CEBMa-REA-Guideline.pdf)

Schutte, P. C. (2017). How to make the most of your human: Design considerations for Human–Machine Interactions. *Cognition, Technology & Work*, *19*(2-3), 233–249. https://doi.org/10.1007/s10111-017-0418-2

<u>Post 2</u>

The study I chose for my third review is "Factors Affecting the Success or Failure of Aviation Safety Action Programs (ASAPs) in Aviation Maintenance in Aviation Maintenance Organizations" authored by Manoj S. Patankar and Ph.D. & David Driscoll.

I chose this paper, because the goal of this study was to identify factors that could lead to the success or otherwise of aviation safety programs. The findings of the study are practical, especially since "Most of the quantitative studies include so-called correlation matrix, which is an overview of the correlation coefficients between all the variables measured in the study" (Barends, et al, 2021, p. 140).

The checklist is Table 7.11. This table would continue to assist me get through critical appraisal questions and to determine cross sectional weaknesses in the study under review.

The sample, from the study under review, was obtained from a population of 83,000 certificated aviation mechanics, and from all 50 states. The sample size of 5022 was selected to conduct the study. This is in line with the textbook's statement "the most reliable way to randomly select a sample is by using computer software that generates numbers by chance." (Barends et al, 2021, p. 163).

The sample of over 5022 was large enough and covered all 50 states. The selection process was also clearly documented, as recommended by" You must clearly document the selection process." (CEBMa, 2017).

In as much as the sample size was large, data dredging, is in a way not directly expressed in the narrative. All other things being equal, I deduce, that it is unlikely the authors engaged in data dredging, because reliable and valid measurements are explicitly made in the conclusions. The results of the survey also indicate that there is an overwhelming belief among the respondents that the ASAP programs can truly improve safety.

References:

Analysis of Maintenance Aviation Safety Action Programs Questionnaire. (n.d.). Retrieved from https://www.faa.gov/about/initiatives/maintenance_hf/library/documents/media/human_factors_maintenance/factors_affecting_the_success_or_failure_of_aviation_safety_action_programs_in_aviation_maintenance_organizations.doc

Barends, E., & Rousseau, D. M. (2021). *Evidence-based management how to use evidence to make better organizational decisions*. Kogan Page.

CEBMa. (2017). Guideline for Rapid Evidence Assessments in Management and Organizations. Center for Evidence-Based Management, Amsterdam, The Netherlands. https://cebma.org/wp-content/uploads/CEBMa-REA-Guideline.pdfLinks to an external site.

Critical Analysis of Research Article

Department of Aviation Science, Saint Louis University ASCI 5020:

Aviation Safety Data Analysis

Dr. Gajapriya Tamilselvan February 22, 2023

Research Problem and Rationale

The article evaluated in this analysis with the title “Failure to Detect Critical Auditory Alerts in the Cockpit: Evidence for Inattentional Deafness”, written by Dehais et al., published in 2014, addresses the question of “whether inattentional deafness is likely to occur in the context of flying and if so, to assess the potential impact of such a phenomenon on the pilot’s behavior” (Dehais et al., 2014). According to the scientists, undetected acoustic signals would cause a threat to aviation safety. This statement is the first indicator, that the practical relevance of this study for my research topic and future developments should be high. To support this statement, evidence by three examples is given, each from a different source, describing the phenomena of lacking response to auditory signals. First, they described the so- called "cry-wolve effect" (Breznitz, 1984; Wickens et al., 2009). Secondly, researchers explored the need to switch off disturbing, annoying signals before searching for the cause (Dehais et al., 2014). Lastly, Beringer & Harris (1999) described an approach assuming that pilots might perceive fewer acoustic frequencies with increasing age. Since these phenomena had been recognized to occur during flights in simulators, a trial to investigate the scientists´ hypotheses of inattentional deafness was conducted.

To substantiate the concept of inattentional deafness, they introduce the topic by first establishing a connection between visual and auditory deafness and present results from research of already performed studies. These were able to prove that stressful situations could cause an unawareness of critical alarms both visually and auditory. Because of the fact, that flight performance requires an enormous amount of multitasking, the researchers of the present study concluded that it may be likely to overhear acoustic signals in the cockpit in stressful situations and also included measurements of the stress level and workload of the pilots during their trial. This tense situation was investigated, using a “multi-criteria approach” (Dehais et al., 2014) with two landing scenarios of different stress levels. One included a windshear during the landing, while the second one did not.

Methodology

The study was conducted with 28 randomly recruited participants. All participants were male "French defense staff from Institut Supérieur de l'Aéronautique et de l'Espace (ISAE) campus" (Dehais et al., 2014). For the experiment, all pilots were randomly divided into two groups: An intervention group and a control group. Both represent "independent variables" (Wilson & Joye, 2017, p. 42), that were manipulated during the trial.

The researchers presented a table to show the characteristics of both groups. While the control group's mean age was slightly younger (about two years) than the intervention group's but had a slightly bigger standard deviation, the flight experience of participants in both groups ranged widely from 30h to 1800h (control group) or to 3500h (intervention group). After comparing the hours of flight experience at the end of the trial, the scientists were able to state, that the "flight experience cannot account for the nondetection of the auditory alarms" (Dehais et al., 2014), and therefore may have no statistical relevance. For this reason, the risk of possible confusion in the result can be eliminated here. A possible side effect of the small age difference is not mentioned in the article.

The design of this study is called a "randomized controlled study" (CEBMa, 2017), which would be a favorable trial in terms of internal validity since confounds will be less likely to occur during this experiment (see Wilson & Joye, 2017).

The intervention group was manipulated with a failing landing gear while completing the windshear-scenario during the landing first. The control group flew the no-windshear scenario first. Both groups had the same training before the actual trial started. A "three-axis- motion […] flight simulator built by the French flight test center" (Dehais et al., 2014) was used for the experiment. This simulator was specially designed to trigger alarms, "8.5 times louder than the global ambient cockpit sound" (Dehais et al., 2014). By including windshear in addition to a failing landing gear during the windshear-scenario, the researchers wanted to increase the pilots' workload.

To measure the outcome of the experiment, both objective and subjective measurements were included and therefore “dependent variables” (Wilson & Joye, 2017, p. 43) were introduced. All pilots had to fill out a questionnaire right at the end of each scenario. The researchers aimed to find out if acoustic alerts or unnormal flight conditions had been noticed and on what basis they decided to fly a go-around. Besides that, heart rate and oscular measurements were taken. While the heart rate was supposed to give an overview of the pilots´ physical condition during the flight, the oscular measurement was taken to evaluate if and when the pilot may have “glanced at the landing gear indicator” (Dehais et al., 2014).

Research Findings

To assess possible inattentional deafness the pilots may have experienced, three criteria had been created which, when all of them had been met, were used as an indicator of the pilot being “unaware of the landing-gear failure due to the nonperception of the critical alarm” (Dehais et al., 2014). The first one applied when the alarm had not been heard, the second one measured if the landing-gear indicator had not been visualized and lastly was observed if a pilot did not “perform an expected maneuver” (Dehais et al., 2014). All findings were presented in a table. Since the pilots were asked to fill out a questionnaire, the researchers were able to compare the subjective results with the objective heart and oscular measurements to conclude possible deafness to alarms in the context of increased workload. All pilots reported a higher stress level in the windshear scenario, than in the no-windshear scenario.

This subjective measurement could be confirmed by the objective heart rate measurement since the heart rate increased significantly. The researchers concluded from both measurements an “increasing mental workload/psychological stress” (Dehais et al., 2014).

With the analysis of the three criteria mentioned above, “11 pilots […] suffered from inattentional deafness in the windshear scenario” (Dehais et al., 2014). In addition, it could be seen, that pilots who did hear the alarm were able to perform correctly. Another significant finding was recorded, when the researchers compared the two groups. The group, who experienced the windshear scenario first, was significantly less able to detect the auditory alarm, than the group who first performed the non-windshear scenario. The researchers stated that “that pre-exposure to the auditory landing-gear failure alarm primed pilots to subsequently detect the same alarm in a more complex situation” (Dehais et al., 2014). To conclude, the authors presented the idea of implementing “case-based” (Dehais et al., 2014) learning into flight training to work against the phenomenon of inattentional deafness.

The limitations of this study were not specifically mentioned. When evaluating the sample size, it seems obvious to me, that only male pilots in a small range of age participated. These characteristics could be more variable in a future trial. For further research, the scientists suggested more participants and including “neurophysiological measurements (e.g., EEG)” (Dehais et al., 2014). After doing more research on this specific topic, it should be noted, that there have been further investigations that addressed some of the aspects the authors mentioned.

All findings were presented in detail. On the one hand, the researchers provided tables with rare trial data and on the other hand overviews and summaries of their conclusions. They described each finding and the conclusions they drew from them. The scientists could build informed conclusions by including different possible explanations for an effect. For example, the scientists cannot be sure whether the "increased HR reflected instead some sort of arousal" (Dehais et al., 2014) but decided, based on the subjective and objective measurements, that the increase in heart rate is mainly due to the higher workload.

Critique

To gather all thoughts and reflect on the effect and trustworthiness of this article, I used the Guideline for Rapid Evidence Assessment (REA) and Barends & Rousseaus Evidence-Based Management (2018) for support to analyze the study.

The researchers were able to clearly demonstrate the meaning and importance of their research hypothesis using examples and related studies already conducted. The goal of the study was known from the beginning of the article, so the authors could always refer their investigations and fundamental ideas to it.

According to the REA guideline, I evaluate the methodological appropriateness of the study to be Level A, a “randomized controlled study” (CEBMa, 2017). All pilots were separated into two groups randomly and were not told what to expect exactly. One of the groups was designated to be a “control group” (CEBMa, 2017). While considering the criteria for a trustworthy study according to Barends & Rousseau (2018), it could be classified to be trustworthy. Besides the high-level trial, this statement relies on the following aspects. The background of the experiment in terms of evidence and evaluation of its relevance was described in the introduction part of the study in a detailed way by including lots of external references. Furthermore, not a single participant dropped out of the experiment. It could also be argued that the study is reputable because it was published in a recognized journal and according to Google Scholar has been cited 166 times. It is appropriate to measure the effect and make an impact on future cockpits (CEBMa, 2017). A weak point, according to the criteria mentioned in Barends & Rousseau (2018) could be the use of a subjective questionnaire, which was only created for the purpose of this study and not explaining a possible statistical relevance in the small difference of age between the two groups in the experiment.

The presentation of results is separated into two parts. One shows all findings about the manipulation of workload and the other one assesses findings in the area of inattentional deafness. Both abstracts include a detailed description of the findings supported by a table showing the performances of all pilots. The results were statistically evaluated and significant findings were exposed.

The results of the experiment show that the hypotheses made at the beginning of the study are valid. Thus, it can be concluded that the practical relevance of the topic is given and should be included in future developments, albeit through further studies.

To put it all in a nutshell, the major strengths of the study are the following aspects: The selected study followed a clear structure for presenting the research question and supported the importance of this trial with a lot of studies and findings in the area of this topic. The researchers could point out the aim of the present study and their hypotheses clearly. Since they chose a “randomized controlled study” (CEBMa, 2017), which is an indicator for more trustworthy results, and showed their method and results in a detailed way, they were able to build up their conclusions on a solid foundation of findings.

The term “best available evidence” (Barends & Rousseau, 2018, p. 165) can be applied to this study. The criteria to be the “best available evidence” are mostly met. At the time it was published, no other studies investigating especially this area of inattentional deafness existed, so no comparisons could be made. In addition, only one flight simulator and only one flight segment were used. Another constraint mentioned by the authors is the small sample size. All these small weaknesses would not degrade the trustworthiness of the study, according to REA. I recommend the study to be used in a research paper when considering other sources as a comparison or extension of its findings as well as to obtain evidence from all possible perspectives.

References

Barends, E., & Rousseau, D. M. (2018). *Evidence-based management: How to use evidence to make better organizational decisions*. Kogan Page Limited.

Beringer, D. B., & Harris, Jr., H. C. (1999). Automation in general aviation: Two studies of pilot responses to autopilot malfunctions. *The International Journal of Aviation Psychology*, 9, 155–174.

Breznitz, S. (1984). *Cry wolf: The psychology of false alarms*. Englewood Cliffs, NJ: Lawrence Erlbaum Associates.

CEBMa. (2017). Guideline for Rapid Evidence Assessments in Management and Organizations. *Center for Evidence-Based Management, Amsterdam, The Netherlands*. Retrieved February 18, 2023, from https://cebma.org/wp-content/uploads/CEBMa-REA-Guide- line.pdf

Dehais, F., Causse, M., Vachon, F., Régis, N., Menant, E., & Tremblay, S. (2014). Failure to detect critical auditory alerts in the Cockpit. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *56*(4), 631–644. https://doi.org/10.1177/0018720813510735

Google Scholar. (n.d.). Retrieved February 20, 2023, from https://scholar.google.com/

Wilson, J. H., & Joye, S. W. (2017). *Research methods and statistics: An integrated approach.* Sage Publications.

Critical Analysis of Research Article

College of Aeronautics, Saint Louis University **ASCI-5020** Aviation

Safety Data Analysis Gajapriya Tamilselvan

February 22, 2023

Introduction

My chosen article for this assignment is “The Application of Scenario Based Recurrent Training to Teach Single Pilot Resource Management (SRM) Under the FAA Industry Training Standards (FITS) Program.” This article addresses the fundamental safety issues in general aviation. General aviation safety has been a great concern for the past few decades in the aviation industry, as statistics revealed that general aviation accounts for 94% of the fatalities in the aviation industry (Boyd, 2017). As stated by Shelnutt, Childs, Prophet, & Spears (1980), general aviation pilots are a very heterogeneous group, which means they vary with respect to training, age, total flight experience, recency of experience, motivation, flight skills, basic abilities, amount of supervision they receive, and on a variety of other parameters” (p.6, para 2). This heterogeneity can be seen as one of the factors contributing to safety issues in the GA community.

In the last few decades, the predominant causes of general aviation accidents have been Loss of control in flight, controlled flight into terrain, fuel mismanagement, an unintended flight into instrument meteorological conditions, midair collisions, low-altitude operations, and other causes associated with pilot errors (Idowu, Augustine, & Shogbonyo, 2023). Therefore, the application of scenario-based recurrent training to teach single pilot resource management (SRM) is essential to mitigate risks associated with general aviation operations.

Research Problem and Rationale of the Research

Technically Advanced Aircraft (TAA) is a new technology developed to enhance general aviation safety. However, this technology, if not used effectively, is inherently dangerous as the advanced equipment, especially the addition of an extremely accurate moving map navigation

capability, can lure pilots into increasingly complex situations (Ayers, 2006). Technically Advanced Aircraft (TAA) are more sophisticated than traditional aircraft. Therefore, they require more distinct training since traditional tasks and maneuver-based training may not prepare the pilot to understand or adapt to the new situation technically advanced aircraft will present, thereby presenting more risks and increasing the tendency of pilot error (Ayers, 2006).
Therefore, this article focuses on training to enhance general aviation safety due to the advanced technology being introduced into the industry. The training required to help general aviation pilots effectively use all available resources is called “single-pilot resource management.”

Single pilot operations are naturally one of the most stressful task-demanding flights a pilot can encounter, as observed by (Im, Kim, & Hong, 2021). Thus, before a pilot can break away from the Earth’s surface in an aircraft, he or she must receive the FAA-mandated ground school training complete with SRM lessons. SRM is the art and science of responsibly handling all the internal and external resources before and during a flight for safe operations (Im, Kim, & Hong, 2021). SRM is a variation of CRM with the goal of reducing accidents rate caused by human errors by teaching pilots about human limitations and how individual performance can be maximized. It’s the art of managing all the resources available to pilots before and during a flight to ensure a successful flight. The essence of the training is to enable pilots to maintain situational awareness by effectively managing automation, aircraft control, and navigation tasks. As a result, pilots accurately assess hazards, manage resulting risk potential and make sound aeronautical decisions. SRM training is based on proper adherence to aeronautical decision-making, risk management, controlled flight into terrain (CFIT) awareness, and situational awareness.

What are a pilot’s resources? Shank emphasizes that anything a pilot needs to complete a flight can be a resource, no matter how insignificant, like a pen and paper. In addition, built-in aircraft systems like a generator and backup fuel pumps are resources available that are initially forgotten about (Shanks, 2014). “Nearly anything can be a resource, but nothing is a resource until you recognize it as such” (Shanks, 2014, p. 6).

The author of this article suggests that scenario-based training is an effective method of teaching single-pilot resource management. It is a teaching method that allows students to practice what they have learned. The author clarifies that scenario-based training is not new, but its application to General Aviation on a larger scale represents a significant change (Ayers, 2006).

Scenario-based training starts with establishing the training objectives to ensure the students clearly understand what needs to be achieved at the end of the training. The training should be designed with different scenarios, and performance measures should be developed. Scenario-based training is to provide feedback, and the data for the training is documented for future scenario-based training (Cox, 2010). Figure 1 describes the cycle of SBT.

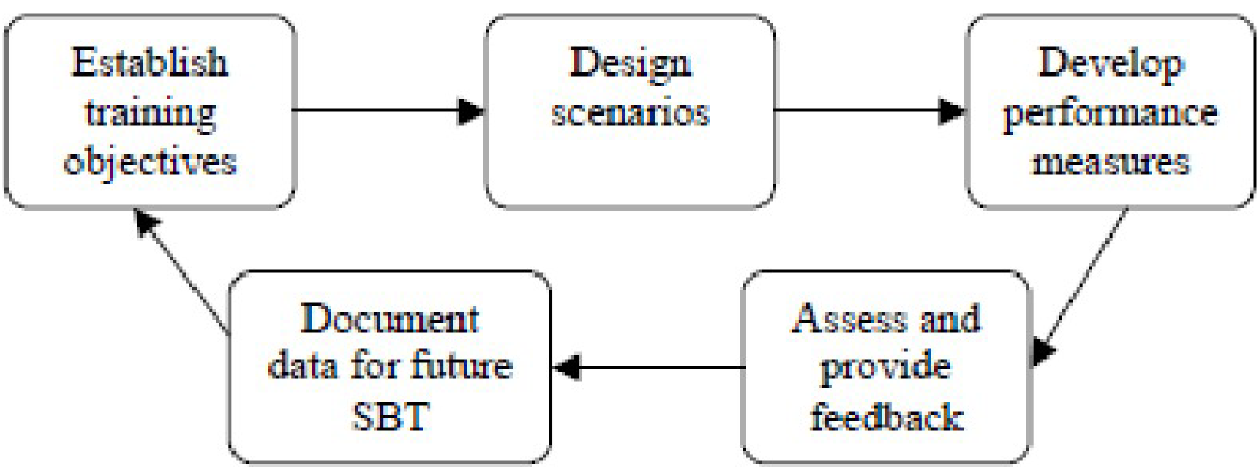

Figure 1

Methodology

The author used a scenario-based approach for this research. He developed four distinct ground and flight scenarios encompassing elements of all five SRM disciplines. Each scenario consisted of a pre-flight, pre-takeoff, en route, and arrival segment(s) that combined normal operations and procedures with abnormal and, eventually, emergency procedures. A total of 54 pilots participated in a total of four seminars conducted at two separate sessions, and each session mirrored different scenarios that pilots usually encountered in flight (Ayers, 2006).

Research Findings

The result showed that participants found the training interesting and enjoyable. The training enabled the participants to understand the concept of single-pilot resource management and allowed them to mentally rehearse and practice real-life situations. The article concludes that Scenario-Based Training and Single Pilot Resource Management appear to be at least initially effective in helping pilots understand how to respond to abnormal and emergency situations because, as expected, the training instilled the philosophy of single-pilot resource management in areas of situational awareness, task management, automation management, risk management, aeronautical decision making, and controlled flight into terrain (Ayers, 2006).

The concept of SRM is tantamount to crew resource management, which uses scenario- based training. Evidence revealed that the implementation of crew resource management (CRM) had taken the aviation industry by storm with predominantly positive feedback and results. After several catastrophic aircraft accidents, due to no fault of technical or engineering issues, the concept of CRM was developed to compel flight crews to maintain positive control of the aircraft no matter the situation. Most of these accidents were due to poor decision-making, loss of situational awareness, and an absence of leadership (Kanki et al., 2019). CRM combines technical skills and human factors in the flight environment. Embry- Riddle Aeronautical University's Frank J. Tullo, a pilot and flight operations manager, took a leaf from former FAA administrator Donald Engen, who stated accidents happen from crews rather than individual crewmembers by simplifying CRM into one word: teamwork. While a safe flight is recognized as the success of a team of employees- pilots, flight attendants, mechanics, dispatchers, fuelers, and ground crew- effectively working together for the same goal, the team for this discussion will focus on the crew members aboard the aircraft (Kanki et al., 2019). Tullo claims, "The true definition of "teamwork" or CRM is its focus on the proper response to threats to safety and the proper management of crew error" (Kanki et al., 2019, p. 55).

Critique

The researcher presented a convincing case to address the research problem. However, the paper lacks a few critical components. First, the paper lacks research questions to address the problem discussed. Due to the lack of research questions, the result and conclusion sections lack focus.

Secondly, the methodology section does not state the method used for the research. This makes it confusing to easily comprehend how the researcher conducted the research. Indeed, a full narrative of how the scenario-based approach was provided. However, using an appropriate method would have communicated the intention more clearer.

References

Ayers, F. H. (2006). The application of scenario based recurrent training to teach single pilot resource management (SRM) under the FAA Industry Training Standards (FITS) Program. *Journal of Aviation/Aerospace Education & Research*, *15*(2), 8.

Boyd, D. D. (2017). A review of general aviation safety (1984–2017). *Aerospace medicine and human performance*, *88*(7), 657-664.

Cox, B. A. (2010). Scenario based training in an aviation training environment.

Idowu, A. G., Augustine, H., & Shogbonyo, M. A. (2023). Determining The Effectiveness of Single-Pilot Resource Management in General Aviation.

Im, K. H., Kim, W., & Hong, S.-J. (2021). A Study on Single Pilot Resource Management Using Integral Fuzzy Analytical Hierarchy Process. *Safety, 7*(4). https://doi.org/10.3390/safety7040084.

Kanki, B. G., Anca, J., & Chidester, T. R. (Eds.). (2019). *Crew Resource Management* (3rd edition). Academic Press.

Shanks, G. (2014, October). Resource management: there are countless tasks involved in flying, and most of those tasks rely on outside resources. Manage those resources for a successful outcome. *IFR, 30*(10), 6-8.
https://link.gale.com/apps/doc/A384968162/AONE?u=nm_a_enmu&sid=ebsco&xid=de3 1541f.

Shelnutt, J. B., Childs, J. M., Prophet, W. W., & Spears, W. D. (1980). *Human factors problems in general aviation*. EMBRY-RIDDLE AERONAUTICAL UNIV DAYTONA BEACH FL.

Technical Report

Department of Aviation Science, Saint Louis University ASCI 5020:

Aviation Safety Data Analysis

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Introduction

Whenever an aviation accident occurs, one of the first questions that might be asked is which factors allowed this accident to happen. In the past, mainly structural problems in aircraft were initially the cause (Rankin, 2007). For example, the breaking in the former part of the fuselage at the Aloha Airlines Flight 243 in 1988 (Villamizar, 2022). According to an article from the aircraft manufacturer Boeing, in which they present their approach to minimizing failure during optimizing maintenance, the situation turned. Nowadays, the number of accidents resulting from human error has increased significantly (Rankin, 2007). It seems like the introduction of new system components has complicated rather than simplified the already stressful working environment in the cockpit.

This research's rationale is to start finding answers to the following question: What does the cockpit have to look like so that this trend could be reversed? To begin with, it is important to know which human errors do occur in the cockpit during a flight. The population addressed within this research is pilots and (software) engineers, who would have to work closely together on the suggested intervention. Both parties should investigate effective optimizations for the cockpit design and important software elements. The outcome should be an enhanced cockpit with a flight management system, that optimally supports the pilot, so the safety onboard could increase in the next years.

The natural, unconscious behavior of the pilots during a stressful situation in the cockpit can give a hint about important adjustments needed in the software and cockpit design. In order not to introduce dangers at this point due to the complexity of software in the cockpit, possible simplifications and new safety elements have to be considered. As a starting point for this broad topic, this research aims to analyze different types of unconscious human behavior in stressful situations and draws conclusions regarding system improvements and the role of a human in the cockpit. It is a significant topic because it needs interdisciplinary investigations, and the trustworthiness of the aircraft industry may profit from this.

Case Study Background

Literature Review

Three examples of the unconscious behavior of pilots during stressful situations are included in this study. Each of them provides a different approach, but their conclusions support each other.

The first one is presented in the study "Failure to Detect Critical Auditory Alerts in the Cockpit: Evidence for Inattentional Deafness" from the Human Factors and Ergonomics Society Journal, published in 2014. This study aspired to prove the occurrence of inattentional deafness in situations with exceptional workloads and what effect it has on safety. Therefore, an experiment with 28 pilots, each of whom was asked to perform a landing approach in a flight simulator two times, was conducted. A stress situation was introduced either during the first or the second landing approach without letting the pilots know about the occurrence beforehand. The scientists concluded that the phenomenon of inattentional deafness exists and especially occurs in stressful situations in cockpits.

The second article presented in this report is "Multimodal analysis of eye movements and fatigue in a simulated glass cockpit environment" written by Naeeri et al., published in 2021. This article deals with the behavior of fatigued pilots in the cockpit and an approach to the recognition process of the fatigue level. For this purpose, depth analysis of the eye movements of twenty participating pilots was studied. The pilots (10 novices and 10 experts) were asked to fly four scenarios in a simulator while several measurements were taken without interrupting them in their activity. Since the level of experience of each participant was different, the scientists were able to observe differences in fatigue levels during their measurements. They concluded that pilots who stare at a certain point for a time longer than average would need more time to process the information and to react, due to their increased fatigue. Their goal was to find a method, that securely predicts pilots' fatigue and based on this suggested the implementation of a warning system (Naeeri et al., 2021).

Both approaches contribute to Schutte's (2017) qualitative study: According to him, the pilot´s work in the cockpit has changed in many ways. Due to the increasing automation of system components, the pilot became more of an "automation manager" or "software programmer" (Schutte, 2017). In his overall study, the author tries to explain, why it is more important to "work on synergizing pilot and automation so that they work better than either can alone" (Schutte, 2017), instead of fighting against automation or removing the pilot from the cockpit. He concludes his article with several suggestions for improvements to increase safety onboard. The overall thought he presents, also by including multiple references, is, that while an improvement in cockpit design would be necessary, the design itself should be kept simple (Schutte, 2017).

Additional Evidence

To complete the behavioral picture of pilots, a fourth article is included as an additional reference, which deals with the topic of inattentional blindness. In their article "Analysis of Eye-Tracking Data with Regards to the Complexity of Flight Deck Information Automation and Management - Inattentional Blindness, System State Awareness, and EFB Usage", Dill and Young (2015) conducted an experiment with 20 pilots in a flight simulator to measure each pilot's eye movements during 230 different flight simulator scenarios. In extend to the current research question, the scientists also focused on the usage of newly implemented "electronic flight back (EFB) [and] system state awareness (SSA)" (Dill & Young, 2015) during their experiments. Only some of the participants had already experienced both components. Similar to the phenomenon of inattentional deafness, pilots faced inattentional blindness during stressful situations in the cockpit and did not react adequately to important optical signals.

Evidence-Based Framework

By “acquiring” data from different sources, the “best available evidence” should be found. For that process, according to Barends & Rousseau (2018), the next step would be the “appraising” of the included literature. Therefore, the Rapid Evidence Assessment Guideline (REA) was used in addition to the above-mentioned book Evidence-Based Management by Barends & Rousseau to evaluate the appropriateness of the chosen resources for the current research question.

The evaluation of the article of Dehais et al. (2014) showed, that the article’s hypothesis of the occurrence of inattentional deafness could be verified, so the relevance for future developments could be classified as high. According to the REA guideline, the methodological appropriateness of the study should be Level A, a “randomized controlled study” (CEBMa, 2017). All pilots in the experiment were separated into two groups randomly and were not told, what to expect exactly. One of the groups was designated to be a “control group” (CEBMa, 2017). The trustworthiness of the study can also be ranked as high because it is appropriate to measure the effect and make an impact on future cockpits (CEBMa, 2017). A variety of external sources were included, and the effect of the result was described.

Limitations may be the small sample size, the use of a flight simulator only, and just one flight segment (Dehais et al., 2014). Different age groups (with different levels of experience) would have been even more purposeful. To put it all in a nutshell, by considering the limitations, the practical relevance of this study for the research topic and future developments should be high and has the potential to be the “best available evidence” (Barends & Rousseau, 2018).

In contrast to that, Schutte’s (2017) paper could be called a “qualitative study” (CEBMA, 2017). The methodological appropriateness for this type of article cannot be as high as in a controlled study for example. Nevertheless, it gives the research question a solid foundation. Besides that, the methodological quality can be measured as high because the author sets up a small-step, highly detailed analysis of the human-machine relationship. Later in his paper, he references the “Synergistic Allocation of Flight Expertise flight deck (SAFEdeck)” (Schutte, 2017), to present one approach to improve the pilot-machine interaction. When considering the tables from Barends & Rousseau’s (2018) Evidence-Based Management, the first two questions from table 7.12 about whether the researcher’s perspective is clearly described and whether the methods he used to collect data can be answered positively within the article. Unfortunately, he does not include quality control. It should rather not be called "best available evidence" (Barends & Rousseau, 2018), but because of the detailed description of the literature review and that the author tried to give so many examples and angles to prove his hypothesis, it is a “solid evidence” that gives the research question a foundation.

The exact terminology for Naeeris’ (2021) study about pilots´ fatigue was not clearly identifiable. Based on the detailed analysis of related work at the beginning of the article, it could be considered a "qualitative study" (Barends & Rousseau, 2018). Since the researchers only use this information to provide a solid background for their experiment, it could rather be called a "non-randomized trial without a pretest". Non-randomized, because the authors do not mention whether the selection process of the pilots was random, and no control group or before/after measurements were taken. Since the process and the experiment are explained and conducted in detail, the methodological appropriateness could be ranked to be Level A, even if it would not perfectly fit in one of the REAs categories (CEBMA, 2017). Reflecting on the questions mentioned in Chapter 7 of Evidence-Based Management, the questions in table 7.12 for a "qualitative study" (Barends & Rousseau, 2018, p. 170) can be answered positively in this study because, as mentioned above, the researchers' perspective is clearly explained, the methods for data collection are clearly described, and they also consider the weaknesses of their experiment. Looking at the questions for the controlled trial in Table 7.8, the first question does not fit the study (no control group), but the second and third questions about participant dropout (non) and measurement reliability and validity are reflected in the article. The last thoughts lead to rather degrading the study to Level B (CEBMA, 2017). Nevertheless, this study has the potential to be the “best available evidence” (Barends & Rousseau, 2018) for the topic as well. The study's research was trustworthy, as shown above, and the scientists also included all their research to show other sources and their findings to support their methodology.

The additional article, dealing with inattentional blindness, completes the picture of unconscious behaviors in the cockpit. The methodology of this study follows the requirements of a "randomized controlled study" (Barends & Rousseau, 2018). The design of the experiment follows a clear structure and transparently presents the preparations, selection of participants, and execution of the experiment (Dill & Young, 2015). Considering table 7.8 from Evidence-Based Management the study only shows a weakness in terms of including a control group. Because of this, the methodological appropriateness can still be ranked to be Level A (CEBMA, 2017). All four articles build up solid evidence to support the research question, each from a different angle.

Databases

The search for evidence to support the research question included using the databases Google Scholar and ProQuest at the beginning. Inclusion criteria were the key terms "reaction pilot cockpit" as well as “human error cockpit” and results were limited to the period since 2013 and the English language. Since the source about inattentional deafness was already published in 2014, the range of additional data was specified to the years after 2015 to retrieve more recent results. To narrow down the results, new key terms for inattentional behavior were used. For additional sources, mainly the online resources of the Federal Aviation Administration (FAA) and the National Transportation and Safety Board (NTSB) were obtained after trying to find evidence at various aviation databases suggested by Curtis (2002). No data, that presents statistical evidence for human errors supporting this research´s aim could be found. Therefore, the nature of the data will mostly be reports and studies about the impact of flight management software on the behavior of pilots in critical situations.

Methodology

Procedure

After very broad initial research about human error in the cockpit on the internet using Google Scholar, the basic idea for the first part of this study emerged. An investigation of which human errors occur unconsciously, especially in stressful, unknown situations where humans struggle to control themselves. For this purpose, the period of studies on this topic was initially kept more open (2013 - 2023). In particular, the topic of inattentional deafness stood out. In deeper research on this particular topic, it turned out that further experiments and articles were conducted in the following years, which confirm the relevance of this topic and solved some of the limitations of the initial study, such as the use of an EEG for example (Dehais et al., 2016). To be able to include various behavioral aspects, the online research was further limited by targeted keywords like “inattentional behavior cockpit” or “unconscious human error cockpit”, and the temporal origin was brought further into the present (2015 - 2023). During this period, various studies on pilot fatigue in the cockpit and its measurements could be found. The paper finally chosen for this research topic contains a very detailed literature review with an evaluation and summary of the results of other experiments (Naeeri et al, 2021).

Since the concept of inattentional blindness came up frequently during the research process, this phenomenon now forms an additional article in this report. It completes the overall picture of the pilot's behavior in the cockpit and is also presented through an experiment with multiple flight scenarios as in the other two studies (Dill & Young, 2015).

In the sense of this research, a second aspect should be illuminated, which is the question of the complete automation of the cockpit as a possible solution to the phenomena mentioned above. The search for an article that provides a holistic overview also succeeded through an online search using Google Scholar. In addition to papers that were either completely against or in favor of automation, this one formed a good overview of both sides and a detailed explanation of the hypotheses raised (Schutte, 2017).

Limitations

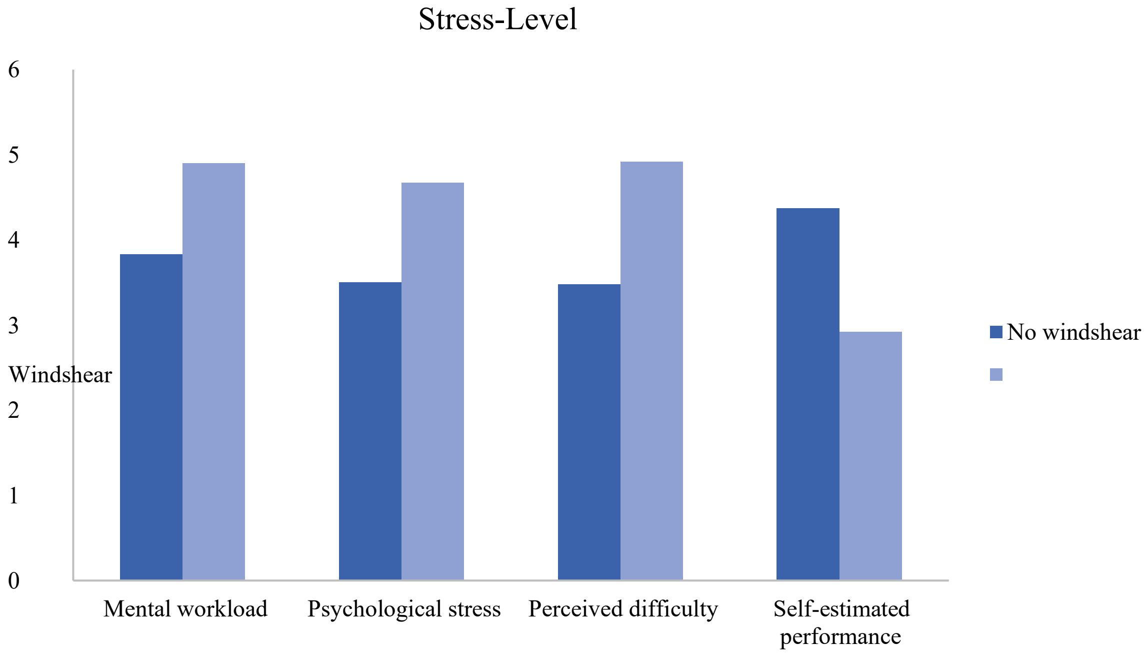
It would have been desirable to include statistical data in this report, showing, for example, the frequency of occurrence of certain behavior patterns of pilots in the cockpit and, in the best case, even a connection to certain incidents. To do this, the pilots would always have to be monitored, which, according to the conducted research, is not done to this extent today. For this reason, the searches at the FAA and the NTSB databases did not come up with any statistical contributions to this report. To extend the scope of this report in the future, several insights into the automation of cockpits could be found when looking for publications of Kathy Abbott, the Chief Scientific and Technical Advisor – Flight Deck Human Factors of the FAA.

Results obtained

The three main issues influencing the ability of pilots to handle unforeseen situations, that were found during the research on human error in the cockpit, are inattentional deafness, inattentional blindness, and pilot fatigue. Starting with inattentional deafness, the influence was found to increase significantly with workload (Dehais et al., 2014). The experiment of the scientists showed that the participants were not able to perceive best-informed acoustic signals in unfamiliar, stressful situations. This result is the first essential finding for future software development and the cockpit's design: The phenomenon must be circumvented to enable the pilot to react quickly and adequately to the (possibly dangerous) situation. Figure 1 shows the measured stress level on a scale of 0 to 5.

Figure 1

Increasing stress level according to Dehais et al. (2014)



As shown in Figure 1, the measured stress level for the three objectively during the flight measured categories (mental workload, psychological stress, perceived difficulty) increased with the unexpected windshear scenario during the landing for about one unit. In the subjective survey, the pilots also ranked their self-estimated performance to be lower, when they had to fly the windshear scenario. While most of the pilots did not recognize important acoustical signals in this scenario, it was easier to detect the sound for those pilots, who had heard the signal in a less stressful situation before (Dehais et al., 2014). That information can be used to improve pilot training on the one hand, but in terms of the ongoing automation of the cockpit, on the other hand, how the signal is presented to the pilot must be investigated.

A similar behavior occurred in the experiment of the scientists who investigated the phenomenon of inattentional blindness. Here optical signals were in focus during the use of eye-tracking measurements within the designated area of interest (AOI) (see Figure 2). It was observed that the optical signal often was not processed and perceived by the pilots in situations with high workloads. This phenomenon also happened to pilots in unfamiliar, stressful situations (Dill & Young, 2015). To take a deeper insight into this behavioral pattern an investigation of which optical signals could be recognized more easily by the pilots (because of the choice of color or position in the AOI in the cockpit for example) should be conducted in further research.

Figure 2

Areas Of Interest, taken from Dill & Young (2014)

Note. Left: AOI overlaid on Research Flight Deck (RFD); Right: Filtered gaze samples with overlaid AOI identification.

Furthermore, the situation appeared, that one of the pilots monitored the displays when the other one looked out of the window. It could also be observed, that during the autopilot mode, the pilots were not looking at the flight mode annunciator (FMA) anymore, so that mode transitions were not realized. The scientists propose a more salient signal here (Dill & Young, 2015). The following conclusion can be made from this: It seems like the pilots trust the automation, and do not control it at any time it is active. That can either be a positive development, or a hint for the increasing number of possible dangerous situations because of the lacking collaboration of pilots and automation as also stated by Schutte (2017).

Using eye tracking measurements as well, Naeeri et al. (2021) were able to prove the increasing fatigue of the pilots during the flight. They concluded, that the longer the pilot is looking at one system element in the cockpit, the longer they would need to focus on the effect of the component as a result of their increased fatigue. To work against this phenomenon, the scientists suggest "proactively detecting fatigue of pilots" (Naeeri et al., 2021). A possible way to use the information from this study could be to create a system component that could detect the increasing fatigue according to the mathematical-based approach made in this study and take over more control until the pilot is fully active again. The figure below shows the key facts to all three issues included in this report that the pilot could experience during a flight.

Figure 3

Major unconscious issues pilots face in the cockpit

		
Inattentional Deafness o Increasing Workload o Deafness to acoustical signals	Inattentional Blindness o Increasing Workload o Signals remain unnoticed	Fatigue o Converging traffic scenarios o Issue for all age and experience levels

Schutte’s (2017) paper puts all the findings from above in a nutshell. He claims that automation should be used “to get the most out of the human in the flight deck” (Schutte, 2017). When considering the issues above, that would mean including a suitable warning system, that detects the pilot’s fatigue and presents urgent issues in a different way to the pilots, so that inattentional blindness or deafness cannot be the reason for nondetection.

Figure 4

Overview of Schutte's conclusions about the synergy of pilot and automation

Pilot	**Automation**
o Negative effects of human errors may become worse without pilots in the cockpit o Pilots are not the only humans on the aircraft	o Behaves as programmed o Replication of full human abilities in automation not yet possible
Pilot + Automation	
o Interaction can lead to human error o Human needs the ability to turn off certain functionalities o Synergizing pilot and automation	

Schutte (2017) hypothesizes that although humans would make mistakes, however, a major advantage of a pilot as opposed to automation is that the pilots can undo or redo their mistakes and respond correctly to the situation. He also asserts that other groups of people are involved in the process of safety than just pilots. The rest of the flight crew, or mechanics, would also need to be considered for example. Automation itself can also only be as good as a human has programmed it to be. In his opinion, the status of holistic thinking through all kinds of situations automation is not yet present, and this human-made system could also only adapt its behavior as it was previously taught. Spontaneous reactions to an unpredictable situation could not be expected from automation. Schutte notes that the best possible solution that would lead to a safer environment aboard the aircraft (given today's technology) would be to create a synergy of machines and humans. In this combination, the best of both components would contribute to flight safety (Schutte, 2017).

Conclusion

The overall results of this research prove the relevance and significance of the asked research question. Three different approaches to unconscious human behavior in terms of inattentional deafness, blindness, and the increase of fatigue during the work of a pilot support the existence of human errors in the cockpit on the one hand. Especially the unforeseen situations challenged the pilots during the experiments and gave the first hint to answer the question about what elements a pilot need in the cockpit to make the flight safer. For differentiating these issues, they could be classified as human failures because they appear unconsciously, rather than as human faults, which would describe an actively controlled wrong behavior. To eliminate them, the awareness of their existence must raise and has to be considered when designing the cockpit and the flight management software.

Additionally, the following can be concluded: The eye-tracking method was used in all experiments and therefore seems to be a solid method to measure the behavior patterns of the pilots inside the cockpit during their work. An advantage is that the pilots´ work does not have to be interrupted and the measurement can be taken without the pilots´ notice. It must be mentioned that all the experiments included in this report were conducted in flight simulators. The results may be different in a realistic environment during a flight.

For further investigations, it would then be important that the studies conducted so far, are also tested during normal flight operations. Statistical investigations would also be helpful in the future to better assess the weighting of possible human errors in the cockpit and to be able to evaluate which condition should be improved first. This research is the beginning of finding an answer to the introduced research question about which elements of the cockpit are necessary for the pilot. It sets a solid base to build up a research procedure but to go even deeper into the topic, it needs ongoing investigations and experiments. After this process of finding the origin of human error, further research into the functionalities of system elements and their effect on the pilot's work while considering the current results should be conducted.

References

Barends, E., & Rousseau, D. M. (2018). *Evidence-based management: How to use evidence to make better organizational decisions*. Kogan Page Limited.

CEBMa. (2017). Guideline for Rapid Evidence Assessments in Management and Organizations. *Center for Evidence-Based Management, Amsterdam, The Netherlands*. Retrieved February 18, 2023, from https://cebma.org/wp-content/uploads/CEBMa-REA-Guide- line.pdf

Curtis, T. (2000). Understanding Aviation Safety Data: Using the internet and other sources to analyze air travel risk. Society of Automotive Engineers.

Dehais, F., Causse, M., Vachon, F., Régis, N., Menant, E., & Tremblay, S. (2014). Failure to detect critical auditory alerts in the Cockpit. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *56*(4), 631–644. https://doi.org/10.1177/0018720813510735

Dehais, F., Roy, R. N., Gateau, T., & Scannella, S. (2016). Auditory alarm misperception in the cockpit: An EEG study of inattentional deafness. *Lecture Notes in Computer Sci- ence*, 9743, 177–187. https://doi.org/10.1007/978-3-319-39955-3_17

Dill, E. T., & Young, S. D. (2015). Analysis of eye-tracking data with regards to the complexity of Flight Deck Information Automation and management - inattentional blindness, system state awareness, and EFB usage. *15th AIAA Aviation Technology, Integration, and Operations Conference*. https://doi.org/10.2514/6.2015-2901

Naeeri, S., Kang, Z., Mandal, S., & Kim, K. (2021). Multimodal analysis of eye movements and fatigue in a simulated glass cockpit environment. Aerospace, 8(10), 283. https://doi.org/10.3390/aerospace8100283

Rankin, L., (2007). MEDA Investigation Process. https://www.boeing.com/commercial/aeromagazine/articles/qtr_2_07/AERO_Q207_article3.pdf

Schutte, P. C. (2017). How to make the most of your human: Design considerations for Human–Machine Interactions. *Cognition, Technology & Work*, *19*(2-3), 233–249. https://doi.org/10.1007/s10111-017-0418-2

Villamizar, H., (2022). Remembering Aloha Airlines Flight 243. Airways Magazine. https://airwaysmag.com/aloha-airlines-flight-243/

The Ineffectiveness of Single-Pilot Resource Management (SRM) in General Aviation

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Abstract

Objective: This study intended to focus on improving general aviation safety through the implementation of human factors awareness training by examining the impacts of SRM in GA, the impacts of CRM training in commercial aviation, the concepts of CRM training in commercial aviation to provide recommendations to enhance the effectiveness of SRM

Background: In an attempt to tackle safety concerns in the general aviation community, several efforts have been made in the last decade. However, little or no improvement is recorded in terms of the number of accidents and incidents. In 2018, a slight increase in GA accidents was recorded compared to the previous year (2017). For this reason, general aviation safety has become a great concern to the aviation industry.

Methodology: The methodology used in this study is qualitative descriptive research design. The data were collected from the report generated by the National Transportation Safety Board (NTSB) and advisory circular 120-51E.

Results: The analyses revealed that the CRM concepts yielded positive and desired results in commercial aviation, but its counterpart, SRM, hasn't yielded positive and desired results in general aviation.

Conclusions: The principles of single-pilot resource management have not been effective in enhancing general aviation safety. It was discovered that a lack of constant and monitored human factors awareness training in GA renders the concept of SRM ineffective, and most GA pilots lack personal development to ensure continuous human factors training.

Introduction

General aviation (GA) is used to describe all civilian aviation operations apart from operations involving paid passenger transport (Boyd, 2017). Research revealed that more than 90 percent of the roughly 220,000 civil aircraft registered in the United States are GA aircraft, and more than 80 percent of the certified pilots in the United States fly GA aircraft (AOPA). Shelnutt, Childs, Prophet, & Spears (1980) stated that "GA pilots are a very heterogeneous group. They vary with respect to training, age, total flight experience, recency of experience, motivation, flight skills, basic abilities, amount of supervision they receive, and on a variety of other parameters" (p.6, para 2). This heterogeneity can be seen as one of the factors contributing to safety issues in the GA community. GA safety has been a significant concern due to a high number of fatalities. Statistics showed that general aviation suffers a higher fatal accident rate than scheduled airline flights (Min, 2018). Boyd (2017) also stated that GA holds a lackluster safety record, accounting for 94% of civil aviation fatalities (p.1, para 1). In an attempt to tackle safety concerns in the general aviation community, several efforts have been made in the last decade. However, little or no improvement is recorded in terms of the number of accidents and incidents. In 2018, a slight increase in GA accidents was recorded compared to the previous year (2017). For this reason, general aviation safety has become a great concern to the aviation industry.

In the last few decades, commercial aviation suffered a series of incidents and accidents that resulted in losses of lives and properties. In 1979, the National Aeronautics and Space Administration (NASA) organized a conference where human error aspects of most air crashes were identified as failures of interpersonal communications, decision-making, and leadership (Helmreich, Merritt, & Wilhelm, 1999). This led to the evolution of cockpit resource management, which was first initiated by United Airlines in 1981. The program focused on correcting deficiencies in individual behavior, such as a lack of assertiveness by juniors and authoritarian behavior by captains' leadership (Helmreich, Merritt, & Wilhelm, 1999). This marked the first generation of crew resource management (CRM). The second generation evolved after another conference NASA organized in 1986, which changed the name from cockpit resource management to crew resource management (CRM). The third and fourth generations evolved as the scope of CRM became broader, and necessary safety improvements were recorded in commercial aviation.

Since human factors awareness training, tagged as CRM in commercial aviation, has a positive impact on flight safety, a replica of such training would be effective in general aviation if organized to suit the need of general aviation pilots. General aviation pilots fly for different purposes such as personal, instructional, aerial observation, ferry, and many other purposes not involving paid passenger transport. Of all the categories, personal flying has the highest number of casualties. This means that to get the best out of human factors awareness training in the general aviation community, the focus must be on pilots flying for personal reasons.

Intent

This study intended to focus on improving general aviation safety through the implementation of human factors awareness training by taking the following steps:

- Examine the impacts of SRM in GA.
- Examine the impacts of CRM training in commercial aviation.
- Examine the concepts of CRM training in commercial aviation to provide recommendations to enhance the effectiveness of SRM.

Research Questions

- Is CRM effective in terms of mitigating human errors and enhancing flight safety in commercial aviation?
- Is the application of single-pilot resource management effective in enhancing general aviation safety?
- What factors are responsible for the ineffectiveness of SRM?
- What factors contribute to CRM effectiveness?

Literature Review (Case Study Background)

The aviation industry has made tremendous strides since the first powered flight in 1903 in aircraft advancements and the development and evolution of human factors training. However, the general notion that flight training only consists of learning how to operate an aircraft vastly underestimates the depth of knowledge necessary for safe flight operations. Human factors are introduced in general aviation (GA) with single pilot resource management (SRM) and continue throughout commercial operations in crew resource management (CRM). While CRM has impacted the safety of commercial flights for the better, research suggests there is a deficiency in the effectiveness of SRM in GA.

Single pilot operations are naturally one of the most stressful task-demanding flights a pilot can encounter, as observed by Im et al. (2021). Thus, before a pilot can break away from the Earth's surface in an aircraft, she must receive the FAA-mandated ground school training complete with SRM lessons. SRM is the art and science of responsibly handling all the internal and external resources before and during a flight for safe operations (Im et al., 2021). What are pilot's resources? Shank emphasizes that anything a pilot needs to complete a flight can be a resource, no matter how insignificant, like a pen and paper. Built-in aircraft systems like a generator and backup fuel pumps are resources available that are initially forgotten about (Shanks, 2014). “Nearly anything can be a resource, but nothing is a resource until you recognize it as such” (Shanks, 2014, p. 6).

Interestingly, Safety’s (2021) study draws attention to the fact that the SRM training curriculum mainly focused on the five Ps (plan, plane, pilot, passengers, and programming) while borrowing from CRM concepts. Contributing Crew Resource Management authors Robert Helmreich and H. Clayton Foushee state that the acceptance of training is ideal, but it has little indication of the effectiveness of said training. A valid point made by the authors is that if there are no behavioral tools to apply the concepts, then the training may have only a minimal change in observable behavior (Kanki et al., 2019). The same point is valid concerning teaching pilots SRM practices. In other words, SRM has primarily been a trickled-down version of CRM without the proper channels teaching the technique in the practical field.

The pinnacle of flight training is the practical check-ride governed by the airman certification standards (ACS), previously known as the practical test standards (PTS). The Aviation Safety magazine defines the ACS as an updated version of the PTS with stick-and- rudder skill requirements, now featuring risk management (Wright, 2020), which gets exercised with the mnemonic PAVE (pilot, aircraft, environment, and external pressures) (Im et al., 2021). Evidence shows that poor risk management is a “major root cause of fatal accidents” (Wright, 2020, p. 5), along with poor judgment and subpar flight planning (Im et al., 2021). The 2020 Aviation Safety article addresses the challenge of teaching existing pilots, tested by the PTS, new risk management skills. Not only do the pilots need amended FAA standardization training, but so do their counterparts, certified flight instructors (CFIs), and designated pilot examiners

(DPEs). The author, Robert Wright, sheds light on how beneficial and effective the ACS has been since its 2016 inception.

Robert Wright is an airline transport pilot (ATP) with over 10,000 hours formerly employed by the FAA who has expressed aversion towards the lack of risk management training up until recently. Through evidence of FAA publications and personal experience, Wright noted that the FAA and industry partners had vague instructions on performing, teaching, and testing risk management. The FAA Risk Management Handbook lacks a thorough explanation of identifying, assessing, and mitigating risks and does not deliver real-world case studies; it still is not updated since its publication in 2009. During Wright's proficiency checks, he requested a risk-based flight review that the General Aviation Joint Steering Committee (GAJSC) issued a safety enhancement recommendation. Unfortunately, Wright's CFIs were unfamiliar with this approach or the advisory circular (AC) 61-98. Consequently, "The resulting flight reviews [he] received were desultory affairs, maneuver-based, unrelated to the missions [he] typically [flies] and utterly unchallenging" (Wright, 2020, p. 6). While Wright remains optimistic that the ACS is a step in the right direction for educating the GA community on risk management and decreasing the GA accident rate, plenty of work remains to be done.

Implementing crew resource management (CRM) has taken the aviation industry by storm with predominantly positive feedback and results. After several catastrophic aircraft accidents, due to no fault of technical or engineering issues, the concept of CRM was developed to compel flight crews to maintain positive control of the aircraft no matter the situation. Most of these accidents were due to poor decision-making, loss of situational awareness, and an absence of leadership (Kanki et al., 2019). CRM combines technical skills and human factors in the flight environment. Embry- Riddle Aeronautical University's Frank J. Tullo, a pilot and flight operations manager, took a leaf from former FAA administrator Donald Engen, who stated accidents happen from crews rather than individual crewmembers by simplifying CRM into one word: teamwork. While a safe flight is recognized as the success of a team of employees- pilots, flight attendants, mechanics, dispatchers, fuelers, and ground crew- effectively working together for the same goal, the team for this discussion will focus on the crew members aboard the aircraft (Kanki et al., 2019). Tullo claims, “The true definition of “teamwork” or CRM is its focus on the proper response to threats to safety and the proper management of crew error” (Kanki et al., 2019, p. 55).

Research demonstrates that CRM has been a welcomed concept by the aviation industry and has a consistent positive influence. The first step in introducing any new idea or concept in an industry is gathering feedback to determine the general census and the best course of action. Data was collected from over 20,000 flight crewmembers, both in civilian and military functions, from around the world. The results were wildly in favor of CRM along with advocacy for line- oriented flight training (LOFT), or “full mission simulation training” (Kanki et al., 2019, p. 25). When comparing the attitudes of crewmembers pre and post-training, there was a noticeable positive increase. For example, two United Airlines flights that ended in an accident had crews who acknowledged the impact CRM training had on them in Flight 811 and Flight 232 emergencies. Each crew worked effectively in the high-stress environment to reduce fatalities.
According to the cockpit voice recorder, both crews managed to maintain positive communication and verification in urgent situations. Moreover, as more organizations incorporate CRM training, more crewmembers will comply with the new norms and standards of behavior.

CRM has transformed the aviation community and is continuously updated and enhanced to best serve aviation professionals in the ever-advancing flight deck. Contributing writer Linda Orlady of Crew Resource Management (2019) witnessed several airlines present their efforts to CRM and human factors. The airlines had similar aspects for their framework; however, no two airlines' CRM programs are identical. Each airline has a unique structured program for its culture and employees. Most importantly, the program receives support from the top management down to the flight line and vice versa. Helmreich's findings included that without recurrent CRM training, the results and benefits of CRM will deteriorate over time. Helmreich administered a cockpit management attitudes questionnaire (CMAQ) a year after one organization's initial CRM training, and the results were disappointing. The data revealed that attitudes returned to their baseline prior to CRM lessons. If long-term change is the goal of CRM, it requires commitment and reinforcement to ensure the information is not 'brain dumped.' Furthermore, the airlines collaborated with the pilots to implement and review the training. The airlines are aware that CRM will always be a work in progress and should continually evolve to deliver the best training to employees (Kanki et al., 2019).

Operating an aircraft solo or as part of a crew is no easy feat, as it requires intensive training both in flight and on the ground. Flight training is further complicated when attempting to learn and know all the available resources. SRM and CRM are multidisciplinary subjects involving more than aviation but also how humans operate in the flight environment. Since the introduction of CRM to commercial aviation, the safety record has improved due to increased coordination of crewmembers. On the contrary, SRM struggles to provide the exact drastic change in GA accident rates compared to CRM in commercial flights. A contributing factor in the variable SRM and CRM accident rates is the level of development of training programs.

Nevertheless, additional research is necessary to determine the effectiveness of both SRM and CRM due to limited research because most studies focus on evaluation rather than effectiveness (Kanki et al., 2019).

Methodology

The methodology used in this study is qualitative descriptive research design because it fits the research questions properly and provides a comprehensive summarization of the descriptive statistical analysis in the study by answering questions of what, who, where, and when. The data were collected from the report generated by the National Transportation Safety Board (NTSB). In addition, a qualitative deductive coding analysis research design was used to analyze the scope of CRM training based on the data collected from advisory circular 120-51E.

The accidents and fatalities report of U.S. general aviation accidents from 2000 to 2019 were also collected and analyzed. A further inquiry was made into the general aviation accidents report to determine general aviation accident aircraft by flight purpose and aircraft category to determine the type of general aviation flying with the highest fatalities. In addition, accident reports for the U.S air carriers operating under 14 CFR 121 scheduled and nonscheduled service from 2000 to 2019 were collected to see the trend of fatalities in U.S part 121 operations and the impact of CRM training on commercial aviation within that period of time, and compare it with the impact of SRM in general aviation.

Data Analysis

Since the goal of CRM and SRM is not to completely eradicate human errors but to mitigate them to reduce the number of accidents and fatalities, the analysis of the data was grouped into three sections to examine the trends of accidents and fatalities and juxtapose them with the number of flight hours within those periods to determine the effectiveness of CRM and SRM. The first analysis focused on part 121, accidents and fatalities from 2000 to 2019, which looked at the trends of accidents and fatalities and compared them with the rate of flight hours during those periods. The second analysis focused on general aviation accidents and fatalities and looked at the trend of accidents and fatalities and juxtaposed them with the rate of flight hours during those periods. The third analysis examined advisory circular AC 120-51D to decipher the approach used in CRM training and factors that might have contributed to its effectiveness.

Results

The analysis of part 121 accidents revealed that from 2000 to 2019, 32.9% of the accidents occurred between 2000 and 2005. 22.9% occurred between 2005 and 2009. 20.7% occurred between 2010 and 2014, and 23.5% occurred between 2015-2019. The main goal was to examine the trend of fatalities to deduce the impact of CRM. So, the analysis of the fatalities revealed that from 2000 to 2019, 82.1% of the fatalities occurred between 2000 and 2005. 15.9% occurred between 2005 and 2009. 1.4% occurred between 2010 and 2014, and 0.6% occurred between 2015-2019. Figures 1 and 2 show the graphical representation of the Part 121 accidents and fatalities from 2000 to 2019.

Figure 1: Part 121 Accidents and Fatalities Graph in five years intervals.

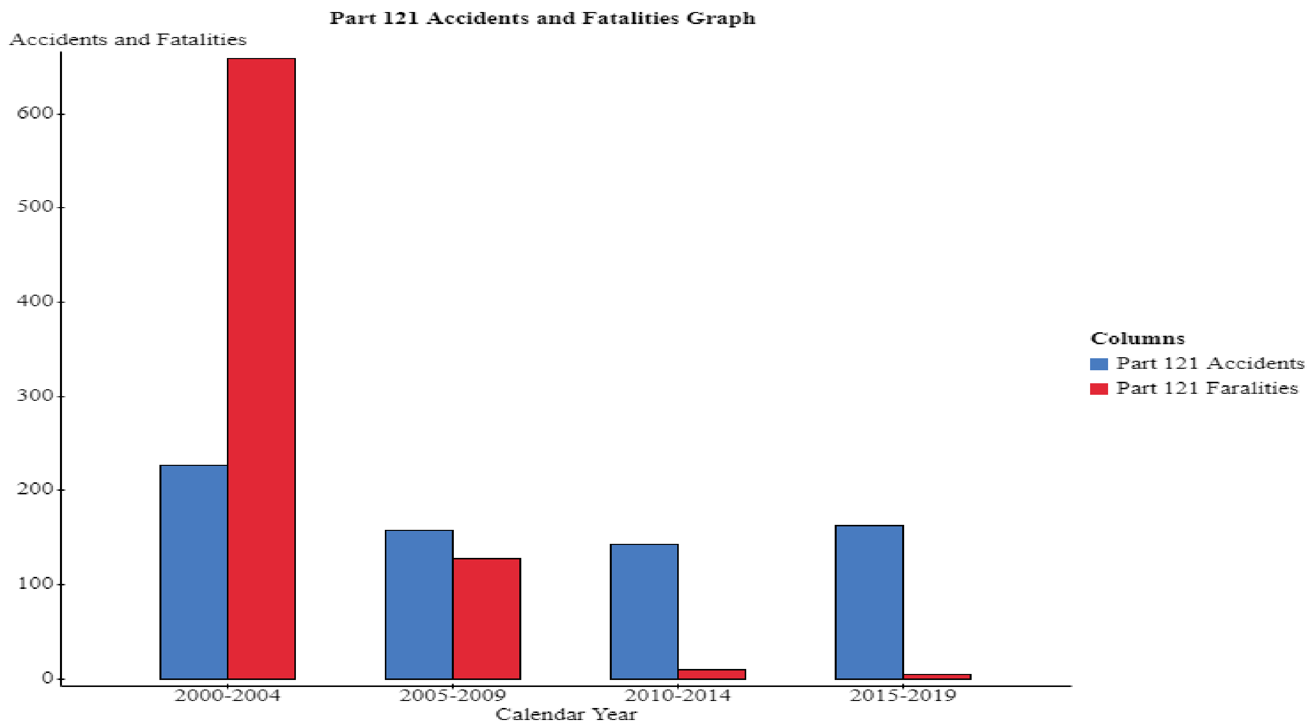
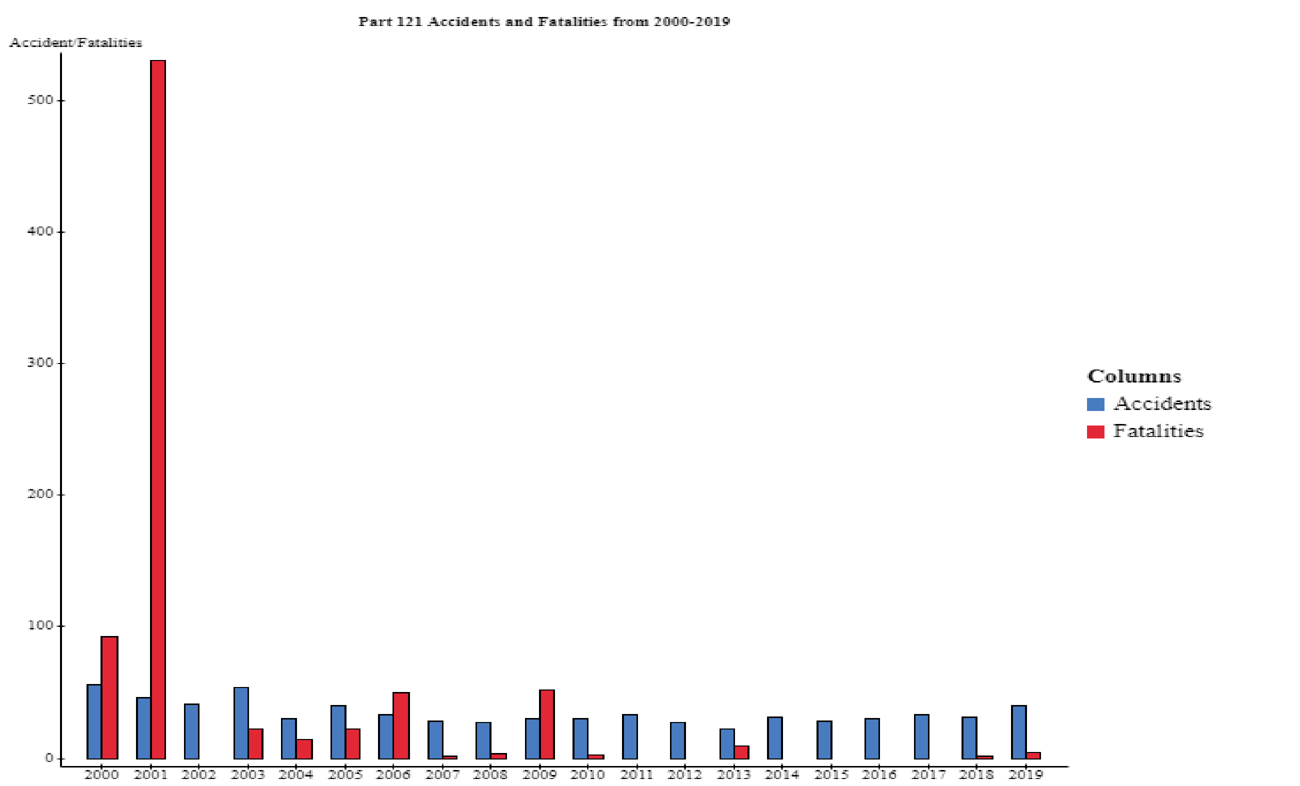


Figure 2: Yearly Part 121 Accidents and Fatalities Graph



Further analysis examined the number of flight hours in part 121 operations from 2000 to 2019. The analysis revealed that from 2000 to 2019, 24.4% of the Part 121 flight hours were flown between 2000 and 2005, 25.9% between 2005 and 2009, 24.2% between 2010 and 2014, and 25.5% between 2015 and 2019. The highest number of flight hours was recorded between 2005 and 2009, followed by 2015 and 2019. This is represented in figures 3 and 4.

Figure 3: Part 121 Flight Hours from 2000-2019

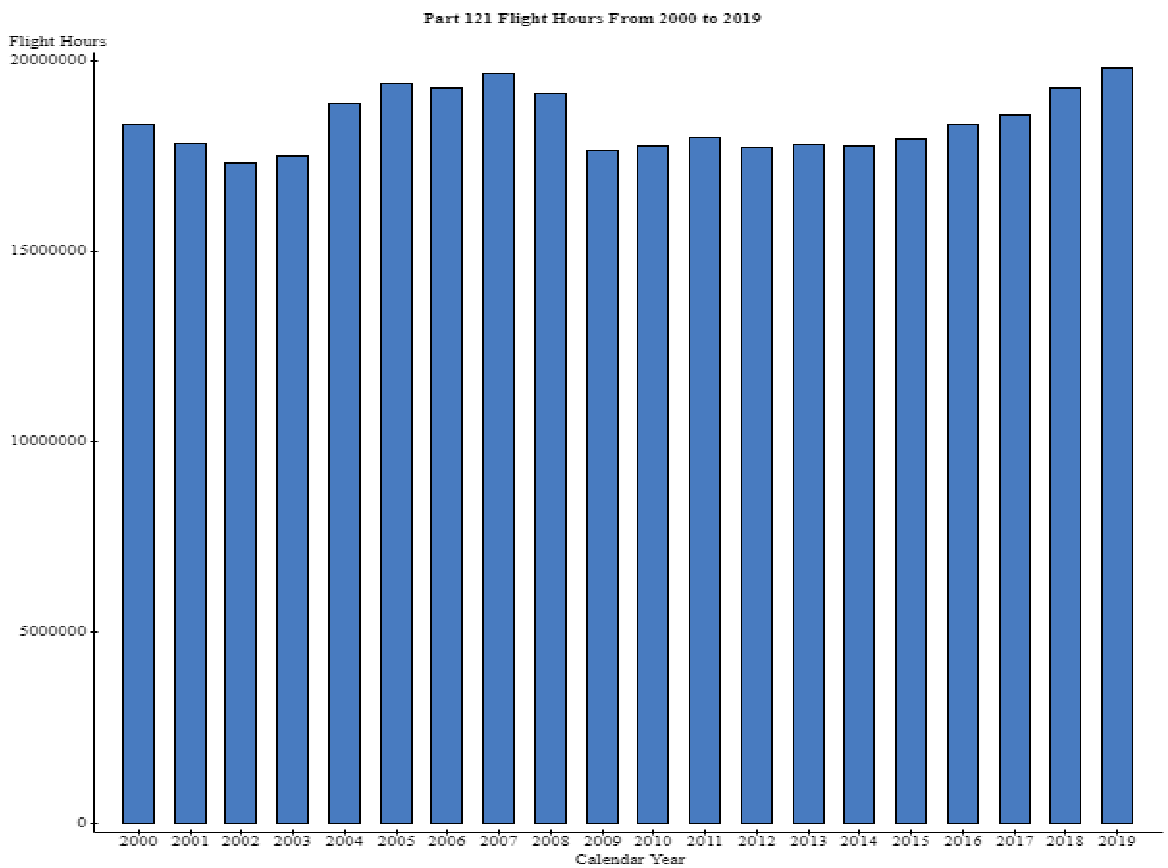
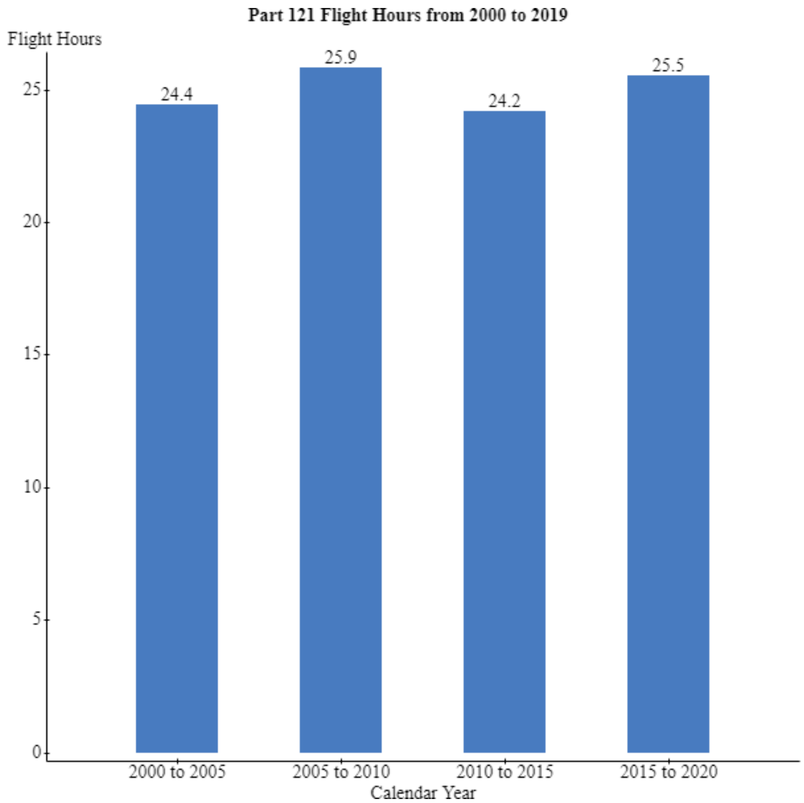


Figure 4: Percentage of Part 121 Flight Hours from 2000-2019 in five years intervals



The analysis of general aviation accidents revealed that from 2000 to 2019, 29.2% of the accidents occurred between 2000 and 2005. 26.7% occurred between 2005 and 2009. 23.1% occurred between 2010 and 2014, and 21% occurred between 2015-2019. As earlier stated, the main goal was to examine the trend of fatalities to deduce the impact of SRM. So, the analysis of the fatalities revealed that from 2000 to 2019, 30.1% of the fatalities occurred between 2000 and 2005, 28.2% occurred between 2005 and 2009, 22.3% occurred between 2010 and 2014, and 19.4 % occurred between 2015-2019. Figures 5 and 6 show the graphical representation of general aviation accidents and fatalities from 2000 to 2019.

Figure 5: General Aviation Accidents and Fatalities Graph in five years intervals

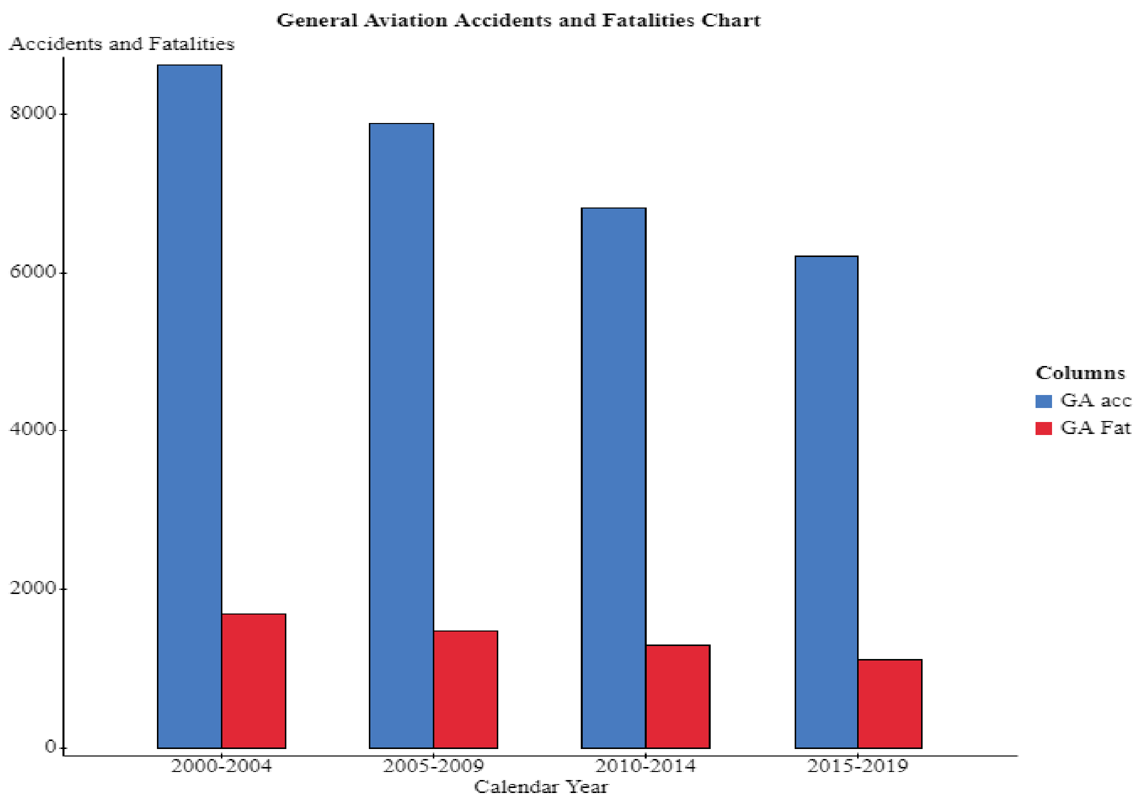
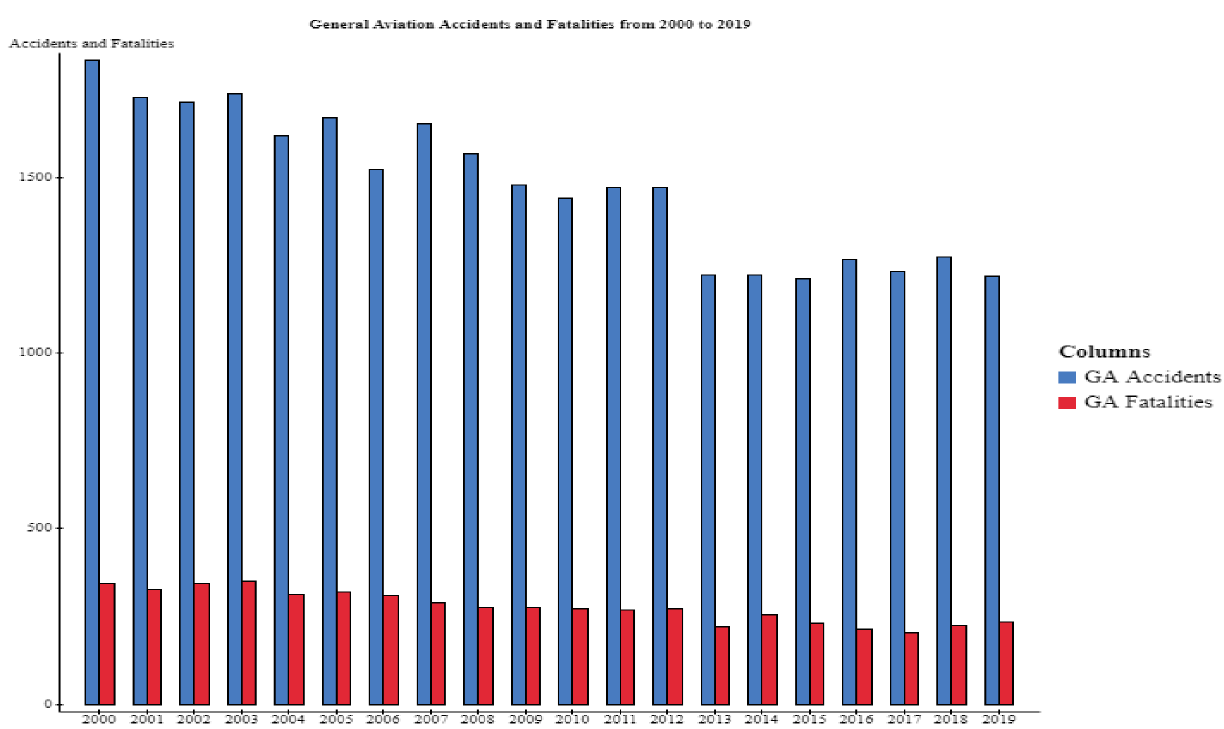
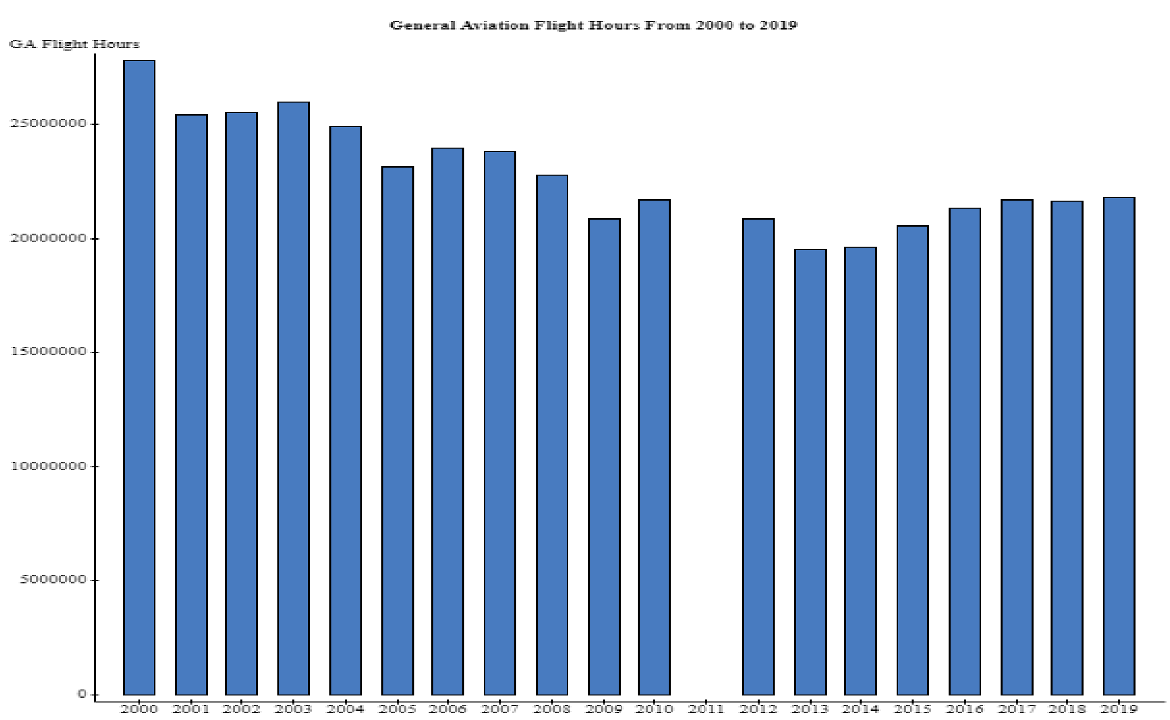


Figure 6: Yearly General Aviation Accidents and Fatalities Graph



The analyses of general aviation Accident and fatality rates showed a gradual decrease in accidents and fatalities. However, this metric cannot be used independently to deduce the effectiveness of SRM. The analysis of general aviation flight hours showed a gradual decrease from 2000 to 2019. Unfortunately, we are unable to calculate the percentage in five years intervals because NTSB did not supply the data for hours flown in the year 2012. However, because of the discrepancy, we could calculate the flight hours by omitting the hours flown from 2010 to 2014. So, the hours flown from 2000 to 2004 are 129,698,000, from 2005 to 2009 is 114,615,830, and from 2015 to 2019 is 107,076,594. This confirms that there has been a gradual decrease in the number of hours flown in general aviation from 2000 to 2019. As a result, the gradual decrease in accident and fatality rates cannot be used to determine the effectiveness of SRM. This is represented in figure 7.

Figure 7: General Aviation Flight Hours from 2000 to 2019



There are many operations in general aviation. So, a closer look was taken to analyze the 2018 general aviation accidents and fatalities report. The data analysis showed that personal flying and instructional flying have the highest number of accidents in general aviation. Personal flying accounts for 69.77% of general aviation accidents, and instructional flying accounts for 15.52% of general aviation accidents.

Figure 8: General Aviation Accidents by flight purpose

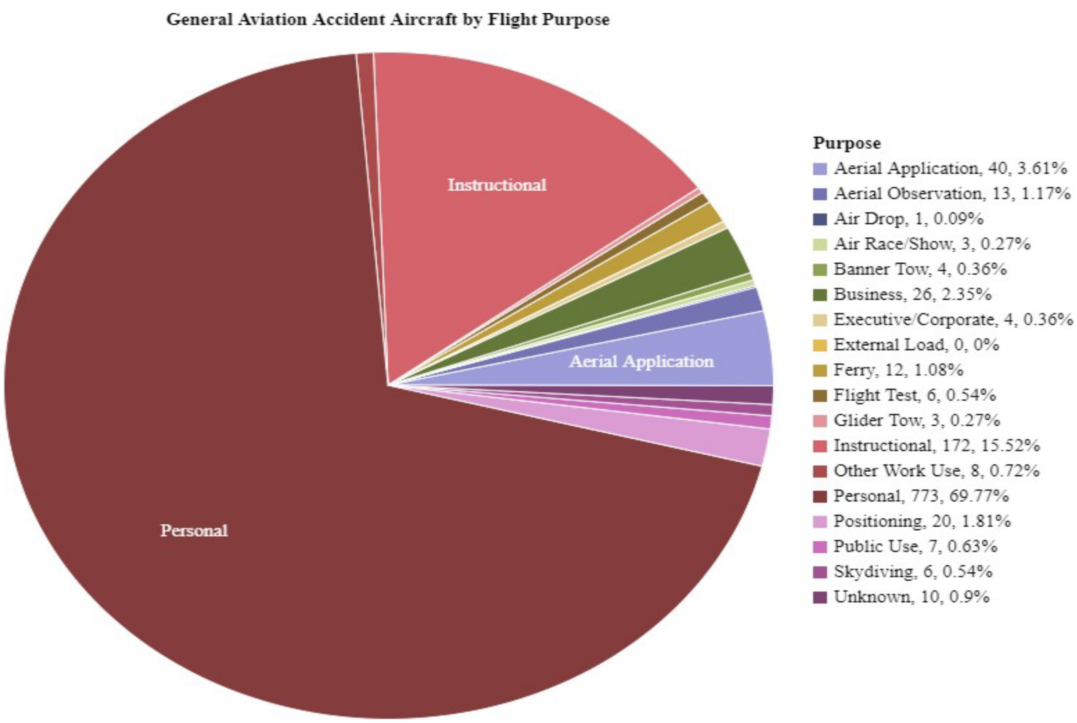


Table 1

Summary of Part 121 and GA Accidents and Fatalities from 2000 to 2019

Year	Part 121 Accidents	Part 121 Fatalities	Part 121 Flight Hrs	GA Accidents	GA Fatalities	GA Flight Hrs
2000	56	92	18,299,257	1,837	345	27,838,000

2001	46	531	17,814,191	1,728	326	25,430,000
2002	41	0	17,290,198	1,716	345	25,545,000
2003	54	22	17,467,700	1,741	352	25,997,000
2004	30	14	18,882,503	1,619	314	24,888,000
2005	40	22	19,390,029	1,671	321	23,167,712
2006	33	50	19,263,209	1,523	308	23,962,936
2007	28	1	19,637,322	1,654	288	23,818,668
2008	27	3	19,126,766	1,569	277	22,804,648
2009	30	52	17,626,832	1,481	276	20,861,866
2010	30	2	17,750,986	1,441	271	21,688,409
2011	33	0	17,962,965	1,471	270	00000000
2012	27	0	17,722,236	1,471	273	20,880,993
2013	22	9	17,779,641	1,223	221	19,492,356
2014	31	0	17,742,826	1,222	255	19,617,389
2015	28	0	17,925,780	1,211	230	20,576,072
2016	30	0	18,294,057	1,269	213	21,333,747
2017	33	0	18,581,388	1,233	203	21,702,719
2018	31	1	19,288,296	1,275	224	21,663,367
2019	40	4	19,786,547	1,220	233	21,800,689

Table 2

The Summary of five years intervals of Part 121 and GA accidents and Fatalities in Percentage and Flight Hours from 2000 to 2019.

Year	Part 121 Accidents (%)	Part 121 Fatalities (%)	Flight Hours	GA Accidents (%)	GA Fatalities (%)	Flight Hours

2000-2004	32.9	82.1	89,753,849	29.2	30.1	129,698,000
2005-2009	22.9	15.9	95,044,158	26.7	28.2	114,615,830
2010-2014	20.7	1.4	88,958,654	23.1	22.3	
2015-2019	23.5	0.6	93,876,068	21	19.4	107,076,594

Fundamentals of CRM training implementation and components of CRM training were deduced in the coding process to have been factors supporting the effectiveness of CRM training. There are six fundamentals of CRM training implementation and three components of CRM training. These fundamentals are the practices that research programs and airline operational experience suggested would benefit the program most. Table 3 shows the summary of the fundamentals and components of CRM.

Table 3

The Summary of the Fundamentals of CRM Training Implementation and Components of CRM Training

Fundamentals of CRM Training Implementation
• Assess the Status of the Organization Before Implementation
• Get Commitment from All Managers, Starting with Senior Managers
• Customize the Training to Reflect the Nature and Needs of the Organization
• Define the Scope of the Program and an Implementation Plan
• Communicate the Nature and Scope of the Program Before Startup
• Institute Quality Control Procedures
Components of CRM Training

- Initial Indoctrination/Awareness
- Recurrent Practice and Feedback
- Continuing Reinforcement

Discussion

CRM training is designed to effectively use all resources to reduce errors, increase flight safety, and improve performance (Velazquez & Bier, 2015). According to the Federal Aviation Administration (FAA), CRM training focuses on situation awareness, communication skills, teamwork, task allocation, and decision-making within a comprehensive framework of standard operating procedures (SOP's) (FAA, 2001). In addition, the training aims to prevent accidents by improving crew performance due to better and more effective crew coordination (FAA, 2001). The evolution of the training started in 1979 but was first implemented in 1981 by United Airlines (Helmreich, Merritt, & Wilhelm, 1999). The training has evolved into the 5th generation with the introduction of the Advanced Qualification Program (AQP), which requires participating carriers to incorporate CRM models into technical training and provide CRM and Line Oriented Flight Training (LOFT) to all the flight crews (Helmreich, Merritt, & Wilhelm, 1999). CRM training is not an error-eliminating mechanism but can help improve flight safety and efficiency by mitigating human errors (Helmreich, Merritt, & Wilhelm, 1999).

The analyses of the study revealed the impact of CRM on flight safety, as the fatalities decreased drastically in commercial aviation, which is the goal of CRM training. In addition, the analyses of the accidents from 2000 to 2019 showed that 82.1% of the fatalities occurred between 2000 and 2005 and 0.6% from 2015 to 2019, which showed improvement in commercial aviation safety over the years. However, Helmreich, Merritt, & Wilhelm (2017) concluded that the effectiveness of CRM cannot be easily determined, especially through the accident rate per million flights during a finite period. Instead, the logical criteria for evaluating CRM would be the behavior of the flight crews on the flight deck and attitudes showing acceptance or rejection of CRM concepts (Helmreich, Merritt, & Wilhelm, 2017). However, further investigation of the effectiveness of CRM showed that the concept of CRM involving LOFT and recurrent training produced desired changes in the behavior of flight crews, and attitudes about flight deck management of the crews had changed positively (Helmreich, Merritt, & Wilhelm, 2017). Therefore, we can conclude that CRM training (human factors awareness) has yielded positive results in commercial aviation.

SRM is a variation of CRM with the goal of reducing accidents rate caused by human errors by teaching pilots about human limitations and how individual performance can be maximized. It's the art of managing all the resources available to pilots before and during a flight to ensure a successful flight. The essence of the training is to enable pilots to maintain situational awareness by effectively managing automation, aircraft control, and navigation tasks. As a result, pilots accurately assess hazards, manage resulting risk potential and make sound aeronautical decisions. Furthermore, SRM training is based on proper adherence to aeronautical decision- making, risk management, controlled flight into terrain (CFIT) awareness, and situational awareness.

From the analyses of general aviation accidents, there was a slight decrease in the rate of fatalities from 2000 to 2019. However, the effectiveness or impacts of SRM cannot be linked to the slight decrease in fatalities and accident rates of general aviation operations because the data collected from NTSB also showed a decrease in flight hours per million flights from 2000 to 2019. So, SRM has not yielded positive results compared to CRM.

A further assessment of the CRM training advisory circular revealed that the fundamentals of CRM training implementation and components of CRM training might have contributed to its effectiveness. Nevertheless, these fundamentals and components are missing in the implementation of SRM. For example, one of the fundamentals of CRM states CRM training is customized to reflect the nature and needs of the organization. Still, SRM is general in scope, not customized to reflect and meet the needs of specific operations in general aviation. General aviation operations consist of personal, instructional, aerial observation, ferry, and many other types of flying. Customizing the training to meet the need of specific operations may yield positive results in terms of reducing general aviation accidents and incidents. For instance, as shown by our analyses, personal flying and instructional flying have the highest number of accidents and fatality rates in general aviation, of which personal flying accounts for 67.77% and instructional flying accounts for 15.52% of general aviation fatalities in 2018.

The quality control procedures of the fundamentals of CRM training implementation are an art of monitoring the delivery of training and determining areas where training can be strengthened. In addition, the instructors, also known as the facilitators, collect systematic feedback from participants in the training through surveys. This is very important in determining the effectiveness of training programs. Nevertheless, such procedures are missing regarding SRM because there’s no standard way of monitoring and determining general aviation pilots’ compliance with the principles of SRM, especially when they graduate from flight schools.

Two important CRM training components are recurrent practice, and Feedback, and continuing reinforcement. These concepts are adopted to ensure pilots practice newly improved CRM skills and to receive feedback on their effectiveness. This is because one-time exposures to the concept of CRM are simply insufficient to produce desired results. So, CRM training is a recurrent training program in commercial aviation. On the contrary, there's no standard way of knowing if general aviation pilots review and comply with the principles of SRM on a regular basis. In addition, pilots are humans and are subject to many limitations, such as forgetting lessons learned, but things most recently learned are best remembered (FAA, 2016).

Conclusions

The principles of single-pilot resource management have not been effective in enhancing general aviation safety. From the analyses of general aviation accidents, there was a slight decrease in aviation accidents from 2000 to 2019. However, this metric cannot be used to justify the effectiveness of SRM because the number of flight hours per million flights decreased from 2000 to 2019.

Several factors have been discovered to have contributed to the ineffectiveness of SRM. It was discovered that a lack of constant and monitored human factors awareness training in GA renders the concept of SRM ineffective, and most GA pilots lack personal development to ensure continuous human factors training.

On the other hand, the analyses of the data of commercial aviation accidents from 2000 to 2019 revealed that CRM training had produced desired outcomes, mitigated human error, and improved safety. In addition, the analyses confirmed that the accident rates from 2000 to 2019 decreased from 82.1% between 2000 to 2000 to 0.6% between 2015 to 2019, which confirmed that CRM training is producing the desired results.

The fundamentals of CRM training implementation and components of CRM training have contributed to the effectiveness of CRM training in mitigating human errors and reducing aviation accidents. In addition, the customization of CRM training to reflect the nature and specific needs of the organization, recurrent practice and feedback, and continuing reinforcement are major contributing factors to the effectiveness of CRM training that, if introduced into the SRM model, general aviation accidents and incidents will reduce.References

Boyd, D. D. (2017). A review of general aviation safety (1984–2017). *Aerospace medicine and human performance*, *88*(7), 657-664.

Federal Aviation Administration (2001). Advisory Circular 120-51D. https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_120-51D.pdf

Federal Aviation Administration [FAA]. (2016). Aviation maintenance technician handbook – General (FAA-H-8083-30A). https://www.faa.gov/ regulations_policies/handbooks_manuals/aviation/ media/amt_general_handbook.pdf

Helmreich, R. L., Merritt, A. C., & Wilhelm, J. A. (1999). The evolution of crew resource management training in commercial aviation. The international journal of aviation psychology, *9*(1), 19-32.

Helmreich, R. L., Merritt, A. C., & Wilhelm, J. A. (2017). The evolution of crew resource management training in commercial aviation. In *Human Error in Aviation* (pp. 275- 288). Routledge.

Im, K. H., Kim, W., & Hong, S.-J. (2021). A Study on Single Pilot Resource Management Using Integral Fuzzy Analytical Hierarchy Process. *Safety, 7*(4). https://doi.org/10.3390/safety7040084.

Kanki, B. G., Anca, J., & Chidester, T. R. (Eds.). (2019). *Crew Resource Management* (3rd edition). Academic Press.

Min, S. (2018). A proactive safety enhancement methodology for general aviation using a synthesis of aircraft performance models and flight data analysis (Doctoral dissertation, Georgia Institute of Technology).

Shelnutt, J. B., Childs, J. M., Prophet, W. W., & Spears, W. D. (1980). *Human factors problems in general aviation*. EMBRY-RIDDLE AERONAUTICAL UNIV DAYTONA BEACH FL.

Shanks, G. (2014, October). Resource management: there are countless tasks involved in flying, and most of those tasks rely on outside resources. Manage those resources for a successful outcome. *IFR, 30*(10), 6-8. https://link.gale.com/apps/doc/A384968162/AONE?u=nm_a_enmu&sid=ebsco&xid=de31541f.

Velazquez, J., & Bier, N. (2015). SMS and CRM: Parallels and opposites in their evolution. Journal of Aviation/Aerospace Education & Research, 24(2), 55-78.

Wright, R. (2020, September). Are The ACS Working? It depends. The implementation is going well, but it could, be years before the new Airman Certification Standards can move the safety needle for GA. *Aviation Safety, 40*(9). https://link.gale.com/apps/doc/A642197966/AONE?u=nm_a_enmu&sid=bookmark-AONE&xid=ec342188.

SAINT LOUIS UNIVERSITY

Aviation Safety Data Analysis

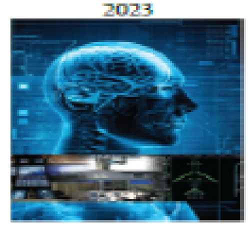
Human Error In The Cockpit Of An Aircraft

Rationale:

1988

Aloha Airlines Flight 243

2023



Human-Machine Interaction

Which factors allowed an accident to happen?

- Mostly structural problems in the past
- Human error resulting from the increasing automation of the cockpit today

Research:

- Databases: Google Scholar, ProQuest, FAA, NTSB
- Time period: 2013-2023
- Area of unconscious behavioral patterns of pilots in the cockpit during a flight
- Thoughts on the human-machine interaction

Research process:

Inattentional Deafness (Dehais et al., 2014)

Inattentional Blindness (Dill & Young, 2015)

Human-Machine Interaction (Schutte, 2017)

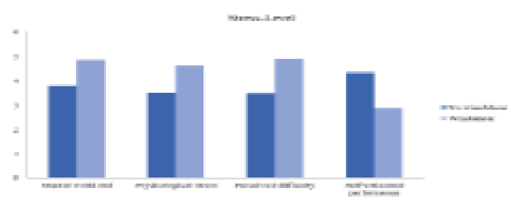
Fatigue (Naeeri et al., 2021)

Research findings:

Human-Machine Interaction

Inattentional Deafness	Inattentional Blindness	Fatigue
○ Increasing Workload ○ Deafness to acoustical signals	○ Increasing Workload ○ Signals remain unnoticed	○ Converging traffic scenarios ○ Issue for all age and experience levels

- Inattentional behavior occurred in all experiments during stressful situations with increased workload.
- It was easier for the pilots to react adequately/quickly to acoustical signals when they had heard the sound before in less stressful situations.
- Pilots awareness of the inattentional behavior patterns needed to improve the synergy of human-machine interactions.
- The presentation of acoustical and optical signals must be adjusted to minimize effects from unconscious behavior.
- Fatigue measurement of the pilot can be helpful to avoid dangerous situations.
- A popular measurement method through all experiments was the eye tracking method - it does not interrupt the tasks of the pilot and remains unnoticed during the flight.



- The measured stresslevel increased with the windshear scenario
- Ranking of personal performance lowered during windshear scenario

Human-machine interaction depends on a variety of approaches. The following overview presents the thoughts of Schutte (2017):

Pilot	Automation
○ Negative effects of human errors may become worse without pilots in the cockpit ○ Pilots are not the only humans on the aircraft	○ Behaves as programmed ○ Replication of full human abilities in automation not yet possible
Pilot + Automation	
○ Interaction can lead to human error ○ Human needs the ability to turn off certain functionalities ○ Synergizing pilot and automation	

Department of Aviation Science, Saint Louis University,
ASCI 5020: Aviation Safety Data Analysis
Dr. Gajapriya Tamilselvan
May 15, 2023

Reference:

Villamizar, H. (2022, April 28). *Aloha Airlines Flight 243*. Airways. Retrieved May 1, 2023, from https://airwaysmag.com/aloha-airlines-flight-243/

Ray, J. (2013, November 1). *Human factors in avionics design*. Avionics International. Retrieved May 1, 2023, from https://www.aviationtoday.com/2013/11/01/human-factors-in-avionics-design/

Graduate Course Performance Indicator Rubric

Assess Student Learning Outcomes

Course: ASCI 5030 Aviation Security Management

Course Instructor: Terrence Kelly

Semester Taught: Spring 2022

Number of Students in Course: 4

Student Learning Outcome Assessed	Assessment Results: (Indicate what % of class achieved a minimum score of 80%)	Benchmark achieved? (Benchmark: 80% of students will score a minimum of 80% = "B")
SLO 3: Apply knowledge of the aviation field of study to address problems in broader contexts.	Precis LM 2 93.7% Precis LM 4 96.3% Precis LM 6 93.7 Precis LM 8 93.5%	Yes, all students achieved a Precis scores (average) above 80%
SLO 4: Articulate arguments or explanations to both a disciplinary or professional aviation audience and to a general audience, in both oral and written forms.	LM 1 DB 1 98% LM 1 DB 2 91.75% LM 1 DB 3 94.5% LM 1 DB 4 95.3% LM 1 DB 5 98.3% LM 1 DB 6 94.25% LM 1 DB 7 94% LM 1 DB 8 95.5%	Yes, all students achieved discussion board scores above 80%

Course Assessment (Intended Use of Results)
The following will be used for recommendations to improve the quality of course delivery based on assessment results. These recommendations may include prerequisite change; changing course outline and adding more topics; adding a third assessment; changing the course sequence, etc.

SLO 3

I am satisfied with student performance with respect to the application of aviation knowledge in the field of aviation security. Each Precis required the student to identify an article from the literature and summarize the content of the major points surrounding the publication. I plan to continue this practice moving forward. In an effort for continuous improvement, I intend to require students to identify a contemporary resource rather than some of the older articles used by (some) students this semester.

SLO 4

I am satisfied with student performance with respect to interactions and discussions on the message boards. I provide questions for each learning module. Students are required to respond to each of my questions and respond (critique) to the commentary provided by their classmates. I intend to help students develop a skillset of articulating both the strengths and weaknesses associate with a particular academic argument. As a means of continuous improvement I intend to require student to posts both strength and weaknesses with the posts made by their classmates.

Precis 1 Examples

Summary of "The Perceived Costs and Benefits that Drive the Acceptability of Risk-Based Security Screenings at Airports"

Name Redacted

Department of Aviation, Saint Louis University

ASCI 5030: Aviation Security Management

Dr. Terry Kelly

February 11, 2022

Stotz, Bearth, Ghelfi and Siegrist (2022) undertook research funded by the Federal Office of Civil Aviation (FOCA) of Switzerland to investigate perceived costs and benefits that impact the acceptability of risk-based security screening. The researchers acknowledged that one way to create a more efficient security system is to implement more risk-based screening—where all passengers would be classified as low-risk and not screened as intensely or as higher-risk and would receive more intense screening—to replace current screening methods (similar to TSA Pre-Check in the US). The team undertook this study to better learn about the perceptions of risk-based screening (and by extension, acceptability) held by the general public and to determine what factors drive acceptability of security practices. In all, findings indicated that the main drivers of the general public's acceptance of security checks are people's perception of the process–like fairness, security perception, and travel comfort–rather than individual characteristics—like confidence in security personnel. The study also found that risk-based security practices are not perceived as an adequate alternative to current security practices. Risk-based security practices are currently perceived to be both a loss of security and unfair.

Previous studies that this research builds upon indicated that a security check is accepted if the individual passenger perceives that their benefits, such as not being selected for rigorous screening, outweigh the costs, like more time and effort required or lower levels of security. Previous research has also focused on the influence that people's individual characteristics (demographics) have on their perception of security checks. Stotz et al.'s work combines perceptions of cost/benefits of security checks along with people's individual characteristics, in the end allowing investigation on the different predictors of acceptability of risk-based security checks. The researchers utilized quantitative study of data from an online survey taken by a sample population of 477 viable candidates from the German-speaking part of Switzerland. The survey collected socio-demographic information and responses about general worldviews and attitudes toward security, then information about risk-based security screening and responses for opinions of that method in comparison with traditional screening checks. Data was analyzed using linear regression models through SPSS 26 to determine which factors predicted the acceptability of risk-based security checks. Independent variables considered were demographic characteristics, cultural worldviews, perception of terrorism at airports, fear of flying, confidence in security personnel. Secondary predictors were security perception, travel comfort, fear of being stigmatized, and fairness. Among the results, the researchers found "the higher the perception of security, fairness and travel comfort in relation to risk-based security checks were to be perceived as an acceptable alternative to traditional security checks" (Stotz, et al., 2022).

Overall, this research further advances conversations about improving aviation security. The major takeaway from lessons of this study (supported by previous similar studies) is that the general public's security perception is the priority driver in acceptance of security check method. So, if the aviation security industry was to move toward more risk-based screening methods, it would have to be demonstrated (not just communicated) that risk-based security practices make the system safer—a unique challenge, given that the formula for risk cannot be publicly shared. The sample of this study was also Swiss; for applicability in other countries, a similar study would likely need to be conducted with its specific population. In the US, where aviation security has been politicized, cultural differences may influence applicability of this study's results. Another limitation is that this study was simply based on hypotheticals through an online survey. Accurately judging the general public's perception might need to involve studying people passing through a risk-based security screening in practice through lived experience. In all, this study further supported that the general public does not perceive risk-based security measures to be as effective to the current screening process, and perception of security screening's effectiveness is subjective.

References

Stotz, T., Bearth, A., Ghelfi, S. M., & Siegrist, M. (2022). The perceived costs and benefits that drive the acceptability of risk-based security screenings at airports. *Journal of Air Transport Management*, *100*, 102183.

Precis LM 4 Example

Precis II: The TSA and Solitude

Name Redacted

Saint Louis University, Parks College of Engineering, Aviation and Technology

March 13, 2022

Wilkinson introduces the article, "Whispers in the closet: Reflections on TSA and solitude" with an introduction to the working definition of *privacy.* Privacy is defined as a legal entity, "a composite of legal definitions," and a "distinct civil right" (Wilkinson, 2020, p. 145).

In doing so, Wilkinson establishes a functional definition which is contrasted to the concept of *solitude*. Solitude, itself, conjures images of remoteness or lonesomeness. Wilkinson define solitude within the boundaries of "vagueness," much like privacy, but it is an entity with a "theological and spiritual dimension" (2020, p. 145). The author notes that as society trends in a technological direction, that "both privacy and solitude may be at risk" (Wilkinson, 2020, p. 145). In introducing us to the thesis, an exploration of solitude, in the modern era, within the context of the TSA's governance of airport security, Wilkinson seeks to introduce us to a philosophical perspective on what airport security means for the individual at a personal and philosophical level. If privacy must be forsaken for security, how do we establish a boundary?

Wilkinson states, one place where the American understanding of privacy has evolved is through "ongoing negotiation has been highly visible is that of airport security checkpoints," noting the example that after 9/11, Americans chose to prioritize security over privacy (2020, p. 145). In presenting this pinnacle event that lead to the formation of the Transportation Safety Administration (TSA), Wilkinson shows us a turning point, philosophically and literally, in how American society changed to deprioritize privacy and solitude in exchange for a renewed sense of security. In this negotiation, Wilkinson offers an example, "Whether it be the now obsolete back scanners that produced near-naked images of passengers or the DHS (paid) Global Entry program, various new protocols have come into place over the years that renegotiate the line between security and privacy for airport travelers" (2020, p.145). In this example, Wilkinson demonstrates the exchange of privacy for security, giving the example of scanners that can produce naked images by "seeing through" clothing (and undergarments). The starkness of the language "near-naked images of passengers" and "new protocols" shows an un-human side of security, one where matter-of-factness, a naked body showing no weapons, and no option for privacy, are prioritized ahead of all else. “Individuals are reduced to numbers and mechanical procedures. Privacy is momentarily forfeited for the greater good” (Wilkinson, 2020, p. 146).

After going through an example where Wilkinson themselves was marked as “SSSS” on a boarding pass, indicating a security threat, requiring extra screening and physically invasive pat downs, Wilkinson ponders, “I thought to myself that there was nothing patriotic in happily accepting the government demonizing its cit- izens in the absence of due process” (2020, 147), which “begs” a good point: does the government forgo privacy, in exchange for (at least the image/appearance of) security at the expense of due process? Would are forefathers consider these “modern” procedures a constitutional violation of due process? Did the post 9/11 security-obsessed “culture” that came from it cause us to begin making legislative decisions and government “processes” out of line with our countries founding principles? Is it an anything to stop “the terrorists” mindset, but boy, we’ve started inflicting the pain on ourselves? Wilkinson speaks to these questions, “I would assume such an atti- tude to be the very opposite of patriotism, considering rule of law and due process are cherished national values,” further asking, “Had I been singled out for my non-European given name, my travel to Muslim majority countries, or my scholarship on Turkish Mus- lim thought?“ (2020, p. 147). In fact, in 2017 the American Civil Liberties Union published information, via a formal study, “criticizing the TSA Screening Passengers by Observation Techniques program as unscientific racial and religious profiling” (Wilkinson, 2020, p. 147). By presenting a study, Wilkinson puts forth the argument, with evidence, that the TSA’s security-first mindset and policies compromise privacy using unscientific methodologies and techniques. Perhaps the law has become a “license to harass,” she posits; one fueled by pseudoscience and bias, as well as, TSA agents with “unquestionable authority” (Wilkinson, 2020, p. 147).

Ultimately, Wilkinson notes that from a legal perspective, privacy is not a guarantee of the US Bill of Rights (Wilkinson, 2020, p. 148). This explicit omission has resulted in a nebulous legal status for privacy. Are private citizens not in control of their own agency and privacy? Is it not reasonable to aggressively "search" individuals in an invasive way, such as naked body scanners and invasive pat downs at the will of a TSA agent acting at the behest of terrorism-hysteria-induced policy? The nebulously legal entity of privacy has to be shrouded beneath other statutes that serve as its lynch-pin, such as fourth amendment rights, protection against unreasonable "search" and seizure, first amendment freedoms of speech and religion, the fifth amendment forbidding the denial of life, liberty, and property without due process, the "right to be left alone," as defined by judge Thomas McIntyre Cooley in 1881, and a variety of legal court cases that speak to privacy protections (Wilkinson, 2020, p. 148-149). Basically, courts decide if the government has overstepped its bounds. Does this mean thou shall overstep and overstep until stopped by the judicial branch? This process sets a dangerous precedent, one where statesman and government actors are blind to the law and our governing documents, until a judge says otherwise. Who is it that decided airports are havens to the commodification of the elimination of privacy and why? Wilkinson, through philosophy, personal example, and the law leaves us to wonder.

Reference

Wilkinson, T. R. (2020). Whispers in the closet: Reflections on TSA and solitude. *Cross Currents, 70(2), 145-158.*

Discussion Board Examples

Question 1

Today, one of the threats to aviation security is due to the geopolitical tensions arising from Europe and the Middle East. Although conflicts seem to be never ending, this can really disrupt commercial flight operations. Geopolitical tensions also further play into the threat of danger areas and no fly zones. Sometimes altitude is no guarantee of safety and certain areas may need to be circumvented, costing time and fuel. An example of this is shown by the downing of flight MH17 over Ukraine in 2014, situations on the ground can have disastrous effects on airspace in excess of 30,000 feet (wtw, 2019 (Links to an external site.)).
These regions of danger areas, no fly zones, or conflict zone areas can be extremely limiting and commercially challenging to airlines. "ICAO Annex 17 requires States to share threat information with one another. This intelligence is designed to help States protect their national interest. This by advising their air carriers, through their National Civil Aviation Authority (NCAA) about any specific risks or evolving aviation threats (Butterfly Training, 2020 (Links to an external site.))." While conflicts are always persistent, as these tensions continue to grow, the threat of these conflict zones increases as well. It is interesting to further discuss how Annex 17 plays such a large role in our commercial operations especially when geopolitical tensions are rising like they are today.
Another interesting perspective is to look at how technology plays into geopolitical tensions. "Such geopolitical disturbances impacting airspace security look likely to continue, and with the spread of technology around the world and into space, the threats may become more unpredictable (wtw, 2019 (Links to an external site.))." Increasing technology can also increase power and weaponization. In a sense, geography starts to play less of a factor since technology is a way to shrink the world and can create even more threats to the US and our commercial operations that continue to be less predictable.

References

Campos, Philippe. "Aviation Security Threats Evolving for the Forthcoming Next Decade." *Blog*, 9 July 2020, https://blog.butterfly-training.net/evolving-aviation-threats/ (Links to an external site.).
Haggman, Andreas. "Four Key Geopolitical Risks Likely to Affect Aviation Industry This Year." *Willis Towers Watson*, 8 Mar. 2019, https://www.wtwco.com/en-

US/Insights/2019/03/4-key-geopolitical-risks-likely-to-affect-aviation-industry-this-year (Links to an external site.).

Discussion Board Example 2

5. Discuss the implications of security on your research interest.

My main research interest, and what I'll be pursuing for my dissertation, surrounds early motherhood in the airlines. Specifically, the experience of mothers who are still nursing while returning to the flight deck from maternity leave. There is some crossover of that topic and aviation security, and what mostly comes to mind is about the hassles of passing through security checkpoints with breastmilk. The TSA does allow breastmilk to be passed through security, and airline pilots typically bypass that anyway with Known Crew Member screening, though.

Another interest of mine, and one that I will likely continue to explore in this course, is the psychological and emotional component of security and interacting with the security system. There are big feelings about aviation security in the US. There's a constant tension between individual privacy and national security; of those in the know, and those watching from outside the system. It's stressful to navigate, its failure could be hugely consequential, and it is often used as a political toy. Oh, and meanwhile, the threats to the system are constantly evolving and changing. Security and the issues it brings are far from a perfect science, and the learning and evolving process that is required by the system can clash with the human desire for stability and consistency.

Both of these topics are about human, lived experience, and the ways that the humans have to navigate the various realities of aviation in the present day. Aviation at large is a huge, complicated system that involves countless people working in tandem to work, and impacts each person differently. I find that fascinating.

Discussion Board Example 3

1. Discuss a few of the ethical considerations associated with secondary screening at TSA checkpoints.

Secondary screening is a standard procedure at the airport through which the TSA gets information for background checks of travelers and crew members. However, there is a privacy concern of airlines that provide passenger identification data to the federal government (Price & Forrest, 2016). Sharing personal data between agencies and institutions is a violation when the individuals have not consented to such transfers. Another ethical concern is that personal documents are used to label people as terrorist, drug smugglers or criminals even if they have not been proven guilty (The screening processes). The other ethical issue is body-search, removing shoes and luggage from the bags. Such a security check is uncomfortable and may denote a lack of respect since searches are done in public (Price & Forrest, 2016). However, most airports now have advanced technologies such as X-ray machines, which preserve the dignity of the passengers. In some cases, the screening procedure can be lengthy and time-consuming since there are at least three check-up points and people have to wait in line, which is time-consuming.

References

Price, J., & Forrest, J. (2016). *Practical aviation security: Predicting and preventing future threats*. Butterworth-Heinemann.

The screening processes. PowerPoint presentation

Discussion Board Example 3

1. Discuss a few of the ethical considerations associated with secondary screening at TSA checkpoints.

Secondary screening at TSA checkpoints is meant to provide risk-based security measures beyond the screening that all passengers receive. The nature of secondary screening not being conducted for every passenger does mean that questions of equity and fairness are raised, and the determinants for secondary screening are not always viewed as fair. By separating passengers in a checkpoint into low- and high- risk categories, the screening process introduces inequitable treatment among passengers.

One first ethical consideration is equity. It's noted that terrorism risk and aviation safety is inversely related to equity (as summarized by Nguyen, Rosoff & John, 2017). When all passengers are screened the same, perceived equity of that treatment is high, but perceived terrorism risk is also higher. When some passengers are treated differently (such as through the secondary screening process), the system may be perceived as safer by the general public, but is also viewed as less equitable. I think that that conclusion depends on whether you are the one selected for secondary screening or not, though.

Another ethical layer in security is the concept of privacy. Just as more equal treatment is perceived as the ethical "right" in the screening process, there is ethical ambiguity (read: differing opinions) on just how much privacy one person should give up to ensure a secure aviation system. The nature of secondary screening is a physical pat down of the passenger or check through their belongings, which at best can be uncomfortable/an inconvenience and at worst can be a violation of individual privacy rights. What each passenger considers to be the line from just to unjust varies between people, and even with procedures standardized through the TSA, I think people will always disagree on what is ethically correct.

Finally, there are opportunities for racial profiling or unjust selections in the secondary screening process. Secondary screening may be conducted at a TSO's discretion. Operating under the knowledge that TSOs are human and humans are biased and can select passengers for additional screening at their discretion therefore creates an opportunity for mistreatment. Behavioral profiling of passengers is utilized in the screening process, but there still exist opportunities for TSOs to allow bias to factor into their decision making. Research has shown that minorities and those with physical impairments and health conditions have been subjected to secondary screening at higher rates (Deno, et al., 2014). Dr. Kelly's example of being selected for a secondary screening, after questioning a TSO, comes to mind in this discussion. It seems to me that while there is a human decision-making process in the security system, it will always be subject to bias, and therefore, at risk of unethical activity.

References:

Nguyen, K. D., Rosoff, H., & John, R. S. (2017). Valuing equal protection in aviation security screening. Risk Analysis, 37(12), 2405-2419.

Deno, F., Diaz, C., Lliguicota, C., Norman, D., & González, R. O. (2014). TSA Screening Procedures: A Threat to Privacy. International Journal of Arts & Sciences, 7(3), 37.

Graduate Course Performance Indicator Rubric

Assess Student Learning Outcomes

Course: ASCI 5220 Aviation Safety Programs Course Instructor: ____Janice McCall____

Semester Taught: ____Fall 2021__________ Number of Students in Course: ___3___

Student Learning Outcome Assessed	Assessment Results: (Indicate what % of class achieved a minimum score of 80%)	Benchmark achieved? (Benchmark: 80% of students will score a minimum of 80% = “B”)
SLO 1: Assess relevant literature or scholarly contributions in the aviation field of study.	100%	Yes
SLO 3: Apply knowledge from the aviation field of study to address problems in broader contexts.	100%	Yes

Course Assessment (Intended Use of Results)
The following will be used for recommendations to improve the quality of course delivery based on assessment results. These recommendations may include prerequisite change; changing course outline and adding more topics; adding a third assessment; changing the course sequence, etc.

Attach description of assignment used for assessment and samples of student work.

SLO 1: Assess relevant literature or scholarly contributions in the aviation field of study.

Module 3 - Canvas Written Assignment (Paper #3):
Complete a 3-5 page paper on one of the topics listed below.

- Non-Punitive/ Voluntary Reporting Systems
- Aviation Quality Programs (FOQA)
- Just Culture

Formatting and submitting the paper

- Use the short paper format in "Course Resources."
- Follow APA 7th style by appropriately quoting, citing, and referencing sources. Writing resources are also available in the "Course Resources."
- Submit your paper by uploading it to this assignment. If you have any problems attaching the paper you may email it to jan.mccall@slu.edu prior to the due date and time.
- Due NLT midnight on 24 OCT 2021, 11:59 pm CST.

Points Possible: 100

Due Date: 24 October 2021

Notification thru: Schedule, Module Lesson Plan, Discussion, Presentation, Email, Announcement

Submission: attached as Word or PDF documents to assignment link

Guidance and resources: Module Lesson Plan, Lecture, Directed Reading of the textbook, Optional Reading of short article, Instructions/Steps to success, sample paper, weblinks SLU Graduate Writing Center and Purdue OWL APA.

Student Submission: Zoe Madigan

Note: *There may be sloght formatting differences as this document was converted from PDF.*

Aviation Quality Programs

Established in 2004 by Advisory Circular) 120-82, FOQA (Flight Operational Quality Assurance) FDM (Flight Data Monitoring) uses aggregate data provided by FAA that "will be kept confidential and the identity of reporting pilots or airlines will anonymous as allowed by law" (FAA, 2004, p. 1). The purpose of FOQA is for the FAA able to gather safety data without compromising the anonymity of any individual airlines. From this data, the FAA intended to make data analyses in order to improve safety make discoveries about incidents in order to fix and reduce them. Protections are Title 14 (14 CFR), part 193 indicating that, “Information submitted to the FAA pursuant program will be protected as ‘voluntarily submitted safety related data’” (FAA, 2004, p. 1). phrasing in the advisory was the legal basis for protections, something which would later problems: liability issues for airlines, as judges ordered to release AR (Quick Access Recorder) data during court cases, a topic discussed in more depth later in this

As described 4 CFR part 13 section 13.401, FOQA data is to be The data is to “be stripped of information that could identify the submitting airline leaving the airline premises and, regardless of submission venue” (FAA, 2004, p. 1). The placed on the airline to ensure that data is “stripped” of identifying data before it is the government, an action ɔsolves the government from the burden of responsibility of removing identifying characteristics As highlighted dvisor Circular 120-82, the “only” used in aggregative capacities and is voluntarily submitted (FAA, 2004, p. 1). voluntary safety program that the FAA and airlines use as a “proactive” tool, catching safety “trends” and issues before they become a mistake or disaster. Charlie former Air Force pilot and space shuttle pilot, speaks in an Avidyne Webinar about Precourt notes, “they aggregate the data into a big database and they look for trends” then trends are used to improve safety (2020). Being able to improve safety is a fundamental maintaining a safe and healthy aviation system. What’s more, FOQA is the first program United States that is able to algorithmically analyze the data of multiple airlines at the same to identify, for example, similarities, trends, and issues. The ability to analyze multiple data comes from the FAA being a government entity, rather than an individual airline who has to only its own

The volunteer nature of the FOQA program means that airlines choose to thus, participation is voluntary from the perspective of the government. Realistically, the may not be rom the perspective of the pilot, as he or she does not volunteer to participate. They are forced by their employer. Alas, employment with an airline is the individual’s by choosing to gain employment with a carrier on the FOQA program, that pilot elects to be of the data aggregation process. Nonetheless, the voluntary reporting of flight data could a source of mistrust for pilots who may feel that it jeopardizes their job unjustly. Pilots who employment now, after FOQA has been in place, and it is known which airlines have which don’t, may have a different perspective because they aren’t being forced into it by airline after their hire

The airlines are to supply the data with a particular data marking stating, This FOQA information is protected from disclosure under 49 U.S.C. 40123 and part 193. It be released only with the written permission of the Federal Aviation Administration Administrator for Regulation and Certification” (FAA, 2004, p. 1). With the authorization statement, the airline enters into an agreement, based off the data marking, once the data is provided to the FAA, the data is only to be released via writing, in the form "permission" from the Associate Administrator for Regulation and Certification. This action is to ensure the security and anonymity of the airlines who opt into this safety Unfortunately, there have been breeches of the anonymity. This is confusing when you that the data is to be scrubbed of identifying information before falling into the hands FAA. Nonetheless, there have been instances where information of a particular flight identified and released in the event of a mishap, such as ASAP discovery on Flight 955 in State, Colombia in 1997 in *Jaffee v. Redmond*, a case where recordings were released as common law "privilege" by a Federal District Court iami (Ali onti, 1998, p. 46).

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> "T he privilege, however, is not absolute but is a qualified privilege, which can be overcome if a plaintiff meets the burden of showing 'the importance of the inquiry forwhich the privileged information is sought; the relevance of that information to its inquiry; and the difficulty of obtaining the desired information through alternative means'" (1998, p. 47).

The finding that the anonymity of aggregated data was to be overturned, in court, did not well to the trust intrinsic, in providing anonymous data to the government. Instead, it was the database could be weaponized against the very airlines who opted in to provide data for the purposes of improved

The United States District Court of Kentucky, Central Division, upheld a similar in 2008 against Comair by Southwest Airlines, Inc. In the upheld opinion, Judge Forrester that, "Comair admitted that 'Congress did not create a statutory privilege specifically for or other voluntary safety reports'" (2008). Unfortunately, the lack of legislative protection that airline "unique" data from QARs aggregated into databases was not protected disclosure. Judge Forrester goes on to describe the scenario of legal action in the case, brief brings to mind cymbals banging together very loudly, foretelling the destruction ASAP program and unsafe skies for the public if ASAP reports are not withheld from the basis of confidentiality" (2008). The cymbals were not enough, however, to discovery of the data recorder recording information sent to the FAA for the anonymous aggregation, and they were released. The judge used a similar logic basis as arguing that need superseded

Ultimately, the pleas of the airlines to protect the flight recorder data were congress who enacted, Public Law 111-216, IRLINE SAFETY AND FEDERAL AVIATION ADMINISTRATION EXTENSION ACT OF 2010 into law on June 1, 2010. Section 214 is entitled, SEC. 214. ASAP AND FOQA IMPLEMENTATION PLAN, w speaks to plans to improve the program, such as accessibility for smaller fleet airlines and carriers and inspectors can better utilize the data (111th Congress, 2010, p. 2366). These were to improve quality and quick data implementation of the ASAP and FOQA programs carriers. Section 213, VOLUNTARY SAFETY PROGRAMS, likely formed the regulatory for the FAA to work with carriers on better protecting the program, as it held the accountable to feedback from the airlines. It required the FAA to submit a report Committee on Transportation and Infrastructure information on, "if an air carrier is using more of the voluntary safety programs, an explanation of the benefits and challenges of each such program" (111th Congress, 2010, p. 2365). The changes achieved in this act protections for the airlines to utilize voluntary safety programs with less fear of retribution. program continues to this day, with 57 voluntary participants (FAA, 2021) and fewer court case rulings against airlines who volunteer to share aggregated, anonymized safety

References

111th Congress. *IRLINE SAFETY AND FEDERAL AVIATION ADMINISTRATION EXTENSION ACT OF 2010.* https://www.congress.gov/111/plaws/publ216/PL 111publ21

Alimonti, F. (1998). *Recent Developments in Aviation Liability Law.* https://scholar.smu.edu/cgi/viewcontent.cgi?article=1497&context

FAA. (2004). Flight Operational Quality Assurance. *Advisory Circular, No: 120-82.* https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_120-

FAA. (2021). *FOQA Participants as of 02/23/2021*. https://www.faa.gov/about/office_org/headquarters_offices/avs/offices/afx/afs/afs20 280/descriptions/media/FOQA_Participant

Forester, K. (2008). 545 F. Supp. 2d 618. In re AIR CRASH AT LEXINGTON, AUGUST 27, 2006. Relating to: All Cases. *United States District Court, E.D. Kentucky, Central Division.* https://www.courtlistener.com/opinion/2446067/in-re-air-crash-lexington-ky-august-27-

Scaled Analytics. (2018). *FOQA and Flight Data Monitoring Series Part 3: Analyzing the Data.* https://scaledanalytics.com/2018/06/23/foqa-flight-data-monitoring-series-analyzing-flight-

SLO 3: Apply knowledge from the aviation field of study to address problems in broader contexts.

Module 10 - Canvas Discussion Board Assignment: Provide an example of how employees adapt to working conditions as discussed in the Safety II literature.

Points Possible: 10

Due Date: 13 December 2021

Notification thru: Schedule, Module Lesson Plan, Discussion, Presentation, Email, Announcement

Submission: attached as Word or PDF documents to assignment link

Guidance and resources: Module Lesson Plan, Lecture, Directed Reading of the textbook, Optional Reading of short article, Instructions/Steps to success.

Student Submission: [redacted]

The White Paper From Safety I to Safety II discusses "some new practices to look for what goes right, focus on frequent events, remain sensitive to the possibility of failure, to be thorough as well as efficient, and to view an investment in safety as an investment in productivity" (Eurocontrol, 2013, p.3). This highlights some of the overarching principles that employees should look for when transitioning to a Safety II mindset. A specific example from the literature is when the Prague Airport increased significantly in size several proactive Safety II-inspired measures were taken, such as new traffic control measures, a new runway to reduce incursions, and new hydrant fuel distributions systems. All of these measures led to continued growth in traffic with a better safety track record than previous years (Kurzweil & Rehor, 2018).

Graduate Course Assessment Form

Assess Student Learning Outcomes

Course : ASCI 5470-01 Quantitative Data Analysis Semester
Taught: Spring 2022
Number of Students in Course: 5

Student Learning Outcome Assessed	Assessment Results: (Indicate what % of class achieved a minimum score of 80%)	Benchmark achieved? (Benchmark: 80% of students will score a minimum of 80% = "B")
2. Apply the major practices, theories or research methodologies in the aviation field of study.	SPSS 1 – 98%; SPSS 2 – 99%; SPSS 5 – 95%; MLR Design – 100%: AVG = 98%	Elements of Assessment (SPSS Assignments & MLR Design) yielded 98% and exceed the desired benchmark of 80%.
5. Evidence of scholarly and/or professional integrity in the aviation field of study.	SPSS 1 – 98%; SPSS 2 – 99%; SPSS 5 – 95%; MLR Design – 100%: AVG = 98%	Elements of Assessment (SPSS Assignments & MLR Design) yielded 98% and exceed the desired benchmark of 80%.

Course Assessment (Intended Use of Results)
The following will be used for recommendations to improve the quality of course delivery based on assessment results. These recommendations may include prerequisite change; changing course outline and adding more topics; adding a third assessment; changing the course sequence, etc.

The assessment of student learning outcomes (2,5) – met the benchmark of 80%, where the students presented their scholarly and/or professional integrity on different aspects: statistical research design, using statistical software to analyze aviation/aerospace data, interpreting statistical data from their own research studies, exploring published research findings, interpreting published research findings, and presenting the research findings in APA format. Specific elements of assessment include Frequency Distribution (SPSS 1), Measures of Central Tendency (SPSS 2), Pearson Correlation (SPSS 5), and Linear Multiple Regression (LMR) design. Practice assignments were given during the course delivery: independent *t* test (SPSS 3), and Analysis of Variance (ANOVA – SPSS 4). For the upcoming semesters, the same elements of assessment "SPSS Assignments & MLR Design" will be used and more participation from the students will be encouraged.

**Attach description of assignment used for assessment and samples of student work.*

Investigating Correlation Between Distance Flown and Fare

Saint Louis University

Introduction

Flight distance is a major factor in how much it costs an airline to fly a given route. As flight distance increases air traffic control fees increase and more importantly fuel consumption increases. Ideally airlines would be able to increase fares as distance increases to counteract the increased costs. However competition often prevents airlines from pricing routes in a manner that directly reflects the cost to fly the routes. For example, fares in the 4th quarter of 2019 between New York and Los Angeles, a 2500 mile flight, averaged $382 (Keizer, 2022) while the much shorter route Charlotte to Myrtle Beach averaged $350 despite only being a 157 mile flight (Keizer, 2022b). Greater competition on the New York to Los Angeles route prevented airlines from raising prices to combat the increased fuel cost as the only charged $0.15/mile flown compared to $2.22/mile flown they charged on the Myrtle beach route.

This research examines the 100 most-flown routes (pre-COVID-19 pandemic) to determine the strength of the correlation between distance flown and average fare. This will give insight into airline pricing models and identify if competition is intense enough on the top 100 routes to remove flight distance as a major factor in influencing price.

Data Source

The Bureau of Transportation Statistics is an organization of the United States government that tracks various air travel statistics such as delays, lost baggage and fares. For fares they have recorded the average fare on the 1,000 most-popular routes (as determined by passenger count) in the contiguous United States every quarter since 1996. This information is stored in Table 1 – Top 1,000 Contiguous State City-Pair Markets of their *Consumer Airfare Report* (Keizer, 2022). For this research only data from the 4th quarter of 2019 was used as that was the last quarter of normal air traffic operations before the COVID-19 pandemic. Along with fares (*fare*) the table also contains the non-stop miles between the city-pair (*nsmiles*), number of daily passengers on the route (*passengers*) – though not necessarily non-stop, as well as other variables that weren't used in this research. *Passengers* was used to limit the data set to the top 100 most-popular routes which ranged from 2,330 to 23,884 passengers. The data set was limited to the top 100 routes to eliminate some of the effects of demand on airline pricing. The original data included routes that had only ~200 passengers a day (less than the equivalent of 2 737s a day) which is two orders of magnitude different from the most popular routes that had 10,000+ passengers a day (50+ 737s). By limiting the data to the 100 most-popular routes this research is comparing routes that all have sufficient demand for multiple airline to compete on that city pair which lessens the effects of the confounding demand variable (i.e. if there are 2300+ passengers a day that is enough demand for multiple airlines to offer multiple flights a day). *Nsmiles* served as the independent variable in this research and *fare* served as the dependent variable. Both *nsmiles* and *fares* are continuous quantitative variables as both can be any value not just specific values or integers (although *nsmiles* is rounded to whole integers and *fares* are rounded to the nearest cent). For visualization purposes an additional variable price-per-mile (*PPM*) was created by dividing each *fare* by its corresponding *nsmiles* value. This variable, while not valuable in determining if there is positive correlation between *nsmiles* and *fare*, allows the variability of the interaction between *nsmiles* and *fare* to be visualized in a frequency distribution as it enables the interaction to be more easily grouped (data is initially ungrouped).

Research Question

On airline routes between city-pairs in the contiguous United States with sufficient demand for there to be multiple airlines with multiple flights daily between the pair, does the average fare (USD) between the two cities positively correlate with the distance (miles) between the two cities?

Data Analysis

SPSS was used to perform the data analysis and the modified "Table 1 – Top 1,000 Contiguous State City-Pair Markets" data containing only the 100 most-popular flights was imported to the software. First, a table of descriptive statistics containing the count, mean, minimum, maximum and standard deviation for *nsmiles*, *fare* and *PPM* was created (Table 1). Second, histograms showing the distributions of *nsmiles*, *fare* and *PPM* were created (Figures 1-3). Third in order to visualization the correlation (or lack thereof) between *nsmiles* and *fare* a scatter plot was created and a trendline was added along with the R^2 value (Figure 4). Finally the Pearson Correlation between *nsmiles* and *fare* was calculated along with its significance level (Table 2).

Discussion

SPSS's descriptive statistics output for *nsmiles*, *fare* and *PPM* (Table 1) showed that no data was missing from the three variables. It also displayed that there was a wide range for each variable (2495 miles for *nsmiles,* $265.75 for *fare* and $0.797/mile for *PPM*).

Table 1. Descriptive statistics output from SPSS for *nsmiles*, *fare* and *PPM.*

	N	Minimum	Maximum	Mean	Std. Deviation
nsmiles	100	209	2704	1120.69	642.852
fare	100	121.55	387.30	208.0985	57.06799
PPM	100	.113914209115282	.911100478468899	.238261580931875	.145889279527713
Valid N (listwise)	100				

Figures 1-3 helped visualize the distribution of the data within those ranges and it was shown that each variable was positively skewed. The variability in *PPM* (Figure 1) is particularly interesting as that directly relates distance flown to fare. If the relationship between distance flown and fare was perfectly linear then the frequency graph would be a single bar (in that scenario the airlines would be charging a fixed amount per mile flown no matter the route). However, the graph shows that there is a wide range of *PPM*s which indicates that the fare per mile flown is dependent on the route. The positive skew does indicate that the overall data might be somewhat linear as the majority of values are concentrated around $0.20/mile with a few routes that the airlines are able to charge much more a mile (3 routes at $0.80/mile or greater).

Figures 2 and 3 don't add much additional value beyond Figure 1 towards determining if there is a positive correlation between *nsmiles* and *fare* as they simply show the distribution of route distances and fare (they are both positively skewed as expected from Figure 1).

CORRELATION BETWEEN DISTANCE AND FARE

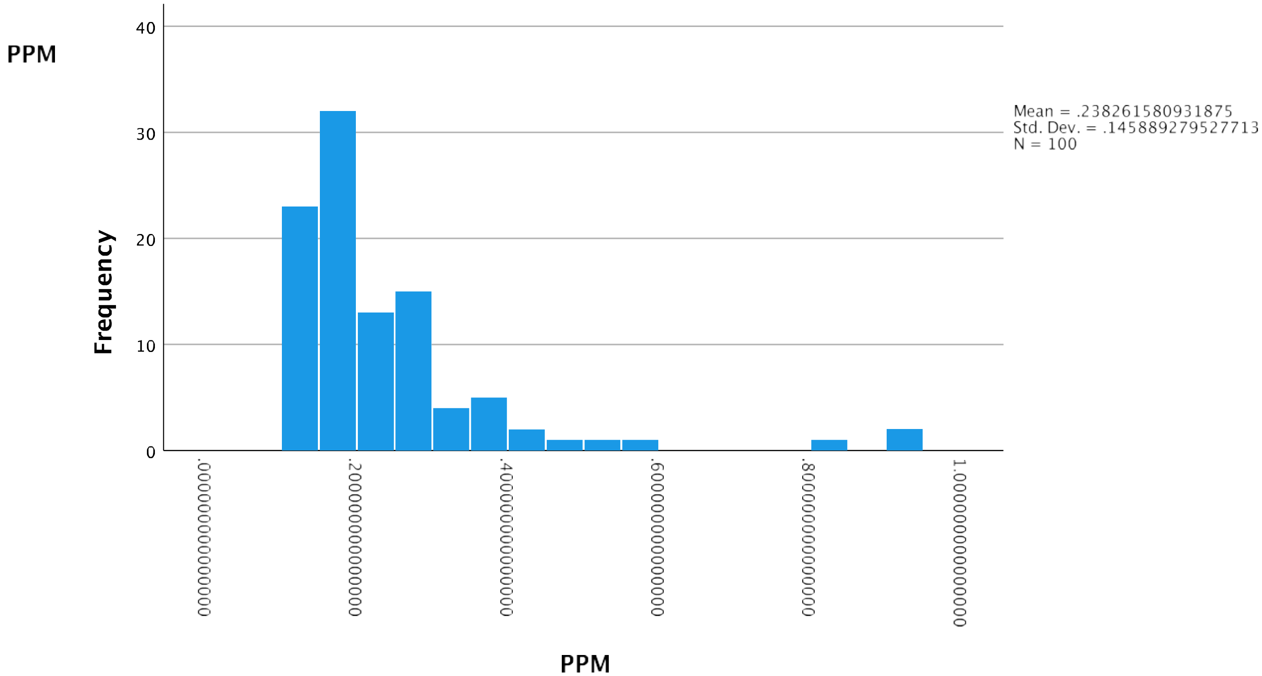


Figure 1. A histogram displaying the frequency of price-per-mile (*PPM*) which indicates how much an airline charged for each mile flown.

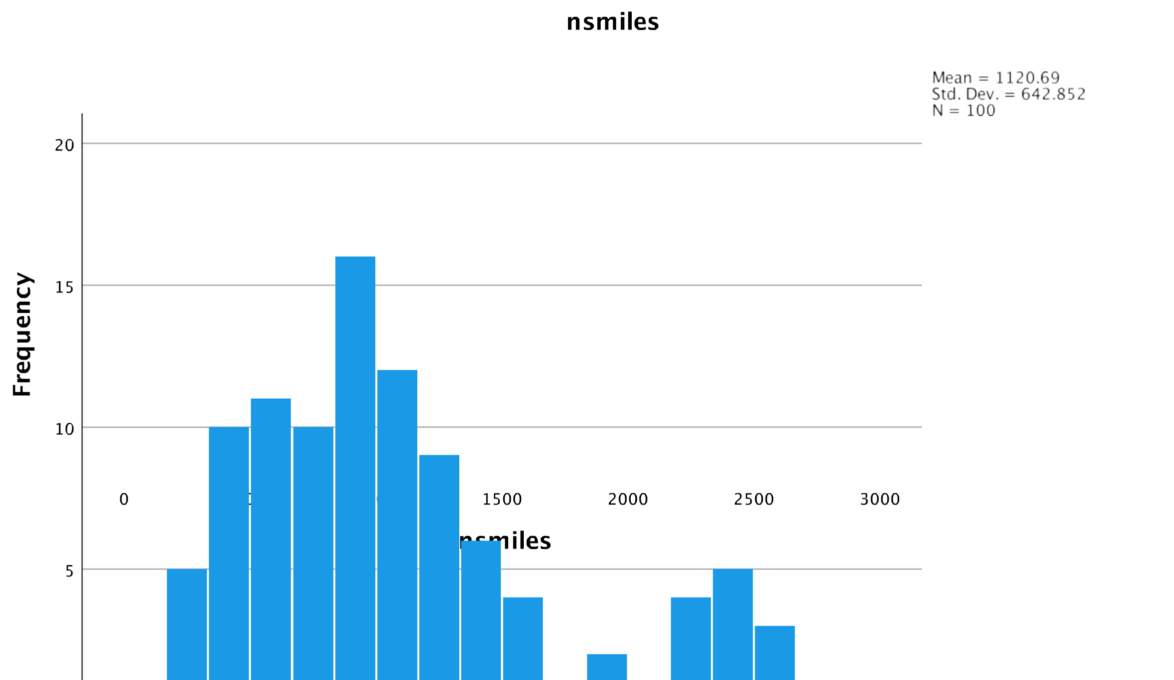


Figure 2. A histogram displaying the non-stop distance of each route in miles (*nsmiles*).

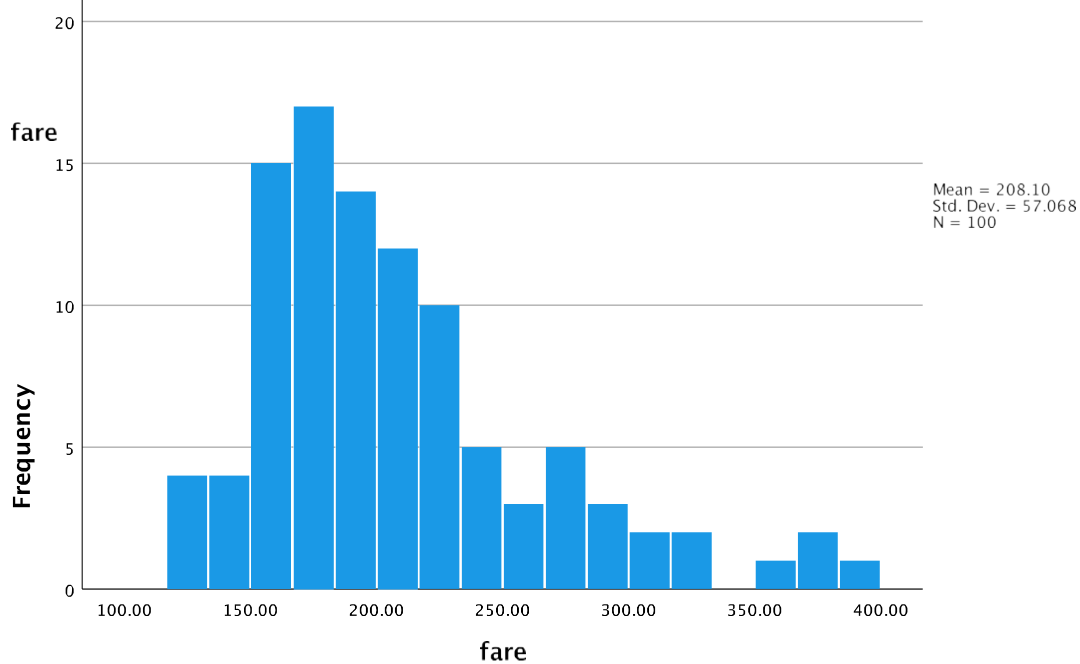


Figure 3. A histogram of the average fare for each route (*fare*).

The relationship between *nsmiles* and *fare* is visualized in Figure 4 and displays a significant positive correlation between the variables (R^2=0.756). Once it was determined that the variables were positively correlated, the Pearson Correlation test was used to determine if that correlation was statistically significant (Table 2). The Pearson Correlation test indicated that the strong positive correlation *nsmiles* and *fare* (r=.870) was statistically significant at the 1% level.

CORRELATION BETWEEN DISTANCE AND FARE

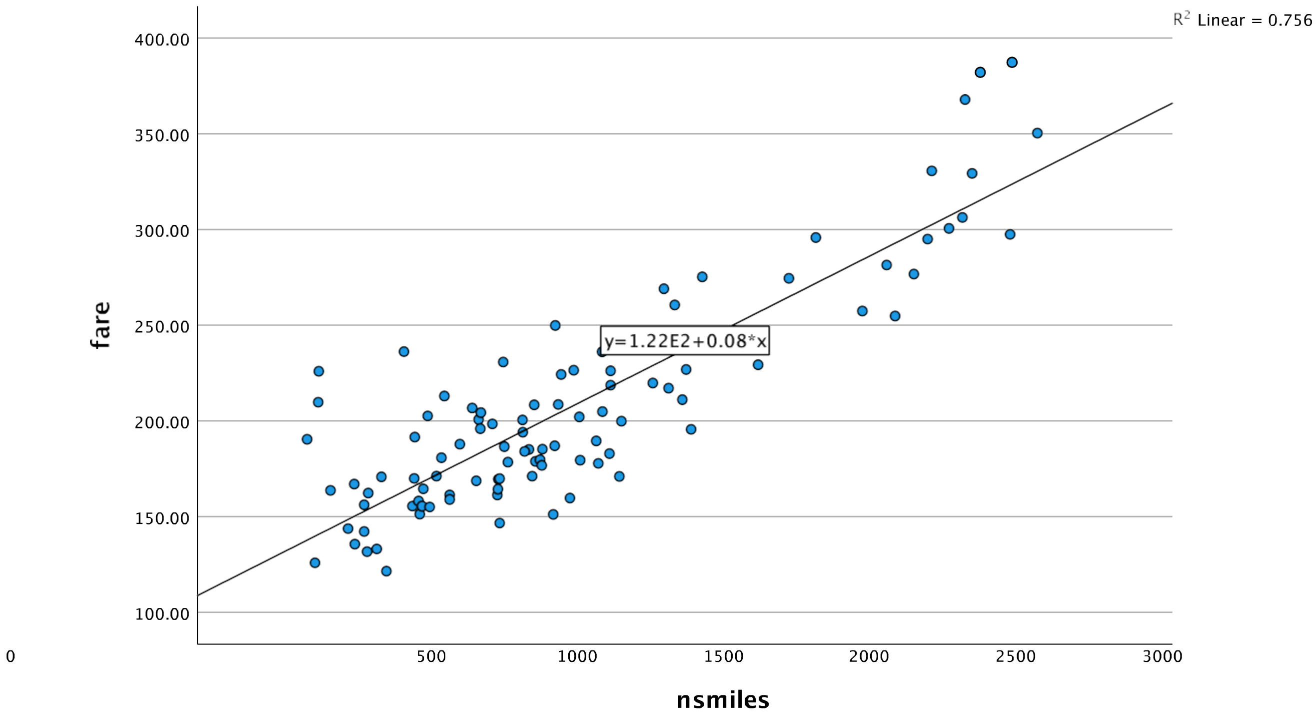


Figure 4. A scatter plot of *nsmiles* vs. *fare* displaying a strong positive correlation between the variables of R^2 = 0.756.

Table 2. SPSS tabular output of the Pearson Correlation test between *nsmiles* and *fare*. The correlation was found to be statistically significant at the 1% level.

		fare	nsmiles
fare	Pearson Correlation	1	.870**
	Sig. (2-tailed)		<.001
	N	100	100
nsmiles	Pearson Correlation	.870**	1
	Sig. (2-tailed)	<.001	
	N	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

Conclusion

The results indicate that there is a significant positive correlation between miles flown (*nsmiles*) and fare (*fare*) on the 100 most-popular airline routes in the contiguous United States. This may indicate that there is a minimum fare/mile flown that airlines are willing to price their flights at in competitive markets (likely around the breakeven point in profitably for those markets).

Higher fares per mile flown in these competitive routes are likely not possible due the competition between airlines for market share which drives to prices to attract more customers to a given airline (and positively skews *PPM*). However, competition will not continuously drive prices lower than what is profitable for the airlines which is likely why the minimum *PPM* is around \$0.114/mile flown which is around the cost per available seat mile (CASM) airlines in the United States which was \$0.115 in 2017(Stalnaker, Alport, Buchanan, & Taylor, 2019). The few routes that are priced much higher than the mean *PPM* (\$0.80+/mile vs. \$0.283/mile) are likely on short popular routes that a single airline has high market share on (ex. a flight from a fortress hub to a mid-sized city). This research is currently limited by only using distance flown as a predictor of fare which can hide the more complex influences on airline revenue management as discussed above. Future research into the influence of distance flown on fare should account for airline market share, number of airlines serving route and differentiation between connecting traffic and non-stop flights.

References

Keizer, R. (2022, January 12). *Consumer Airfare Report: Table 1 - top 1,000 contiguous state city-pair markets: Department of Transportation - Data Portal*. Transportation.gov.
Retrieved February 26, 2022, from https://data.transportation.gov/Aviation/Consumer- Airfare-Report-Table-1-Top-1-000-Contiguo/4f3n-jbg2

Keizer, R. (2022, January 12). *Consumer Airfare Report: Table 6 - contiguous state city-pair markets that average at least 10 passengers per day: Department of Transportation - Data Portal*. Transportation.gov. Retrieved February 26, 2022, from https://data.transportation.gov/Aviation/Consumer-Airfare-Report-Table-6-Contiguous- State-C/yj5y-b2ir

Stalnaker, T., Alport, G., Buchanan, A., & Taylor, A. (2019). (rep.). *Airline Economic Analysis*.
Oliver Wyman. Retrieved February 25, 2022, from https://www.oliverwyman.com/content/dam/oliver-wyman/v2/publications/2019/apr/APRIL262019_Airline_Economic_Analysis_2018- 2019vFweb.pdf.

SPSS Assignment 1

Evaluating the Impact of Augmented/Virtual Reality Training in Student Pilots Achieving Instrument Proficiency

Parks College, Saint Louis University AVIA 5470, Quantitative Data Analysis Professor Tamilselvan

SPSS assignment, due 25 February 2022

Evaluating the Impact of Augmented/Virtual Reality Training in Student Pilots Achieving Instrument Proficiency

The advances of Virtual Reality (VR) and Augmented Reality (AR) in aviation simulation have allowed training quality to increase and cost to decrease exponentially in recent years (Coleman & Thirtyacre, 2021). However, it is still a new and emerging technology, requiring many more studies and analysis to verify and document its potential impact in helping pilots train and increase in proficiency at a more rapid pace.

US Air Force Pilot Training is starting to incorporate AR and VR into their pilot training in an effort to decrease both cost and time required to train. In an effort to understand and evaluate the impact that AR/VR training can have in student pilot training, a snapshot is studied with the goal of ascertaining what level of benefit this additional training could have. In addition to flights, student pilots receive training in Aircraft Training Devices (ATD), or simulators. It is in these ATD that the AR/VR headsets are used to enhance training, not in the actual aircraft. The theory is that this additional training speeds up the process of learning in the aircraft. The entire pilot training syllabus is comprised of several different phases of training. In an effort to narrow down the scope of this research, only the instrument phase of training will be investigated. Proficiency is defined as achieving a grade of 4+ on a scale of 1-5, and a student pilot has 8 flights to achieve this proficiency before proceeding to the checkride (AETC, 2021).

Method of Analysis

Research Question

Did AR/VR training reduce the number of flights required for student pilots to achieve proficiency in the instrument phase of training, and if so, by how much?

Data Collection

As no websites have this information or data, and the author has not had a chance to procure the permission required by USAF to collect this data from pilot training bases, a dataset was constructed in Excel using the RANDBETWEEN function. Eight flights were listed, but the function was setup to randomly pull from flights number four through eight, as it was assumed based on the author's experience that no students achieved proficiency on the first three flights. The data was then transferred from Excel to SPSS in order to conduct analysis.

Data Analysis

The data used is grouped and discrete as it is round, defined numbers that represent the number of flight in which a minimum grade of four out of five was achieved. It is also very clearly quantitative in nature. Descriptive statistical analysis is performed using frequency analysis to compare the 12 students who had AR/VR training to the other 12 students from the class who did not receive that same training.

The data is presented using frequency analysis to display as histograms with a normal curve to help visualize the number of flights required for each student to achieve proficiency level of 4+. Table 1 is included to show the data used for this study. Two different figures are used to compare the half of the class that received the additional AR/VR training to the other half that did not receive the additional training.

Results

Summary and Conclusion

When reviewing the results of the students without AR/VR training, the mean was 6.42 flights when the students achieved the required proficiency. Upon comparing this to the mean of the students who did receive the additional training, which was 6.08, it is clear that the research shows a small advantage in favor of those with the additional training, 0.34 flights to be exact. A limitation to this study is the small sample size, which would limit the statistical significance of the study. However, a solid case can be made to further investigate the impact of AR/VR training in pilot training, as it can reduce flying hours required which can save significant costs, and increase pilot proficiency at a more rapid rate.

Tables

Table 1. List of students flight # on which proficiency achieved.

Student	AR/VR training	# of flight (achieved proficiency)
1	Y	5
2	Y	4
3	N	4
4	Y	5
5	N	6
6	Y	6
7	N	5
8	Y	8
9	N	8
10	N	7
11	Y	4
12	N	6
13	N	6
14	N	8
15	Y	7
16	Y	6
17	N	5
18	N	8
19	Y	8
20	N	5
21	Y	5
22	N	5
23	Y	8
24	N	6

Figures

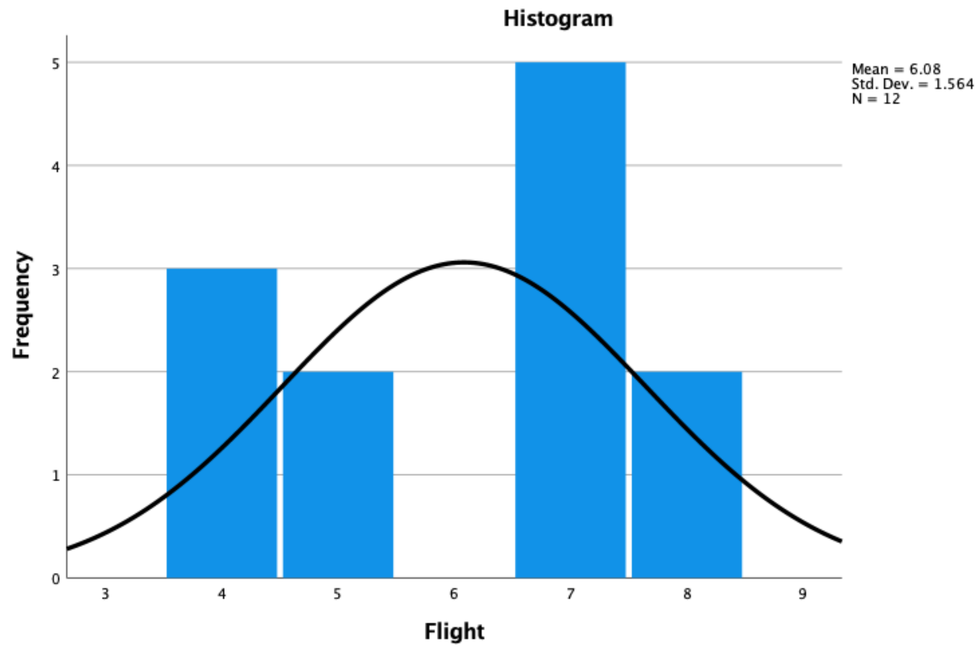


Figure 1. Total flights required to achieve proficiency for sample with AR/VR trainin

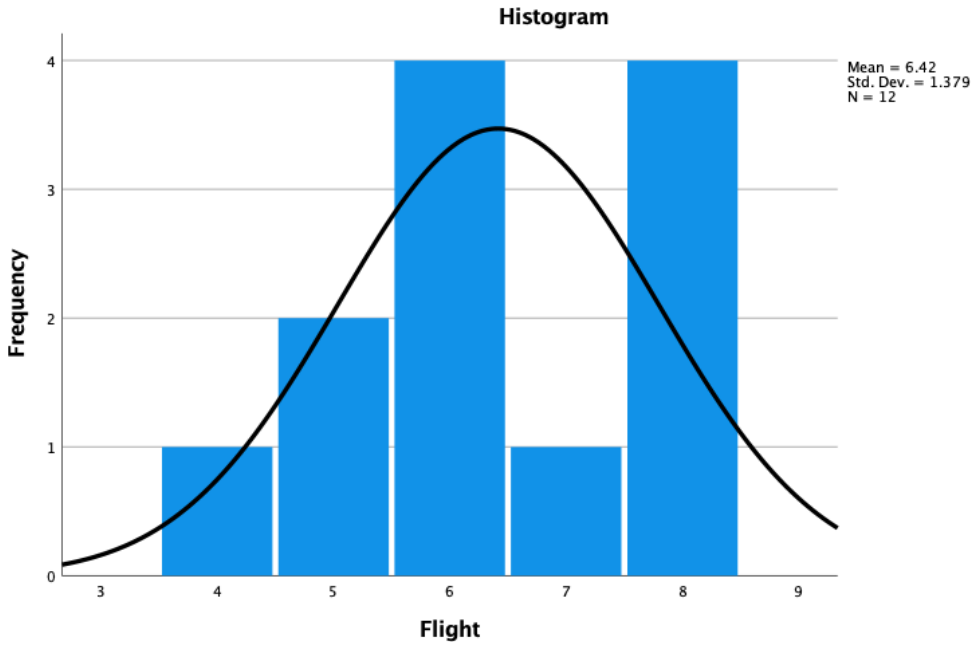


Figure 2. Total flights required to achieve proficiency for sample without AR/VR training

References

Air Education Training Command (AETC) (2021). AETC / ENJJPT Syllabus P-V4A-N (T-6) https://community.apan.org/cfs-file/ key/docpreview-s/00-00-19-62-50/AETC-ENJJPT-Syllabus-P_2D00_V4A_2D00_N-_2800_T_2D00_6_2900_-APR-21-POST-TQRB.pdf

Coleman, J., & Thirtyacre, D. (2021). Remote pilot situational awareness with augmented reality glasses: An observational field study. *International Journal of Aviation, Aeronautics and Aerospace, 8*(1), 3. https://ezp.slu.edu/login?url=https://www-proquest-com.ezp.slu.edu/scholarly-journals/remote-pilot-situational-awareness-with-augmented/docview/2488140980/se-2?accountid=8065

Influence of Origin Airport on Airfare at Large Airports

Saint Louis University

Introduction

There are several thousand commercial airports in the United States and prices to fly from these airports vary significantly. The fare for a route originating from a given airport is driven by both passenger demand and the supply of airlines' seats. Factors affecting each include the size of the city, season, number of competing airlines, and number of available non-stop destinations. For example JFK airport in New York City usually offers cheaper fares to many cities than a small airport like Peoria, Illinois. This is because JFK has many competing airlines (due to the large passenger demand) that fly to almost every city in the US with multiple frequencies which gives passengers more opportunities to influence price by flying a different airline or at an off-peak time. In contrast passengers flying from Peoria, Illinois have little ability to influence price as there are only a handful of flights a day to major cities on select airlines which means that passengers are largely forced to pay whatever the airline is charging for each route.

This research examines if large airports in the United States (defined for the purpose of this research as 1M+ originating passengers in 3Q 2021) have similar average fares as they all offer flights to many cities on many airlines at multiple frequencies a day. The aim is to provide insight into airlines' control over pricing at heavily competed large airports and passengers' willingness to pay high fares at those airports.

Data Source

The Bureau of Transportation Statistics is an organization of the United States government that tracks various air travel statistics such as delays, lost baggage and fares. Included in their database is the average fare paid by originating passengers at each airport grouped by airport size. For this research, only airports with over 1 million originating passengers in the 3rd quarter of 2021 were used. The 1 million passenger cutoff was selected to eliminate smaller airports with less gross passenger demand and fewer airlines competing for passengers. The 3rd quarter of 2021 was chosen as that was the latest available data and only a quarter was chosen as the Bureau doesn't publicly release the annual statistics for this data. Three data sets were collected from the Bureau to reflect all airports that met the 1 million originating passengers cutoff. They were: "Table 7.Fares at Airports with 2,000,000+ Originating Passengers 3rd Quarter 2021", "Table 8. Fares at Airports with 1.5M-1.99M Originating Passengers 3rd Quarter 2021", and "Table 9. Fares at Airports with 1M-1.49M Originating Passengers 3rd Quarter 2021" (United States Department of Transportation). A fourth data set was created by combining those three data sets to encompass all airports that served 1 million or more originating passengers in the 3rd quarter 2021. Each data set had the following columns: *Passenger Rank*, *Origin*, *3rd Quarter 2021 ($)*, and *3rd Quarter 2021 Originating Passengers*. *Passenger Rank* was dropped as it was simply a marker of the order of the airport by passenger count (i.e. second largest airport was "2") and summary statistics of it would not be illuminating. *Origin* was kept as it represented which airport the data was for. *3rd Quarter 2021 ($)* is the average fare in USD paid by originating passengers at the origin airport in the 3rd quarter of 2021, regardless of if the trip was one-way, round-trip, first class, or economy. *3rd Quarter 2021 Originating Passengers* is the number of passengers originating from the airport in the 3rd quarter of 2021 and was not included in the analysis aside from being used to identify which airports had over 1 million originating passengers.

Operational Definitions

For this research *Origin* serves as the independent variable as the research is aiming to observe the effect of the originating airport on average fare of an airport with over 1 million originating passengers in the 3rd quarter of 2021. The dependent variable is *3rd Quarter 2021 ($)* which is used to measure the effect of the originating airport on the average fare at airports with 1 million or more originating passengers in the 3rd quarter of 2021.

Research Question

For airports with over 1 million originating passengers in the 3rd quarter of 2021, did the originating airport have a significant effect on the average fare paid by those passengers?

Data Analysis

SPSS was used to perform the data analysis. Each of the four data sets were imported into SPSS for the purpose of gathering descriptive statistics. SPSS's Descriptive Statistics tool was used to calculate/record the N Statistic, Range Statistic, Minimum Statistic, Maximum Statistic, Sum Statistic, Mean Statistic, Standard Error, Standard Deviation Statistic, and Variance Statistic.

Each table of statistics was saved and will be presented in the Discussion section of this report.

Discussion

The results for "Table 7.Fares at Airports with 2,000,000+ Originating Passengers 3rd Quarter 2021" were examined first as it was expected that those fares were the most likely to be similar across airports as the passenger demand and airline supply/competition were the highest at those airports (Table 1).

Table 1. Descriptive statistics output from SPSS for airports with over 2 million originating passengers in the 3rd quarter of 2021.

	N	Range	Minimum	Maximum	Sum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
3rd Quarter 2021 ($)	5	61.4678310	269.196203	330.664034	1507.82261	301.564521	10.3189988	23.0739827	532.409
Valid N (listwise)	5								

In the 3rd quarter of 2021 there were five airports that had over 2 million originating passengers, they were (in order of passenger count): Los Angeles, Chicago, Denver, Atlanta and Seattle. The mean fare at these airports was $301.56 (SD=$23.07) and the average fare at a given airport ranged from $269.20 (Denver) to $330.66 (Los Angeles). The minimum and maximum indicate that the average fare at each of the five airports was within 2 standard deviations (+/- $46.14) of the mean.

Table 2. Descriptive statistics output from SPSS for airports with between 1.5 and 1.99 million originating passengers in the 3rd quarter of 2021.

Descriptive Statistics

	N	Range	Minimum	Maximum	Sum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
3rd Quarter 2021 ($)	8	175.463917	223.659458	399.123375	2532.44046	316.555057	21.8474919	61.7940388	3818.503
Valid N (listwise)	8								

There were eight airports in the 3rd quarter of 2021 that had between 1.5 and 1.99 million originating passengers. They were (in order of passenger count): Newark, Dallas-Fort Worth, Boston, Orlando, Phoenix, New York JFK, San Francisco, and Las Vegas. The average fares at these airports for originating passengers ranged from $223 (Orlando) to $399 (San Francisco) with a mean of $316.56 (SD=$21.85). This range of $175.46 is almost triple the size of the range for those airports with over 2 million originating passengers ($175.46 vs. $61.47). The standard deviation was also much greater at $61.79 compared to $23.07. The increased range and variability of fares in airports with 1.5 to 1.99 million originating passengers reflects the increased variety of airports in this range. Instead of only business-oriented hub airports as seen in the 2 million passenger airports, this set of airports included tourist destinations such as

Orlando (average fare = $223) and Las Vegas (average fare = $233) which have a lot of low-cost carriers competing for customers and aiming to incentivize travelers with lower fares. The lower prices of leisure-oriented airports also reflects the greater price sensitivity of leisure travelers compared to business travelers. At the higher end of this range where business-oriented airports San Francisco (average fare = $399) and New York JFK (average fare = $362) that sell more premium seats and serve price-insensitive business traffic.

Table 3. Descriptive statistics output from SPSS for airports with between 1 and 1.49 million originating passengers in the 3rd quarter of 2021.

Descriptive Statistics

	N	Range	Minimum	Maximum	Sum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
3rd Quarter 2021 ($)	12	123.920810	218.657833	342.578643	3604.82304	300.401920	10.6881256	37.0247532	1370.832
Valid N (listwise)	12								

Twelve airports served between 1 and 1.49 million originating passengers in the 3rd quarter of 2021. They were (in order of passenger size): Philadelphia, Houston Bush, Minneapolis/St. Paul, New York LaGuardia, San Diego, Detroit, Ft. Lauderdale, Baltimore, Tampa, Austin, Portland and Miami. The average fares for these airports ranged from $218.66 (Ft. Lauderdale) to

$342.58 (Portland) with a mean of $300.40 (SD=$37.02). Again we see a leisure-oriented destination as the lowest average fare likely due to the same reasons listed for airports between

1.5 and 1.99 million originating passengers. Portland having the highest average fare is likely due to it being a less popular leisure destination that is not served by many competing airlines. Delta and Alaska Airlines dominate the market share at Portland and are able to use that market share dominance to keep air fares high. It is interesting that despite there being more airports in the 1-1.49 million passenger range than the 1.5-1.99 million passenger range that this range had a smaller range. This is likely due to none of these airports being one of the United States' largest business markets rather they include secondary business markets which often have lower premium seat demand and a greater number of leisure travelers. This appears to make these airports price below the very busy business-oriented airports which results in a smaller average fare range between the airports in the 1-1.49 million passenger range.

Table 4. Descriptive statistics output from SPSS for airports with greater than 1 million originating passengers in the 3rd quarter of 2021.

Descriptive Statistics

	N	Range	Minimum	Maximum	Sum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
3rd Quarter 2021 ($)	25	180.465542	218.657833	399.123375	7645.08610	305.803444	8.68936616	43.4468308	1887.627
Valid N (listwise)	25								

Combining the data for all airports with over 1 million passengers results in a data set of 25 airports that have average fares ranging from $218.66 (Ft. Lauderdale) to $399.12 (San Francisco) for a range of $180.47. The mean fare across these airports was $305.80 (SD=$43.44). It is interesting to note that the range and the standard deviation was the smallest for the airports with over 2 million originating passengers which reflects the idea stated in the introduction that airports with the most passengers and airlines competing would have similar average fares due to the balancing of passenger demand with airline supply.

Conclusion

The results in Table 4 indicate that the originating airport is an influential factor in the average fare for airports with over 1 million originating passengers in the 3rd quarter of 2021. Average fares were more similar for the busiest 5 airports in the United States that had over 2 million originating passengers in the 3rd quarter of 2021, this could indicate that with enough passenger demand and competing airlines, fares at very large airports start to settle around a common average fare. At airports with 1 to 1.99 million passengers there was greater variance in mean fares as large leisure-oriented airports appeared in that range while some major business-oriented airports remained. Competition between low-cost airlines and greater elasticity in passenger demand at large leisure-oriented airports caused their fares to be significantly lower than fares at large business-oriented airports.

References

United States Department of Transportation. (n.d.). *Table 7. fares at airports with 2,000,000+ originating passengers 3rd quarter 2021*. Bureau of Transportation Statistics. Retrieved March 21, 2022, from https://www.bts.gov/topics/airlines-and-airports/table-7-fares- airports-2000000-originating-passengers-3rd-quarter-2021

United States Department of Transportation. (n.d.). *Table 8. fares at airports with 1.5m-1.99m originating passengers 3rd quarter 2021*. Bureau of Transportation Statistics. Retrieved March 21, 2022, from https://www.bts.gov/topics/airlines-and-airports/table-8-fares- airports-15m-199m-originating-passengers-3rd-quarter

United States Department of Transportation. (n.d.). *Table 9. fares at airports with 1M-1.49m originating passengers 3rd quarter 2021*. Bureau of Transportation Statistics. Retrieved March 22, 2022, from https://www.bts.gov/topics/airlines-and-airports/table-9-fares- airports-1m-149m-originating-passengers-3rd-quarter-2021

SPSS Assignment 2

Analyzing differences in student pilots who receive additional augmented reality training to those who do not receive that training

Parks College, Saint Louis University AVIA 5470, Quantitative Data Analysis Professor Tamilselvan

SPSS assignment 2, due 21 March 2022

Analyzing differences in student pilots who receive additional augmented reality training to those who do not receive that training

As technology advances, so do training environments, as they are both so intertwined.

Augmented and Virtual Reality, especially in the aviation training environment, have the potential to increase speed of learning and proficiency for student pilots (Coleman & Thirtyacre, 2021). This capability is being implemented by the U.S. Air Force at Vance AFB in Joint Specialized Undergraduate Pilot Training 2.5. The simulators, called Aviation Training Devices (ATD), were configured to work with new Augmented Reality goggles in order to help students learn tasks hopefully at a quicker pace and higher proficiency than with just the ATD and aircraft that was previously used.

In an effort to understand and evaluate the impact that AR/VR training is having in USAF student pilot training, a snapshot is studied with the goal of ascertaining what level of benefit this additional training could have. The theory is that this additional training speeds up the process of learning in the aircraft. The entire pilot training syllabus is comprised of several different phases of training. In an effort to narrow down the scope of this research, only the instrument phase of training will be investigated, which consists of eight flights (AETC, 2021). Students all receive the same number of ATD training, half of them without AR/VR enhancement, and the other half with. Each student’s grade is captured for every flight, and then the average is calculated to use that as the overall performance in the instrument block of training.

Method of Analysis

Research Question

How did students who received AR/VR training differ in proficiency from students who did not receive this additional training during the instrument phase in USAF pilot training? The answer to this question could show that this is a new, efficient way to train student pilots. However, as it is a small sample size, further investigation would be warranted to corroborate any potential findings in this study.

Data Collection

As the author has not had a chance to procure the permission required by USAF to collect this data from pilot training bases, a random dataset was constructed in Excel using the researcher's expertise from having been a pilot training instructor for five years. The grades for eight flights for 24 students were compared and averaged, and this average grade was used as the continuous, dependent variable in the testing. The data was then transferred from Excel to SPSS in order to conduct analysis.

Data Analysis

The data analyzed is on a small sample size, and there are many factors that play into how students perform in pilot training besides AR/VR training. Some examples of this are prior flying experience, age, motor skills, cognitive skills, etc. It is assumed that since it is a random sample in that these students just happened to be in this class this variability will be negligible.

Descriptive statistical analysis is performed to calculate the range, the sum, the mean, the standard deviation, and the variance of each of the subsets of 12 students. These two sections of the class are then compared to the other half in an attempt to ascertain if there are any differences in proficiency.

Tables 1 and 2 are included to show the data used for this study. Table 1 contains the grades on each of the eight flights for the 12 students who received AR/VR training and Table 2 has the grades for the eight flights for the 12 students who did not receive AR/VR training.

Data Interpretation

The range between the minimum and maximum statistic of flight grades average was identical in both sets of data, 1.75. This is both realistic and expected, as the grades could be between 1 and 5, with both a grade of 1 and 5 not being given very frequently. A grade of 1 is basically no proficiency at all, and a grade of 5 is equivalent of excellent, and no improvement required. A grade of 2 equals unsatisfactory, which is common in the first flight or two; a grade of 3 equals fair, and a grade of 4 is a good, and the minimum proficiency required to pass this phase of training.

When comparing the mean of both sets of data, the students who received AR/VR training performed slightly better than those that didn't. The mean was 3.34 with a standard deviation of .144 and variance of .207, compared to 3.23 with a standard deviation of .131 with a variance of .25. The standard deviation and variance indicate that there are normal and expected differences in the reported grades, as there should be progression throughout the phase of training.

Summary of Research Findings

Descriptive Statistics

	N	Range	Minimum	Maximum	Sum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
grade	12	1.750	2.375	4.125	38.750	3.22917	.131312	.454877	.207
Valid N (listwise)	12								

Figure 1. Table of descriptive statistics of students who received AR/VR training

Descriptive Statistics

	N	Range	Minimum	Maximum	Sum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Grade	12	1.750	2.500	4.250	40.125	3.34375	.144440	.500355	.250
Valid N (listwise)	12								

Figure 2. Table of descriptive statistics of students who did not receive AR/VR training

Conclusion

When reviewing the results of the students without AR/VR training, the mean was slightly below the mean of the students with AR/VR training. The data shows a small advantage in favor of those with the additional training, as their grades were slightly higher, albeit only 0.12 on a scale of 1-5. A limitation to this study is the small sample size, which would limit the statistical significance of the study. However, a solid case can be made to further investigate the impact of AR/VR training in pilot training, as it can increase pilot proficiency at a more rapid rate with the added training and ultimately provide costs savings.

Tables

Flight #	St1	St2	St3	St4	St5	St6	St7	St8	St9	St10	St11	St12
1	2	1	2	3	3	3	2	3	3	2	2	1
2	2	2	3	3	3	3	2	3	4	2	2	2
3	3	2	3	3	3	4	3	3	4	3	3	2
4	3	2	4	3	4	4	3	3	4	3	3	2
5	3	3	4	4	3	4	4	4	4	4	3	3
6	4	3	3	4	4	4	4	4	5	4	4	3
7	4	3	4	5	4	4	4	4	5	4	4	3
8	4	4	5	5	4	4	5	4	5	4	4	4
average	3.125	2.5	3.5	3.75	3.5	3.75	3.375	3.5	4.25	3.25	3.125	2.5

Table 1. List of grades for eight flights for students who received AR/VR training

Flight #	St13	St14	St15	St16	St17	St18	St19	St20	St21	St22	St23	St24
1	2	1	2	2	3	3	2	3	3	2	2	1
2	2	2	2	3	3	3	2	2	4	3	2	1
3	2	3	2	3	3	3	3	3	4	3	3	2
4	3	3	4	3	4	4	3	3	4	3	3	2
5	3	3	3	4	3	4	4	4	4	3	3	3
6	3	3	4	4	4	4	4	4	5	4	3	3
7	4	3	4	4	4	4	4	4	4	4	4	3
8	4	4	4	5	4	4	4	4	5	4	4	4
average	2.88	2.75	3.13	3.5	3.5	3.63	3.25	3.38	4.13	3.25	3	2.375

Table 2. List of grades for eight flights for students who did not receive AR/VR training

References

Air Education Training Command (AETC) (2021). AETC / ENJJPT Syllabus P-V4A-N (T-6)

https://community.apan.org/cfs-file/__key/docpreview-s/00-00-19-62-50/AETC-ENJJPT-Syllabus-P_2D00_V4A_2D00_N-_2800_T_2D00_6_2900_-APR-21-POST-TQRB.pdf

Coleman, J., & Thirtyacre, D. (2021). Remote pilot situational awareness with augmented reality glasses: An observational field study. *International Journal of Aviation, Aeronautics and Aerospace, 8*(1), 3. https://ezp.slu.edu/login?url=https://www-proquest-com.ezp.slu.edu/scholarly-journals/remote-pilot-situational-awareness-with-augmented/docview/2488140980/se-2?accountid=8065

A Review of the Southwest Effect

Saint Louis University

Introduction

In 1993, Randall Bennett and James Craun coined the term "�e Southwest Effect" to capture the idea that when Southwest Airlines entered a market their low fares caused the fares of the other carriers serving that market to drop in order to compete with Southwest (Bennett & Craun, 1993). Further research by Steven Morrison in 2001 estimated that the Southwest Effect was responsible for $9.5 billion dollars in lower fares at airlines competing with Southwest (Morrison, 2001). In recent years Southwest has raised their prices to be much closer to competitors while maintaining the perception that they are still a low-cost carrier (French & Geller, 2022). �is research examines fares on the 100 most-flown routes in the United States in the 4th quarter of 2019 (pre-COVID-19 pandemic) to investigate if there is continued evidence of the Southwest Effect. �is is done by limiting the 100 most-flown routes to markets that Southwest Airlines offers the lowest average fare and observing the correlation between their fares and the average fare across all airlines for those markets. A strong correlation between Southwest fares and the average fare for a given market would provide continued evidence of the Southwest Effect. However, if there is not a correlation between Southwest fares and the average fare then the Southwest Effect may be a thing of the past as the other airlines aren't allowing Southwest to influence their fares.

Data Source

�e Bureau of Transportation Statistics is an organization of the United States government that tracks various air travel statistics such as delays, lost baggage and fares. For fares they have recorded the average fare on the 1,000 most-popular routes (as determined by passenger count) in the contiguous United States every quarter since 1996. �is information is stored in Table 1 –

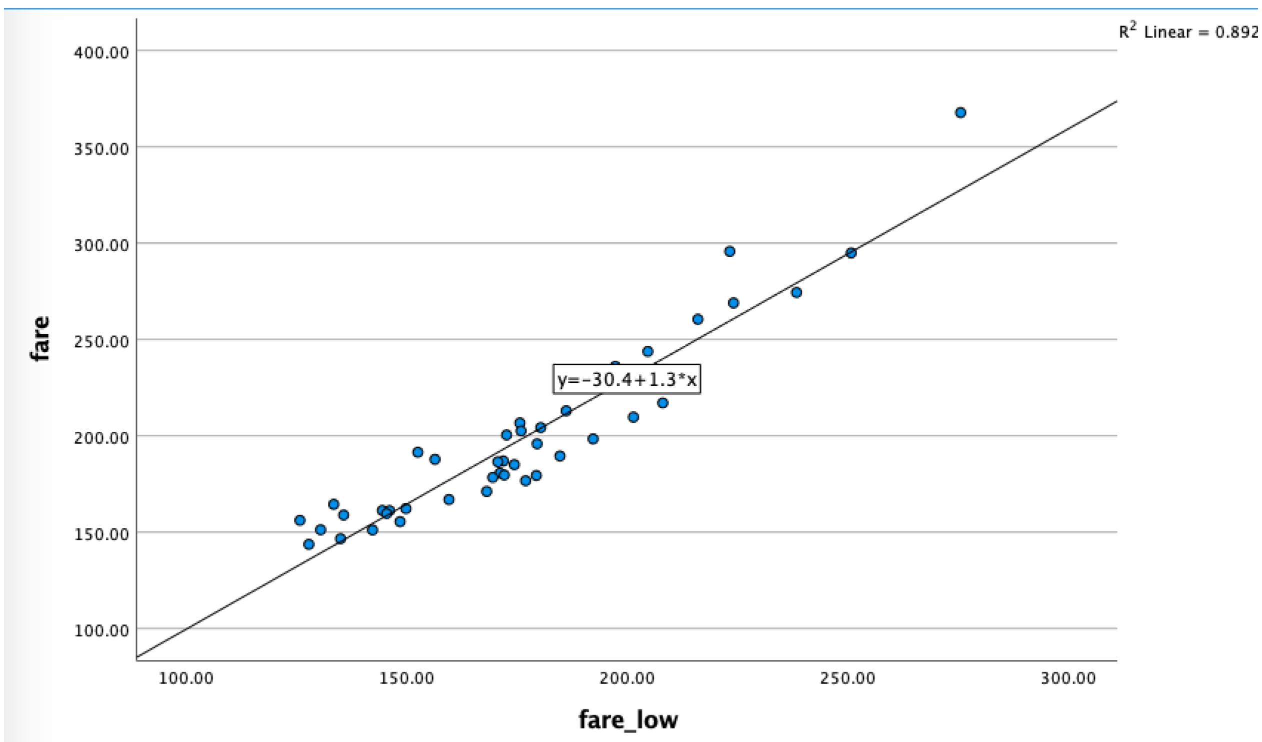
Top 1,000 Contiguous State City-Pair Markets of their *Consumer Airfare Report* (Keizer, 2022). For this research only data from the 4th quarter of 2019 was used as that was the last quarter of normal air traffic operations before the COVID-19 pandemic. Along with fares (*fare*) the table also contains the average fare on each route of the airline that offers the lowest average fare on that route (*fare_low)*, the airline offering the lowest average fare on a given route (*carrier_low)*, the market share of each route of the airline that offers the lowest average fare (*lf_ms*), number of daily passengers on the route (*passengers*)(not necessarily non-stop), and other variables that weren't used in this research. �e data set was limited to the top 100 routes (measured by *passengers*) to eliminate some of the effects of demand on airline pricing. �ese 100 routes had passenger counts ranging from 2,330 to 23,884 passengers. �e original data included routes that had only ~200 passengers a day (less than the equivalent of 2 737s a day) which is two orders of magnitude different from the most popular routes that had 10,000+ passengers a day (50+ 737s). By limiting the data to the 100 most-popular routes this research is comparing routes that all have sufficient demand for multiple airlines to compete on that city pair which lessens the effects of the confounding demand variable (i.e. if there are 2300+ passengers a day that is enough demand for multiple airlines to offer multiple flights a day). �ose 100 routes were then limited to the 45 routes where Southwest offered the lowest average fare (i.e. was *carrier_low*) to better test the Southwest Effect. (�e fact that Southwest offers the lowest fare on 45 of the 100 most popular routes in the United States does on its own lend credence to the Southwest Effect.) Southwest being *carrier_low* served as the independent variable in this research while *fare* and *fare_low* served as the dependent variables. *Carrier_low* is a categorical variables while both *fare* and *fare_low* are continuous quantitative variables as both can be any value not just specific values or integers (*fare and fare_low* are rounded to the nearest cent).

Verification of Statistical Assumptions

To use the Pearson Correlation for analysis, the data needs to meet four assumptions: random sampling, independence, linearity and normality. For this data set collected by the Bureau of Transportation we assume that the random sampling and independence assumptions have been satisfied. To test the linearity assumption the scatterplot observance method was used (Figure 1). Figure 1 demonstrates that there is a positive linear relationship (R^2=0.892) between the two dependent variables *fare* and *fare_low*, thus the linearity assumption is satisfied.

Figure 1

Scatterplot of Linear Relationship Detween *Fare* and *Fare_low*



�e normality assumption was tested using the Shapiro-Wilk Test and the Q-Q Normal Test for both independent variables. Based on the Shaprio-Wilk Test *fare*_low was determined to be normally distributed as it had a p-value greater than 0.05. However, the p-value for *fare* was significant at the 5% level indicating that the data may not be normally distributed. �e Q-Q Normal Test was used to further investigate if the variables could be assumed normal for this study. Figures 2 and 3 display that the data points for *fare* and *fare_low* are both distributed close enough to the diagonal line to indicate that they meet the normality assumption for the purposes of this study.

Table 1

�e Results of the Shapiro-Wilk Test for Normality for *Fare* and *Fare_low*

	Shapiro-Wilk		
	Statistic	df	Sig.
fare	.876	45	<.001
fare_low	.957	45	.095

Figure 2

The Normal Q-Q Plot for Fare Demonstrating That It Meets the Normality Assumption

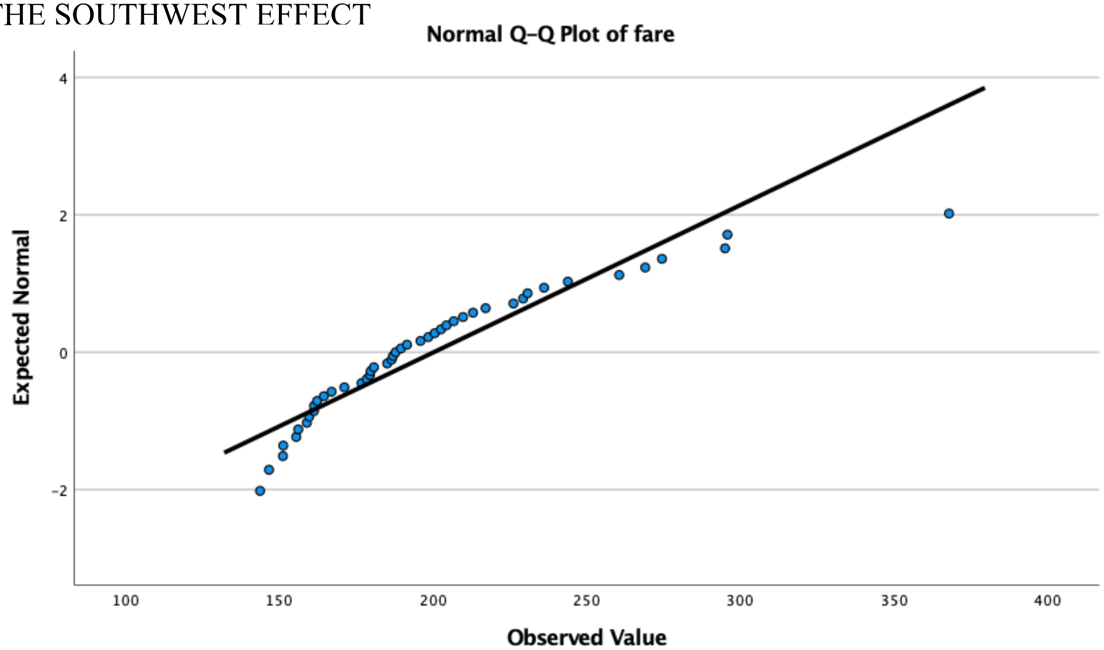
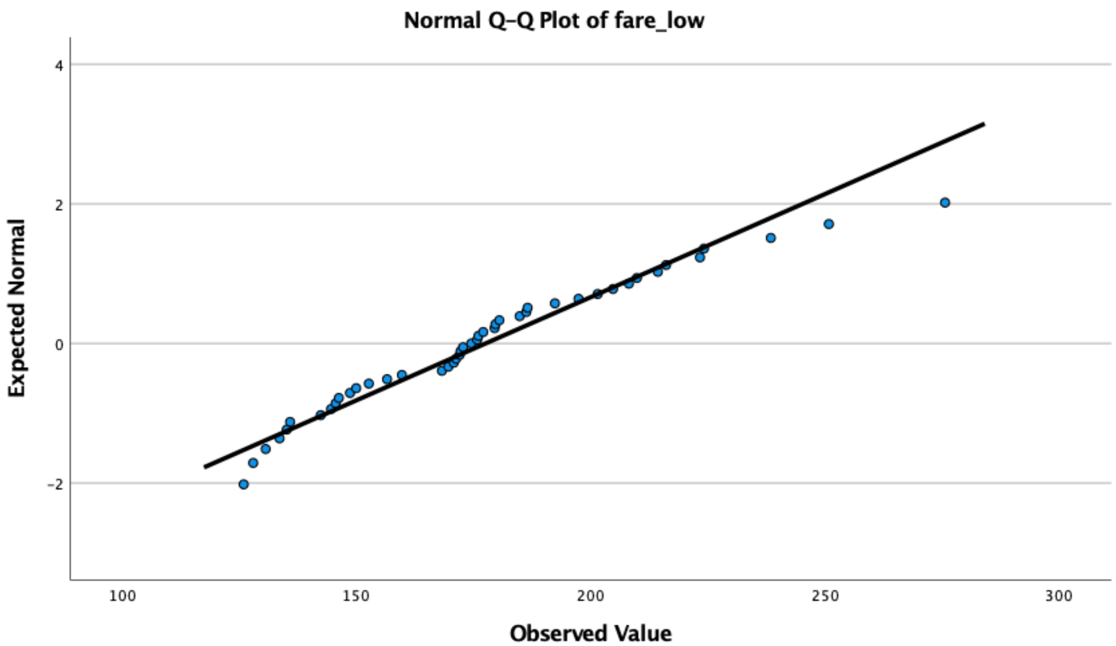

Normal Q-Q Plot of fare
Expected Normal
4
2
0
-2
100
150
200
250
300
350
400
Observed Value

Figure 3

The Normal Q-Q Plot for Fare_low Demonstrating That It Meets the Normality Assumption



Research Question

On airline routes between city-pairs in the contiguous United States where Southwest Airlines is the airline that offers the lowest average fare on the route, is there a correlation between average fare and the average fare offered by Southwest on those routes?

Statistical Hypotheses

H_0: $\rho = 0$, �ere is not a significant relationship between the average low fare and the average fare on routes where Southwest is the airline with the lowest average fare.

H_1: $\rho \neq 0$, �ere is a significant relationship between the average low fare and the average fare on routes where Southwest is the airline with the lowest average fare.

Population

�e target population for this study is all flights operated on routes that were served by Southwest Airlines in 2019. Of that target population, data is accessible for flights operated in the fourth quarter of 2019 on the top 1000 city-pair routes in the United States (across all airlines). As described in the **Data Source** section the sample used for this study was the 45 routes of the 100 most-trafficked routes in the United States in the 4th quarter of 2019 where Southwest offered the lowest average fare.

Data Analysis

SPSS was used to perform the data analysis and the modified “Table 1 – Top 1,000 Contiguous State City-Pair Markets” data containing only the 45 routes that Southwest was the lowest cost carrier (of the 100 most-popular routes) was imported to the software. First, SPSS was used to create a scatter plot of *fare_low* versus *fare* to determine if the linearity assumption required to use the Pearson Correlation was met (Figure 1). Second, the normality assumption for both *fare_low* and *fare* was investigated using SPSS’s Shaprio-Wilk Test as well the Q-Q Normal plotting function to develop a Q-Q Normal plot for both variables (Figures 2 & 3). Finally, a two-tailed Pearson Correlation was calculated using SPSS. �is created a table of descriptive statistics containing the count, mean, and standard deviation for *fare* and *fare_low* (Table 2) as well as the Pearson Correlation table showing the correlation between *fare* and *fare_low* along with its significance level (Table 3).

Discussion

SPSS’s descriptive statistics output for *fare* and *fare_low* (Table 2) showed that across the 45 routes that Southwest offered the lowest average fare, their fare (*fare_low*) was on average $22.71 cheaper than the overall average fare (*fare*) on a given route ($177.54 compared to $200.25). It is interesting to note that the standard deviation for *fare* was also higher than the standard deviation for *fare_low* (46.55 vs. 33.84) which could indicate that the relationship between *fare_low* and *fare* is route-dependent as airlines compete differently on price for different routes.

Table 2

Descriptive Statistics Output from SPSS for Fare and Fare_low

	Mean	Std. Deviation	N
fare	200.2467	46.55169	45
fare_low	177.5380	33.84125	45

�e Pearson Correlation output (Table 3) shows that there is a strong positive relationship between *fare_low* and *fare* that is statistically significant at the 1% significance level (r(45) = 0.944, p<0.001). �is indicates that 89.2% of variation in *fare* can be explained by variation in *fare_low* (R^2=0.892). �e positive direction of the correlation between *fare_low* and *fare* means that an increase in *fare_low* is correlated with an increase in *fare* (Figure 1). As the correlation between *fare_low* and *fare* is statistically significant at the 1% level the null hypothesis is rejected.

Table 3.

The Result of the Pearson Correlation Test Between Fare and Fare_low

Inter Correlation between Variables (N=45)

Variable	1	2
Fare	-	.944**
Fare_low	.944**	-

**p<0.01

1 – Fare; 2 – Fare_low

Conclusion

�e results indicate that there is a statistically significant positive correlation between the fare offered by the carrier that offers the lowest average fare (*fare_low*) and fare (*fare*) on the 45 routes that are both one of the 100 most-popular airline routes in the contiguous United States and have Southwest as the airline that offers the lowest fare on the route. �is result rejects the null hypothesis that there would not be a significant relationship between the average low fare and the average fare on routes where Southwest is the airline with the lowest average fare. A failure to reject the null hypothesis would have been evidence that the Southwest Effect is no longer relevant as other airlines displayed indifference to Southwest's fares with their own fares.

While the results of this paper demonstrate that the Southwest Effect may be alive and well in 2019, further research needs to be performed to determine if the Southwest Effect's effect is unique to Southwest or if a similar correlation would be found for any airline that offers the lowest average fare on a subset of routes. A comparison of the correlation between *fare_low* and *fare* across all of the 100 most-trafficked routes versus the correlation on just routes that

Southwest offers the lowest average fare (the research of this paper) would help determine if it matters that Southwest is the airline that offers the lowest fare on a route.

References

Bennett, R. D., & Craun, J. M. (1993). *The Airline Deregulation Evolution Continues: The Southwest Effect*. Office of Aviation Analysis.

French, S., & Geller, E. (2022, May 17). *Why Fly Southwest Airlines?* nerdwallet. Retrieved May 18, 2022, from https://www.nerdwallet.com/article/travel/reasons-southwest-is-still-a-top- airline

Keizer, R. (2022, January 12). *Consumer Airfare Report: Table 1 - top 1,000 contiguous state city-pair markets: Department of Transportation - Data Portal*. Transportation.gov.
Retrieved February 26, 2022, from https://data.transportation.gov/Aviation/Consumer- Airfare-Report-Table-1-Top-1-000-Contiguo/4f3n-jbg2

Morrison, S. A. (2001). Actual, Adjacent, and Potential Competition Estimating the Full Effect of Southwest Airlines. *Journal of Transport Economics and Policy*, *35*(2), 239–256.
Retrieved May 18, 2022, from https://docserver.ingentaconnect.com/deliver/connect/lse/00225258/v35n2/s5.pdf?expires=1652928779&id=0000&titleid=1311&checksum=C588FFB7B2C7ADF959271EBE26B53DF9&host=https://www.ingentaconnect.com.

Appendix A

Raw SPSS Output

Graph

Notes

Output Created		15-MAY-2022 02:14:19
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	Split File	<none>
	N of Rows in Working Data File	45
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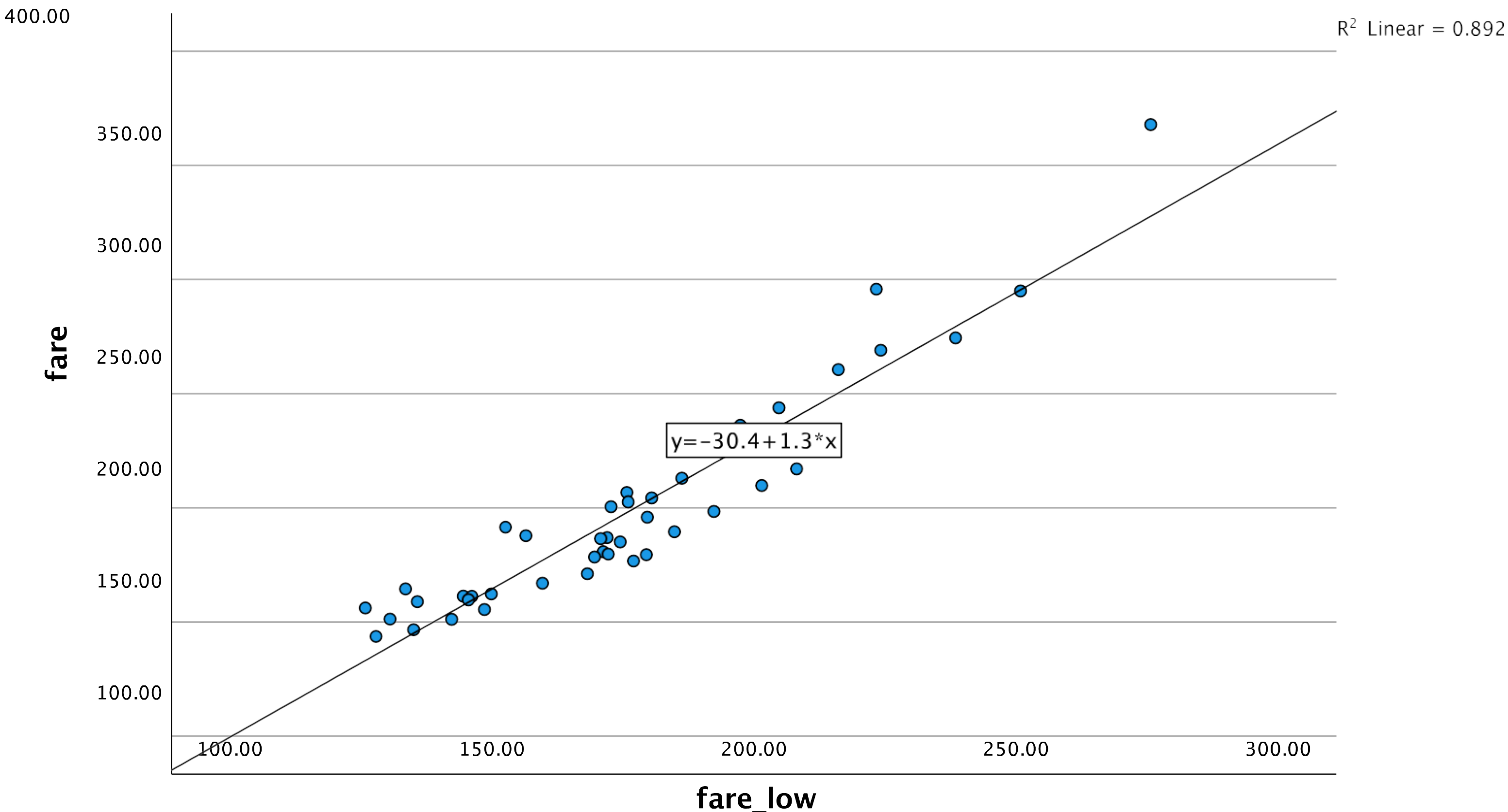

Notes

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	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	45

Missing Value Handling	Definition of Missing	User-defined missing values for dependent variables are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any dependent variable or factor used.
Syntax		EXAMINE VARIABLES=fare fare_low

		/PLOT BOXPLOT STEMLEAF /COMPARE GROUPS /STATISTICS DESCRIPTIVES /CINTERVAL 95 /MISSING LISTWISE /NOTOTAL.
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	Elapsed Time	00:00:00.00

Explore

Notes

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	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	45
Missing Value Handling	Definition of Missing	User-defined missing values for dependent variables are treated as missing.

	Cases Used	Statistics are based on cases with no missing values for any dependent variable or factor used.
Syntax		EXAMINE VARIABLES=fare fare_low /PLOT BOXPLOT STEMLEAF NPPLOT /COMPARE GROUPS /STATISTICS DESCRIPTIVES /CINTERVAL 95 /MISSING LISTWISE

		/NOTOTAL.
Resources	Processor Time	00:00:00.71
	Elapsed Time	00:00:01.00

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
fare	45	100.0%	0	0.0%	45	100.0%
fare_low	45	100.0%	0	0.0%	45	100.0%

Descriptives

			Statistic	Std. Error
fare	Mean		200.2467	6.93952
	95% Confidence Interval for Mean	Lower Bound	186.2610	
		Upper Bound	214.2323	
	5% Trimmed Mean		196.1866	
	Median		187.8500	
	Variance		2167.060	
	Std. Deviation		46.55169	
	Minimum		143.75	
	Maximum		367.82	
	Range		224.07	
	Interquartile Range		58.21	
	Skewness		1.501	.354
	Kurtosis		2.777	.695
fare_low	Mean		177.5380	5.04476
	95% Confidence Interval for Mean	Lower Bound	167.3710	
		Upper Bound	187.7050	
	5% Trimmed Mean		175.7192	
	Median		174.5000	
	Variance		1145.230	
	Std. Deviation		33.84125	
	Minimum		125.91	

	Maximum	275.64	
	Range	149.73	
	Interquartile Range	50.16	
	Skewness	.712	.354
	Kurtosis	.482	.695

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
fare	.133	45	.043	.876	45	<.001

fare_low	.110	45	.200*	.957	45	.095

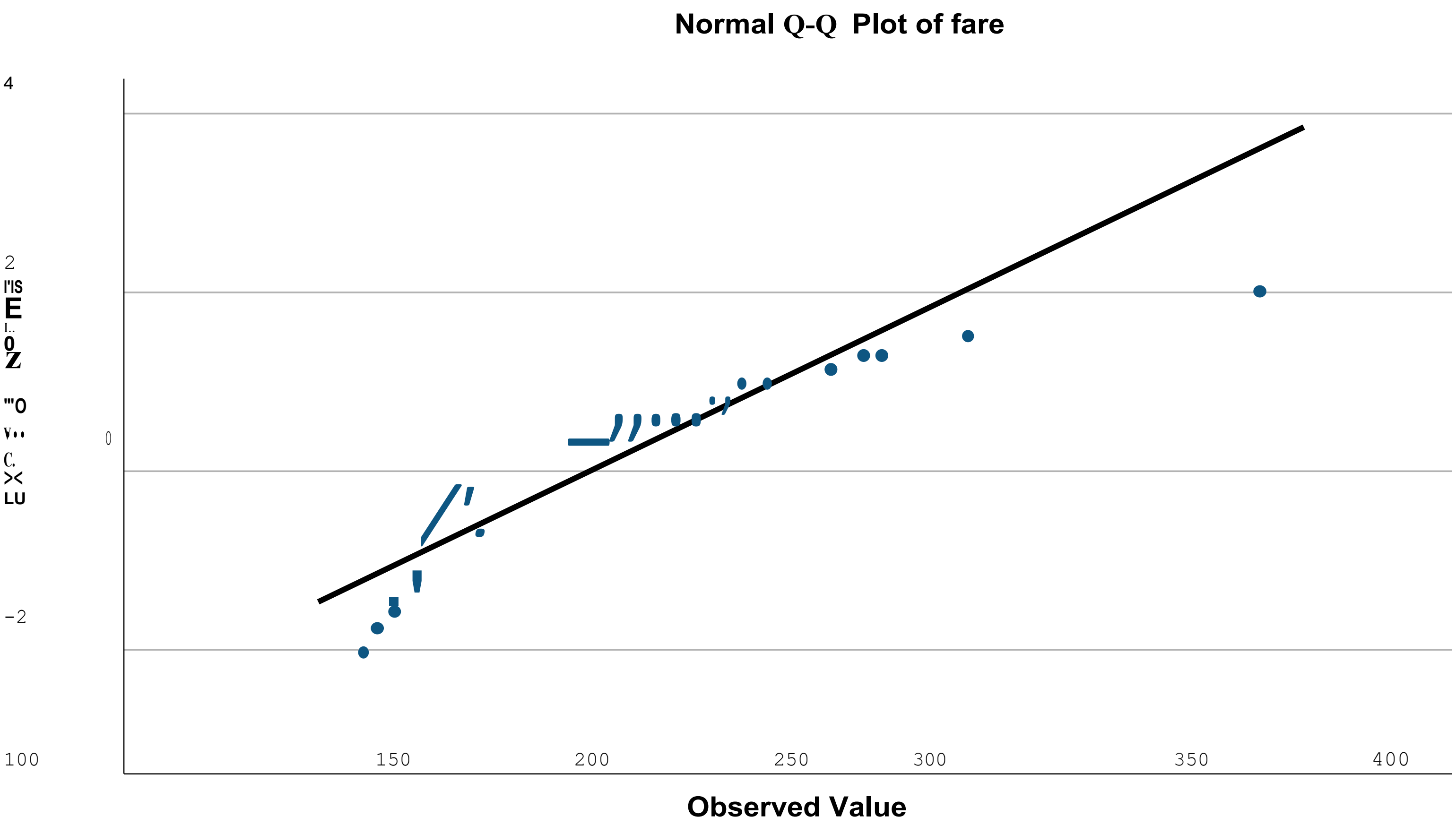
*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

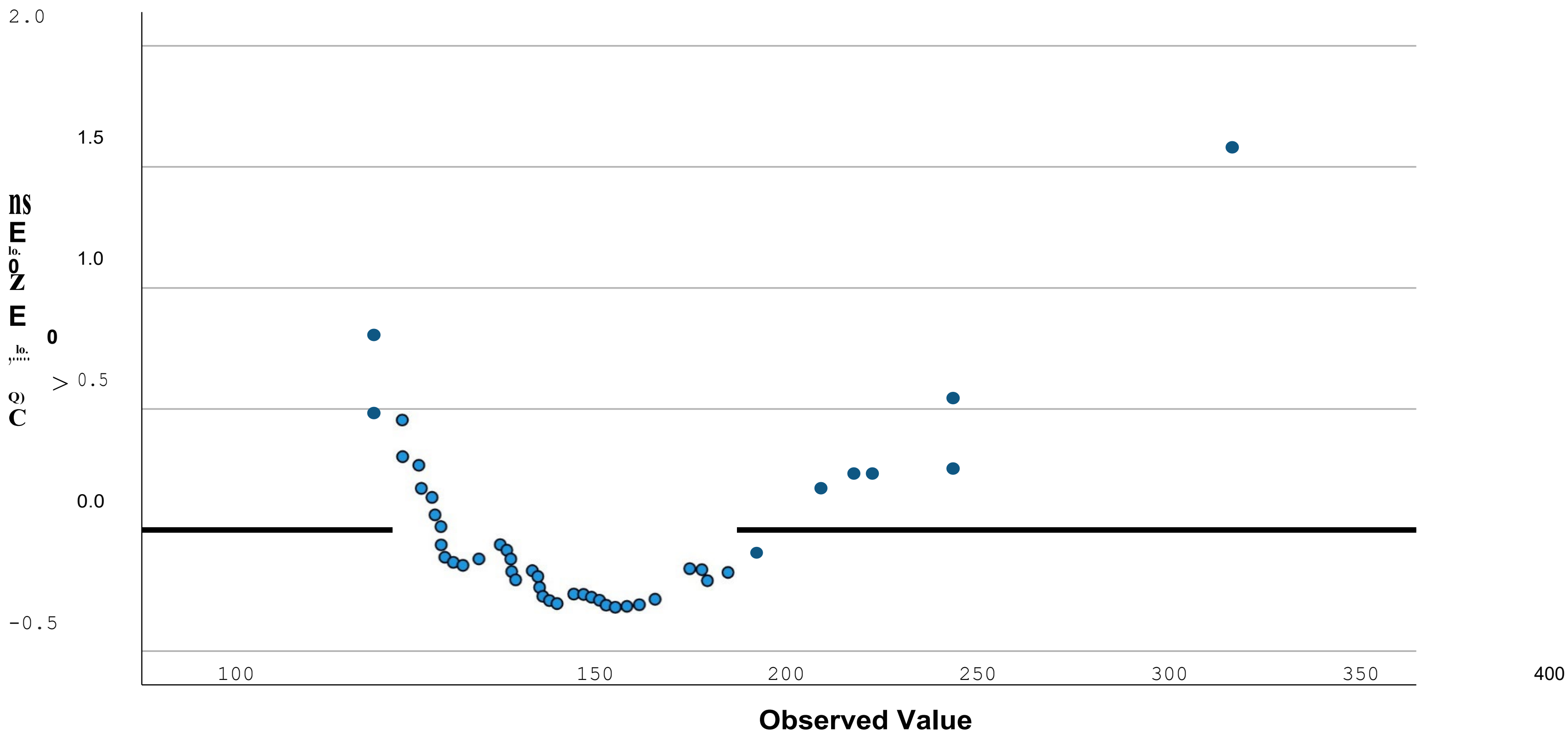
fare

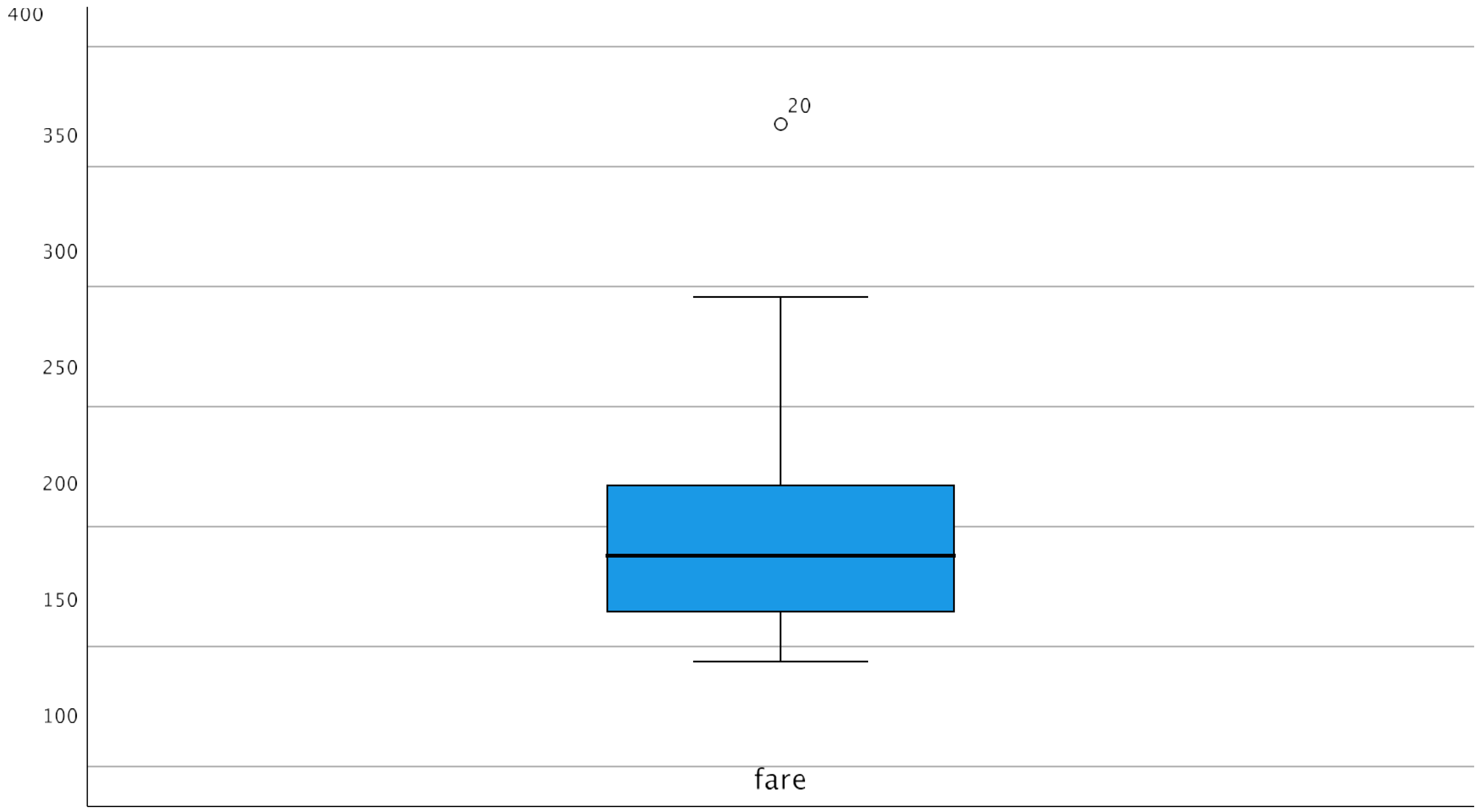
fare Stem-and-Leaf Plot Frequency   Stem & Leaf

```
    8.00        1 . 44555555
   10.00        1 . 6666677777
    9.00        1 . 888888999
    7.00        2 . 0000011
    4.00        2 . 2233
    1.00        2 . 4
    3.00        2 . 667
    2.00        2 . 99
    1.00 Extremes    (>=368)
 Stem width:  100.00
 Each leaf:   1 case(s)
```


Normal Q-Q Plot of fare
4
2
0
-2
100
150
200
250
300
350
400
Observed Value

Detrended Normal Q-Q Plot of fare



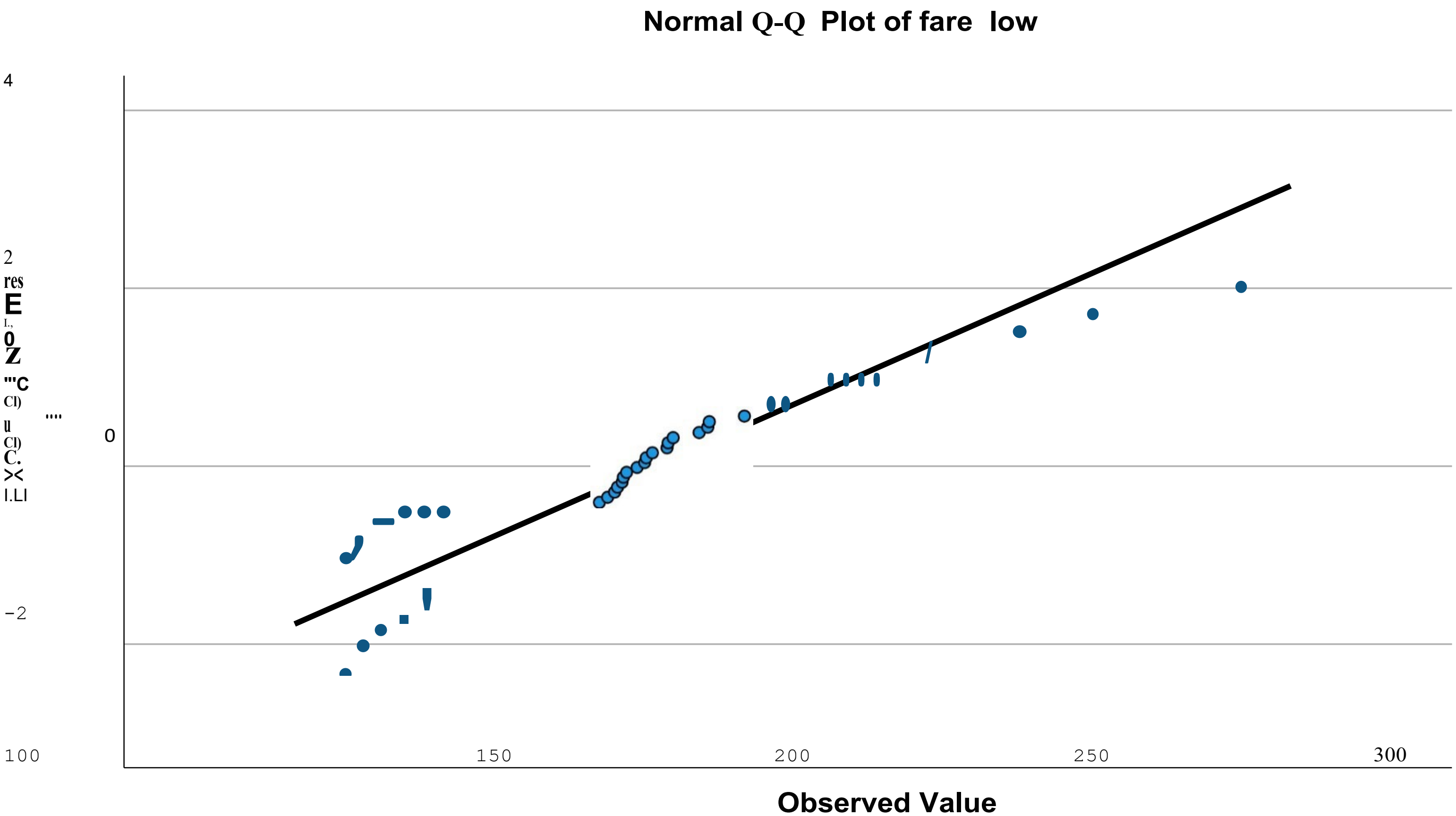


fare_low

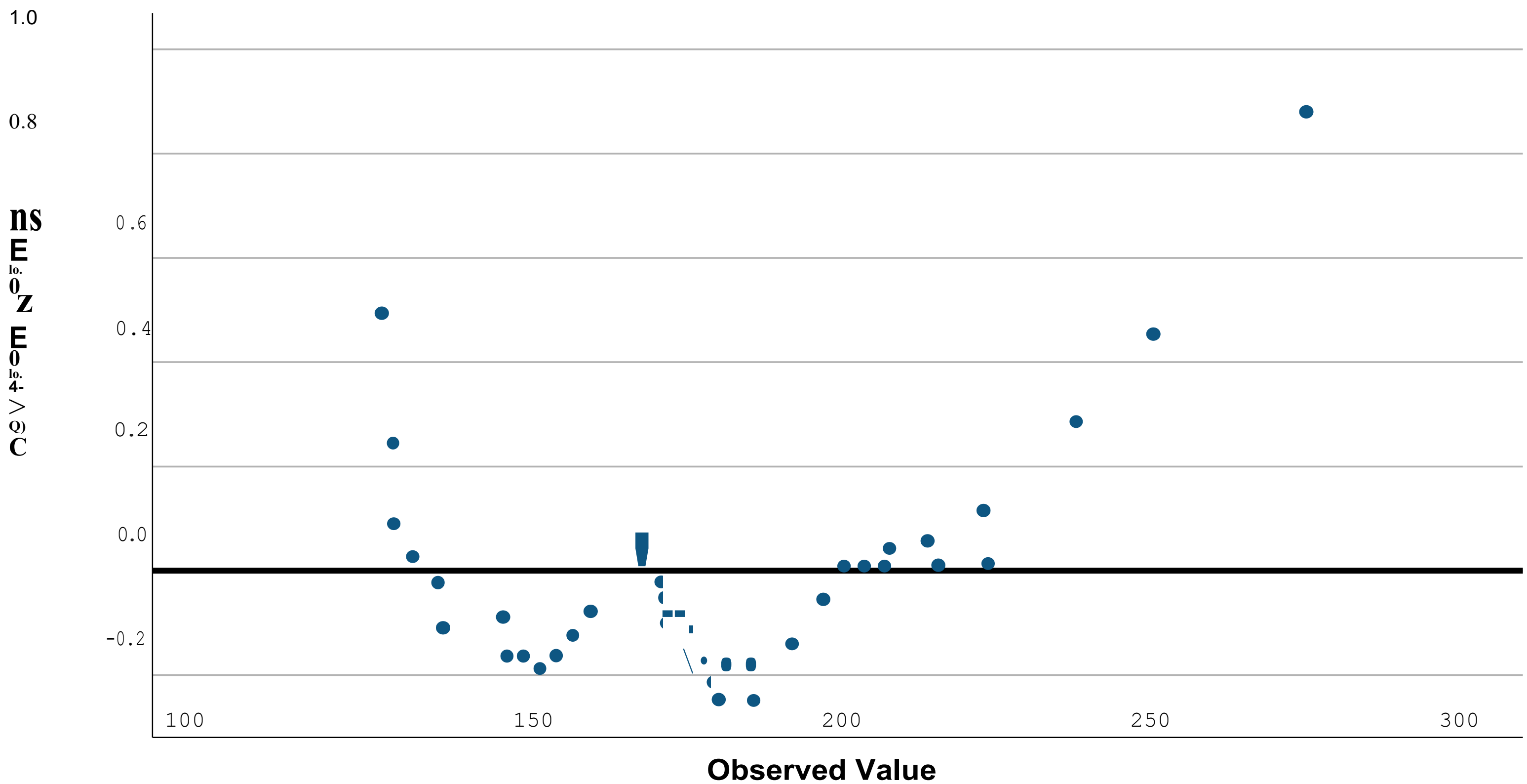
fare_low Stem-and-Leaf Plot Frequency Stem & Leaf

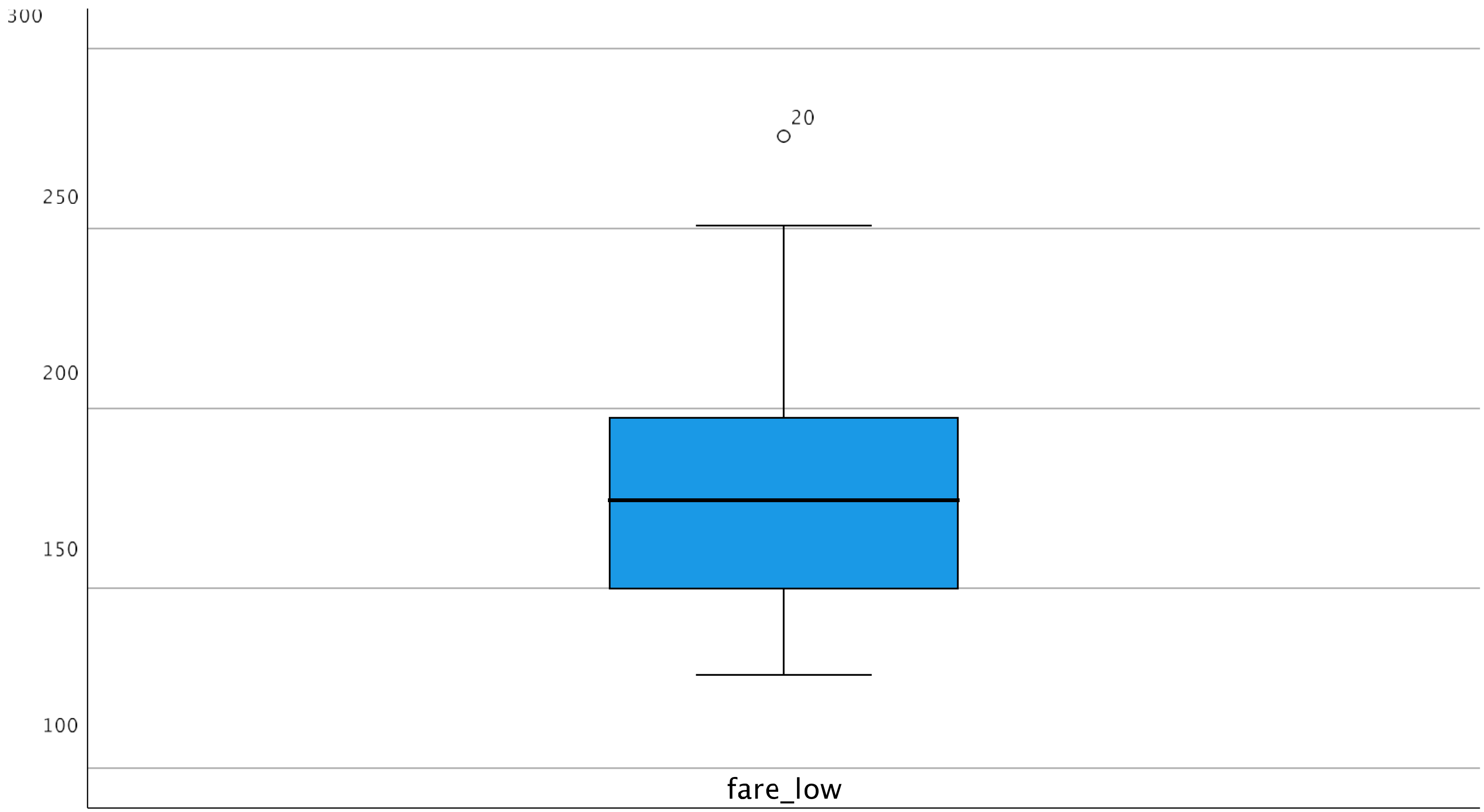
6.00	1 .	223333
9.00	1 .	444444555
13.00	1 .	6677777777777
6.00	1 .	888899
6.00	2 .	000011
3.00	2 .	223
1.00	2 .	5

1.00 Extremes (>=276) Stem width: 100.00
Each leaf: 1 case(s)


Normal Q-Q Plot of fare low
4
2
0
-2
100
150
200
250
300
Observed Value

Detrended Normal Q-Q Plot of fare_low





Correlations

Notes

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	N of Rows in Working Data File	45
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.

Syntax		CORRELATIONS /VARIABLES=fare fare_low /PRINT=TWOTAIL NOSIG FULL /STATISTICS DESCRIPTIVES /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.00

Descriptive Statistics

	Mean	Std. Deviation	N
fare	200.2467	46.55169	45
fare_low	177.5380	33.84125	45

Correlations

		fare	fare_low
fare	Pearson Correlation	1	.944**
	Sig. (2-tailed)		<.001
	N	45	45
fare_low	Pearson Correlation	.944**	1
	Sig. (2-tailed)	<.001	
	N	45	45

**. Correlation is significant at the 0.01 level (2-tailed).

SPSS Assignment 5

Pearson Correlation Assessment for Impact of Augmented/Virtual Reality Training in Student Pilots

Parks College, Saint Louis University AVIA 5470, Quantitative Data Analysis Professor Tamilselvan

SPSS assignment, due 18 May 2022

Pearson Correlation assessment for Impact of Augmented/Virtual Reality Training in Student Pilots

As Virtual Reality (VR) and Augmented Reality (AR) technology advances, especially in aviation training devices, both training quality and realism increase, which in turn can lead to a cost decrease and faster paced learning (Coleman & Thirtyacre, 2021). However, it is still a developing technology; many more studies and analysis are required to verify and document its potential impact in helping pilots train and increase proficiency at a more rapid pace.

US Air Force Pilot Training is starting to incorporate AR and VR into their pilot training in an effort to decrease both cost and time required to train. In an effort to understand and evaluate the impact that AR/VR training can have in student pilot training, one phase of instrument training of one class of 20 students is analyzed with the goal of determining what impact this additional training could have. In addition to flights, student pilots receive training in Aircraft Training Devices (ATD), or simulators. It is in these ATDs that the AR/VR headsets are used to enhance training, not in the actual aircraft. The theory is that this additional training speeds up the process of learning in the aircraft.

The entire pilot training syllabus is comprised of several different phases of training. In an effort to narrow down the scope of this research, only the instrument phase of training will be investigated. Proficiency is defined as achieving a grade of 4+ on a scale of 1-5, and a student pilot has 8 flights to achieve this proficiency before proceeding to the checkride (AETC, 2021).

Data Source

The data used in this study was simulated using information from the author’s experience and time spent in USAF Pilot Training as an instructor to represent a realistic sampling of actual pilot training students’ performance. The data represents normal and average student progression with some variations to represent over and under achievers. The two dependent variables analyzed will be grade point average in the eight-flight phase of instrument training for a class of 20 students, and the flight number at which each student achieved minimum instrument proficiency, as previously defined.

Verification of Statistical Assumptions

This analysis will be making several assumptions as it tests for a linear correlation between these two variables. One assumption is homoscedasticity, where is it assumed that the data variance is equally scattered on the scatter plot. The next assumption is linearity, where it is assumed that the best way to represent a correlation of data is using a straight line. The third assumption is normality, where it is assumed that the data points are normally distributed (Privitera, 2018). Additionally, the data can be considered random sampling as a random pilot training class was selected, which is comprised of students of different ages, gender, and skill level. When looking at the resultant scatter plot below from SPSS, the linearity of the data can be observed and a determination can be made that a relationship exists between the two dependent variables.

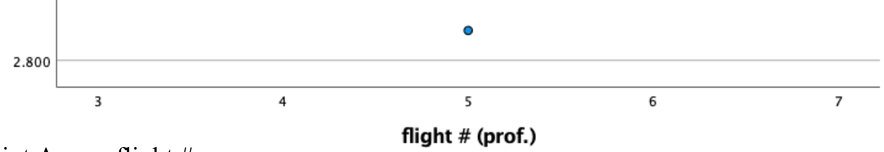


Figure 1. Grade Point Avg v. flight #

Research Question

What is the relationship between grade point average (GPA) in the instrument phase of training and flight number in which proficiency is achieved for students who receive AR/VR training in USAF pilot training?

Hypothesis

H_0 : P=0 There is no relationship between GPA in the instrument phase of flight and flight number in which proficiency is achieved for students who receive AR/VR training in USAF pilot training.

H_1 : P≠0 The is a significant relationship between GPA in the instrument phase of flight and flight number in which proficiency is achieved for students who receive AR/VR training in USAF pilot training.

Population Sample

The population is comprised of one class of 20 USAF pilot training students who have received AR/VR training, but could be enlarged to include multiple classes. The current analysis only includes one small phase of training comprised of eight instrument flights and the associated simulators, but could also be amplified to include student performance in all phases of pilot training. These students in pilot training represent a small sample of all students who have ever completed or are currently completing USAF pilot training (UPT), as there are five UPT bases and 15-16 classes every year.

Operational Definitions

Grade Point Average is defined as the average of the eight grades received for the eight flights in the instrument phase of training. The flight number in which proficiency is achieved is counted between the first flight and the eighth, or last flight in the instrument phase of training.

The results vary from achieving proficiency on the third flight all the way to the seventh flight, with the mean being 5.1.

Data Analysis

The data was analyzed using several different tests in SPSS. The first consisted of a scatter plot that showed linearity between the variables. The line on Figure 1 indicates a negative correlation, showing an inversely proportional relationship between the two variables. This can be attributed to the fact that the earlier many of these students achieve proficiency in this phase of training, the higher the GPA. Shapiro-Wilk analysis was conducted as a test of normality. Q-Q plots were also conducted as tests of normality, along with a Pearson Correlation to determine if the correlation between the variables was statistically significant.

Data Interpretation

As aforementioned, the line on the scatter plot indicates a negative relationship, or inversely proportional between the GPA and on what flight the student achieves proficiency. This indicates that students who performed better earlier in the phase of training tended to perform better throughout the whole phase of training. The slope of the line indicates that the relationship is moderate between the two variables. The results for the Shapiro-Wilk test were greater than 0.05, satisfying the normality assumption for the data analyzed. Both Q-Q plots have the data very closely aligned with the diagonal line, also showing the normality assumption is satisfied. The results for the Pearson Correlation show that the results were statistically significant, $r(20) = .021$, $p < .05$ (Table 3). This shows a significant correlation between the two variables. Another study would have to be conducted examining all students, including those who do not receive the additional training, to determine if AR/VR training shows statistically significant improvement in student performance.

The angle of the slope indicates that there is a moderate relationship between the two variables. A student who receives AR/VR training and achieves proficiency earlier in the phase of training will have a higher GPA.

Summary of Research Findings

Table 1 Shapiro-Wilk Test of Normality

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
flight # (prof.)	.209	20	.022	.916	20	.082
Grade Point Avg	.172	20	.125	.931	20	.164

a. Lilliefors Significance Correction

Table 2 Descriptive Statistics for SPSS Assignment 5 Dataset

Descriptives

			Statistic	Std. Error
flight # (prof.)	Mean		5.10	.216
	95% Confidence Interval for Mean	Lower Bound	4.65	
		Upper Bound	5.55	
	5% Trimmed Mean		5.11	
	Median		5.00	
	Variance		.937	
	Std. Deviation		.968	
	Minimum		3	
	Maximum		7	
	Range		4	
	Interquartile Range		2	
	Skewness		−.217	.512
	Kurtosis		−.060	.992
Grade Point Avg	Mean		3.50625	.059793
	95% Confidence Interval for Mean	Lower Bound	3.38110	
		Upper Bound	3.63140	
	5% Trimmed Mean		3.52083	
	Median		3.56250	
	Variance		.072	
	Std. Deviation		.267404	
	Minimum		2.875	
	Maximum		3.875	
	Range		1.000	
	Interquartile Range		.344	
	Skewness		−.825	.512
	Kurtosis		.453	.992

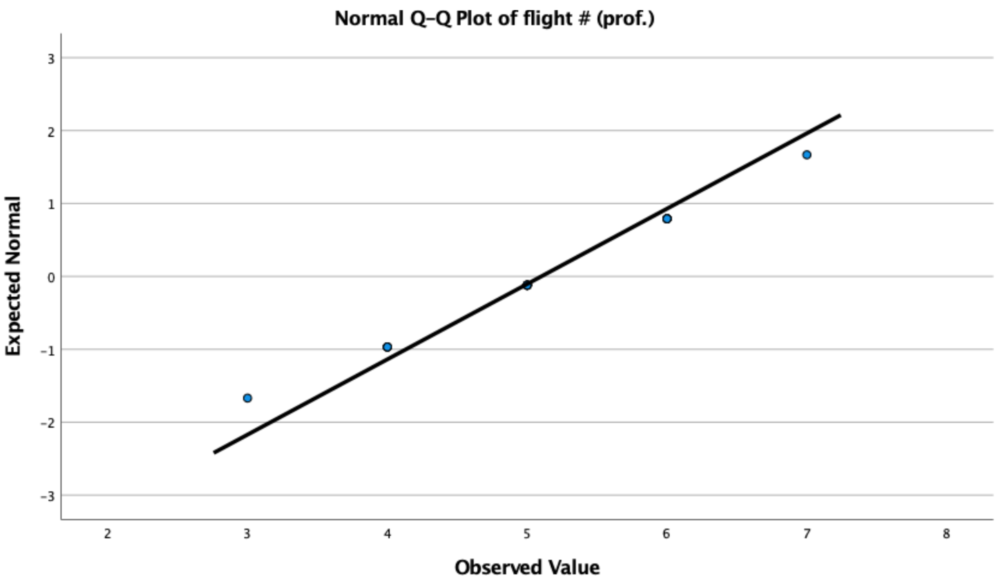


Figure 2. Q-Q Plot of flight # proficiency

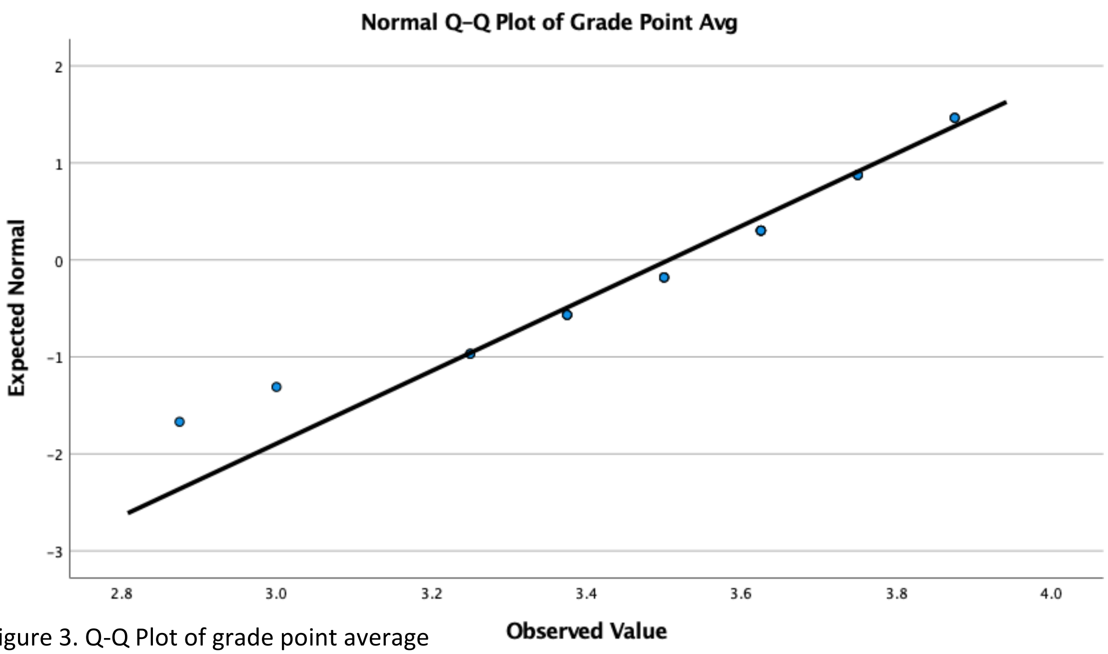


Figure 3. Q-Q Plot of grade point average

Table 3 Pearson Correlation for SPSS Assignment 5 Dataset

Correlations

		flight # (prof.)	Grade Point Avg
flight # (prof.)	Pearson Correlation	1	-.511*
	Sig. (2-tailed)		.021
	N	20	20
Grade Point Avg	Pearson Correlation	-.511*	1
	Sig. (2-tailed)	.021	
	N	20	20

*. Correlation is significant at the 0.05 level (2-tailed).

Conclusion

The conclusion of this study shows that there is a significant correlation between the two variables described, thus the null hypothesis is rejected. Using the data sampled there was an impact in how well a student performed based on receiving AR/VR training and performing well earlier in the instrument phase of training. This is a positive result that speaks to continuing with AR/VR assisted training throughout USAF pilot training.

This training is a very rigorous program, and results often vary in student performance based off of many different variables. With the right assumptions and keeping in mind certain limitations of the scope of the study, it would be possible to sample larger groups of students and perform statistical analysis of more phases of training in an attempt to broaden the statistically significant data results. If the data supports increased student performance with AR/VR training, this can be of real value to the USAF, as it can result in increased performance at a faster pace and decreased costs.

References

Air Education Training Command (AETC) (2021). AETC / ENJJPT Syllabus P-V4A-N (T-6) https://community.apan.org/cfs-file/ key/docpreview-s/00-00-19-62-50/AETC-ENJJPT-Syllabus-P_2D00_V4A_2D00_N-_2800_T_2D00_6_2900_-APR-21-POST-TQRB.pdf

Coleman, J., & Thirtyacre, D. (2021). Remote pilot situational awareness with augmented reality glasses: An observational field study. *International Journal of Aviation, Aeronautics and Aerospace, 8*(1), 3. https://ezp.slu.edu/login?url=https://www-proquest-com.ezp.slu.edu/scholarly-journals/remote-pilot-situational-awareness-with-augmented/docview/2488140980/se-2?accountid=8065

Privitera, G. J. (2017). *Statistics for the behavioral sciences* (3rd ed.). Sage Publications.

Linear Multiple Regression

1. Purpose Statement

The purpose of this study was to determine the relationship between Augmented Reality and Virtual Reality (AR/VR) training in an Air Force Pilot Training program and student pilot performance, taking into account several factors like age, phase of flight, previous flight training, previous exposure to AR/VR devices, and number of AR/VR training events.

2. Variables (Predictors)

Predictors

- Age
- Phase of flight
- Previous flight training
- Previous exposure to AR/VR devices
- Number of *ARNR* training events

3. Dependent Measures

Student pilot performance in the sample pilot training classes, as measured by the grades achieved at the end of each phase of training during pilot training.

4. Operational Definitions

Age denotes the difference in age, which can be up to a 9-year gap, and can be significant as younger students may be more likely to adapt quicker to AR/VR devices. The phase of flight relates to the different stages of training during pilot training, which can be impacted at varying levels by additional training in AR/VR. Previous flight training can be as little as 20 hours in USAF Introduction to Flight Training, or over 1,000 hours and a Commercial Pilot Rating. Previous exposure to AR/VR devices, even if not flying related, can be advantageous as it is a new method of learning that can take some getting used to. The number of AR/VR training events indicates how many events or simulators with AR/VR capability the student has performed.

5. Research Questions

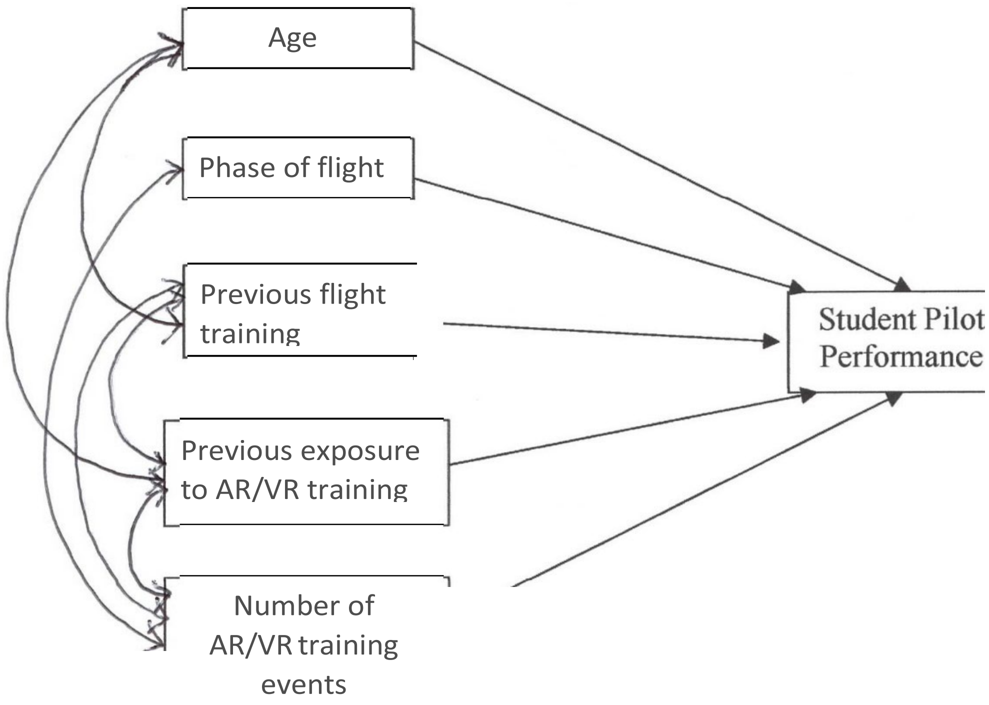
What is the relationship between AR/VR training in Air Force Pilot Training and student pilot performance, taking into account several factors like age, phase of flight, previous flight training, previous exposure to AR/VR devices, and number of ARVR training events?

6. Statistical Hypotheses

HO: p = 0 There is no significant relationship between AR/VR training in Air Force Pilot Training and student pilot performance, taking into account several factors like age, phase of flight, previous flight training, previous exposure to AR/VR devices, and number of ARVR training events?

H1: p *i*- 0 There is a significant relationship between AR/VR training in Air Force Pilot Training and student pilot performance, taking into account several factors like age, phase of flight, previous flight training, previous exposure to AR/VR devices, and number of ARVR training events?

7. Path Display



Linear Multiple Regression

Pearson Correlation SPSS Quiz 12

May 13, 2022

Linear Multiple Regression

A correlational study of the effects of pilot and crew training on combating aircraft cyber- attacks has been presented to describe how each variable affects the other.

Purpose statement

This study aimed to determine the relationship between pilot and crew training and aircraft cyber security attacks. The various factors considered in the study included; pilot training results, crew performance outcomes, the aviation institution, technological advancement, flight numbers, types of aircraft, qualification of pilots, number of crew on board, and the cyber aircraft reports Variables

The predictors included:

- Pilot training results
- Crew performance results
- Aviation institutions
- Technological advancement
- Flight numbers
- Types of aircrafts
- Pilot qualifications
- Number of the crew on board Dependent measure

The dependent measure is the number of aircraft cyber-attacks in the aviation industry available from the Federal Aviation Administration (FAA) database.

Operational definitions

The pilot training results involved the performances of individual pilots when the cybersecurity training was conducted in various aviation institutions. These results were recorded, and pilots were graded based on their outcomes. The crew performance outcomes involved the performances of every crew on board and the staff working on different airplanes and aircraft on their preparedness to handle the cyber-attacks on the planes (Patel, 2017). The aviation institutions are accredited learning institutions that offer the training to both the crew and pilots to assess their preparedness to handle the various attacks when they are experienced.

The aviation institutions are further classified as either private or public. The public aviation institutions are controlled and funded by the government and offer training at subsidized charges (Federal Aviation Administration, 2017). Private aviation institutions are those learning centers that have been given the power to operate but under the management of private entities. The technological advancement in this study referred to changes and improvements in technology application which has contributed to an increase in aircraft cyber-attacks. The technological advancement witnessed was primarily from human-induced activities and other natural factors.

The flight numbers represented the various flights operating in the Triple E, Colorado airlines, obtained from the FAA database for the last five years. The aircraft types involved the designs, nature, size, and the purposes of the different aircraft in the aviation industry (Johnson, 2019). Pilot qualifications are the basic requirements that the pilots must have obtained before being licensed to operate the aircraft. The qualification of various pilots was assessed based on their academic, professional, and working experience across multiple airline operations. The aircraft cyber-attacks included the outcome of all the factors and the results from different independent variables.

Research question

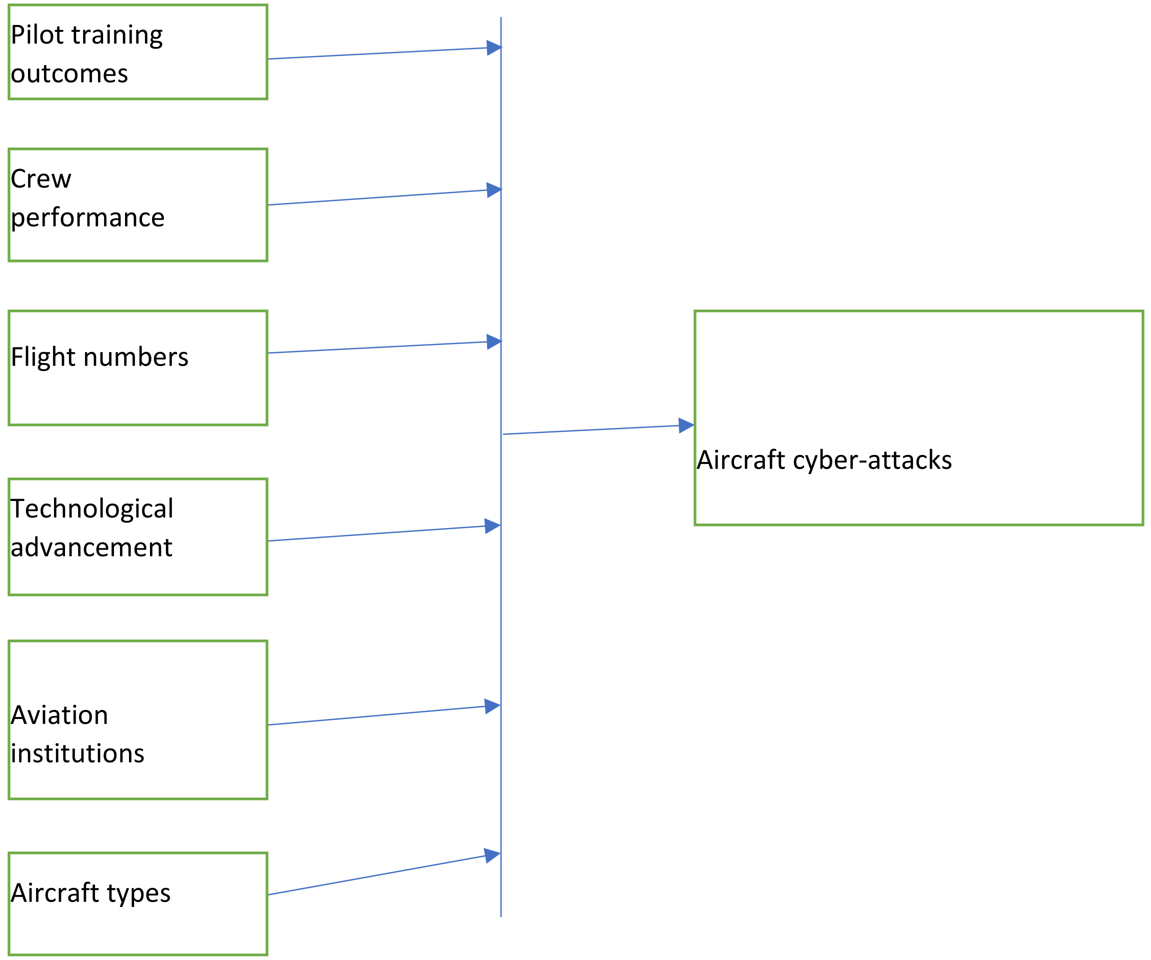
What is the relationship between combating the aircraft cyber-attacks in the Triple E, Colorado, and various factors such as pilot training outcomes, crew performance results, flight numbers, technological advancement, and the aviation institutions available?

Statistical hypotheses

H0: $\rho = 0$, There is no significant relationship between combating the aircraft cyber-attacks in the Triple E, Colorado, and various factors such as pilot training outcomes, crew performance results, flight numbers, technological advancement, and aviation institutions available.

H1: $\rho \neq 0$, There is a significant relationship between combating the aircraft cyber-attacks in the Triple E, Colorado, and various factors such as pilot training outcomes, crew performance results, flight numbers, technological advancement, and the aviation institutions available

Path display


Pilot training outcomes
Crew performance
Flight numbers
Technological advancement
Aviation institutions
Aircraft types
Aircraft cyber-attacks

References

Johnson D. P. (2019, August 30). Civil aviation and cybersecurity. *Honey-well Aerospace Advanced Technology*, 56-59. Retrieved from http://www.aviationtoday.com/2016/12/29/raytheon-is-working-onan-airplane-cyber- attack-warning-system

Federal Aviation Administration. (2017, June). Aircraft cybersecurity: The pilot's perspective. *Air Line Pilots Association*, 1-8. Retrieved from; https://www.alpa.org/-/media/ALPA/Files/pdfs/news-events/white-papers/white-paper-cybersecurity.pdf?la=en Patel, R. (2017, March 21). Managing cybersecurity risk in weapon systems. *Aircraft Systems Authorizing Official, US AIrforce, LCMC*, 36-46.

Graduate Course Performance Indicator Rubric

Assess Student Learning Outcomes

Course: ASCI 6010 Federal and International   Course Instructor:____Janice McCall____________________________

Semester Taught: ___Spring 2022________________

Number of Students in Course:___1____

Student Learning Outcome Assessed	Assessment Results: (Indicate what % of class achieved a minimum score of 80%)	Benchmark achieved? (Benchmark: 80% of students will score a minimum of 80% = "B")
SLO 2: Apply the major practices, theory, or research methodologies in the aviation field of study.	100%	Yes
SLO 4: Articulate arguments or explanations to both a disciplinary or professional aviation audience and to a general audience, in both oral and written forms.	100%	Yes

Course Assessment (Intended Use of Results)
The following will be used for recommendations to improve the quality of course delivery based on assessment results. These recommendations may include prerequisite change; changing course outline and adding more topics; adding a third assessment; changing the course sequence, etc.

NOTE: In SLO 4, I did not require the student to provide an oral presentation. Nonetheless, through engagement on the Discussion Board the student demonstrated the ability to clearly and succinctly articulate a cogent argument.

**Attach description of assignment used for assessment and samples of student work.*

SLO 2: Apply the major practices, theory, or research methodologies in the aviation field of study.

ASSIGNMENT SLO 2

Intro to Mod 4

Intro to LM:

In the last learning module, we looked at how regulations are created for the aviation industry within the USA and abroad. The World Justice Project (2021 (Links to an external site.)) emphasizes that "regulations, both legal and administrative, structure behaviors within and outside of the government." Therefore, strong rule of law necessitates that such regulations and administrative provisions are enforced effectually, and are applied and enforced without inappropriate influence by public officials or private interests (World Justice Project, 2019 (Links to an external site.)). In Module 4 we explore the process of enforcing these regulations in the U.S.A versus the process in the European Union.

"Enforcement is the process of ensuring compliance with laws, regulations, rules, standards, and social norms" (Juliano, 2019 (Links to an external site.)). In the U.S.A. this function falls to the FAA, for the E.U. it is EASA and E.U. member states. Throughout the world, National Aviation Authorities or Civil Aviation Authorities, have the mandate to investigate conduct that violates statutes, or regulations, under their control.

Note that this Module is intended as an overview of enforcement rather than an in-depth exploration of specific types of fines, actions, and penalties, which will be covered through discussion in Module 5.

There is one assignment for this LM:

- Short paper due 13 March 2022 (possible 60 points) Due date extended to 20 Mar2022
  - 3-5 page paper comparing and/or contrasting enforcement process between FAA, EASA's memberstates.
  - Follow the short paper formatting requirements and sample paper
  - Submit the paper by attaching a Word document to the assignment link

STUDENT SAMPLE SLO 2

Amy Preis
ASCI 6010
20 March 2022

Rise of Unruly Passengers and Regulatory Response

Verbal abuse, threatening behavior, and physical aggression from airline passengers is sadly becoming more and more of a reality for airline crew members. In February 2022, a passenger on American Airlines Flight 1775 from Los Angeles to Washington, D.C. attempted to open the main cabin door in flight after threatening crew with escalating, aggressive behavior. In order to subdue the perpetrator, a crew member resorted to bludgeoning the unruly passenger with a coffee pot while other crew and passengers restrained him with tape and zip ties. The flight ended with an emergency landing in Kansas City and authorities waiting to collect the perpetrator at the gate (Chung & Lukpat, 2022). While this incident made headlines and stands out, such dangerous behavior from passengers presents a continual threat to airline crew members and the traveling public.

Commercial air travel has seen a rise in unruly passenger incidents over recent years. The International Civil Aviation Organization (ICAO) defines 'unruly passengers' as:

> Passengers who fail to respect the rules of conduct on board aircraft or to follow the instructions of crew members and thereby create a threat to flight safety and/or disturb the good order and discipline on board aircraft. (ICAO, 2019, Section 1.1)

There have been unruly passenger incidents since passengers began flying on board commercial aircraft. The international aviation industry first recognized threats presented by unruly passengers in the Tokyo Convention of 1963. Recently, the industry has seen a spike in unruly passenger events amidst the global COVID-19 pandemic, with a total 5,981 unruly passenger reports in 2021 (FAA, 2022).

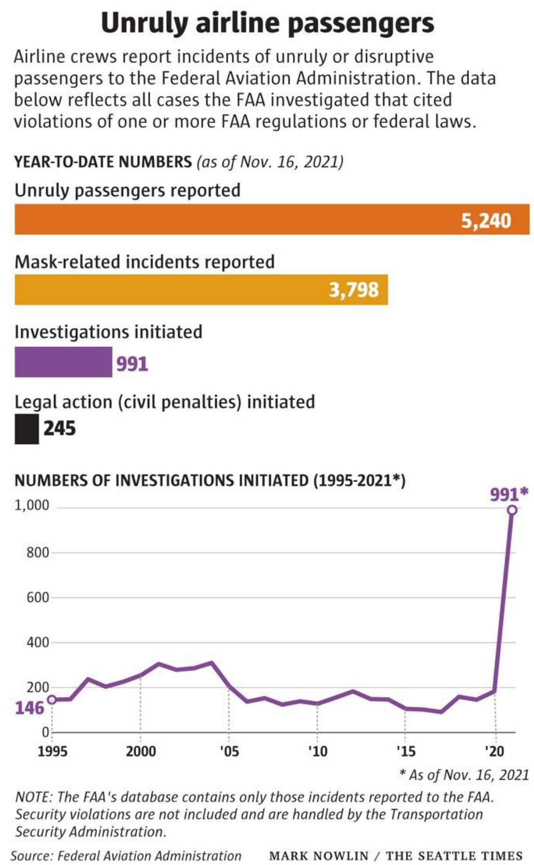


Figure 1 (Shankar, 2021)

It is assumed the real number of incidents exceeds the rate tracked by the United States' Federal Aviation Administration (FAA), as data not reported by a crewmember is not reflected in the FAA tracking system. Globally, airlines and air crew members are calling for stronger methods of deterrence, beyond what currently stands, to combat the wave of unruly passengers seen in recent years. Such incidents pose safety and security threats not just to crew members, but to other passengers, the flight, and the global aviation system at large.

The United States and the FAA's Response

The United States Federal Aviation Administration (FAA) has a series of processes it works through to impose regulatory compliance among passengers. At its disposal are legal enforcement actions through civil penalties, administrative actions through warning notices or compliance actions including counseling (FAA, 2022). Prior to the COVID-19 Pandemic's beginning, the U.S. Congress issued a Reauthorization Bill which increased the proposed maximum civil penalty for unruly passengers to $37,000 from $25,000 per offense. In 2021, the FAA released a new Zero-Tolerance policy, which offered it the ability to impose fines without a warning and the option for the Administration to refer unruly passengers to the Department of Justice for criminal charges (FAA, 2021, Change 7). The FAA also launched a social media and advertising campaign to inform the general public of these reforms, warning against disruptive behaviors in flight:

Figure 2: Social media and advertising signage (FAA airport digital signage, 2022)

Even amidst the threat of up to a $37,000 fine from the FAA and criminal prosecution, unruly passenger incidents only continued to increase after 2018 (FAA, 2022). The majority of incidents in 2020 and 2021 related to compliance with COVID-19 mask regulations. The conclusion is that even in the face of large fines and the threat of criminal prosecution, such behavior aboard aircraft has not significantly deterred.

The European Union and EASA's Response

While the United States' response to unruly passengers works through the FAA and its own legal systems, the European Union signed an international agreement between many nations to act against unruly passengers. The Montreal Protocol 2014 (MP14) took effect at the beginning of January 2020, and gives authorities in an aircraft's arrival country authority to prosecute unruly passengers (Wood, 2019). Previously, the country to which the aircraft was registered was responsible for prosecuting unruly passengers. In effect, this meant that there was no ability for law enforcement in an arrival country to meet the passenger at the gate and no true incentive to dedicate time, resources, and coordination efforts to finding and penalizing an unruly passenger. Similar to the situation in the United States, prior to MP14, research found that six of ten offenses on board flights were going unpunished (Wood, 2019). The treaty allows for more immediate repercussions for unruly passengers and authority for countries to intervene and provide punitive penalties.

The effectiveness of MP14 is yet to be seen, though. Despite MP14's launch at the beginning of 2020, unruly passenger incidents continued to increase through 2020 and into 2021, and just 32 out of 193 ICAO member states had ratified MP14—meaning only about one-third of international traffic is expected to be covered by the treaty (IATA, 2021). The COVID-19 Pandemic has continued to exacerbate unruly passenger incidents in flight and the penalties for these actions do not appear to prevent such behavior from passengers. The United States has yet to sign MP14, and until the majority of countries around the world come to agreement on an effective multilateral treaty, the aviation industry lacks a global standard for unruly passengers in airline travel.

Moving Forward

The legal means are in place to give regulatory bodies authority to take punitive action against unruly passengers. The nature of seeking justice through the legal system, however, involves time, costs, and coordination efforts to gather information and present a case—a reality that means legal reaction is slow and ineffective. In the United States, legal experts note that while federal agencies have the authority, and a multitude of legal tools, to prosecute against unruly passengers, there is a need to invest resources into making sure that process of enforcement is well-funded and considered a priority among all authorities (Keithley, 2022). As such, the punitive measures being taken are not significantly deterring dangerous behavior among unruly passengers, presenting a continued threat to the safety of flight.

Globally, airlines and the International Air Transport Association (IATA) are calling for swifter, more decisive actions against unruly passengers. Steeper fines in the U.S. and more widespread enforcement abilities in the E.U. are not providing enough disincentive for unruly behavior. From IATA, there are calls for the global community to prosecute passengers criminally for such disturbances (Schengenvisainfo News, 2021). Airlines within the U.S. are petitioning the Department of Justice to include unruly passengers on a national no-fly list, a list which currently prevents suspected terrorists and extremists from boarding an aircraft (Shepardson, 2022). Such an action would prevent passengers that were deemed unruly in one incident from boarding any U.S. airline flight. Terrorists typically act upon political or ideological motivations and carry out premeditated acts, where unruly passenger incidents tend to be in reaction to stressful situations and often involve alcohol consumption. Grouping badly behaved passengers and terrorists under the same policy could present legal and operational conflicts. The No-Fly list, as it stands, poses civil liberty implications and has already been challenged in court numerous times (Sampson, 2022). A federal unruly passenger list would likely bring similar legal challenge and discourse.

As unruly passenger incidents continue to trend upward, immediate action is needed. This includes continued pressure on all ICAO members to ratify MP14 and bolstering federal agencies' abilities to investigate and prosecute unruly passengers. While regulatory bodies continue to issue new rulings, their ability to quickly prosecute individuals may aid in effectively deterring other negative behaviors. At the same time, global conditions, such as the highly stressful ongoing coronavirus disease of 2019 (COVID-19) pandemic, create environmental stressors that likely to continue to influence passenger behavior. The key will be in finding an appropriate equilibrium between the hazards presented by unruly passengers and an effective response from government and industry to curb dangerous behaviors.

References

Chung, C. and Lukpat, A. (2022, Feb. 13). Flight makes emergency landing after passenger tries to enter cockpit. *The New York Times*. https://www.nytimes.com/2022/02/13/us/american-air-emergency-landing.html.

FAA (2022). Unruly passengers. *Federal Aviation Administration.* https://www.faa.gov/data_research/passengers_cargo/unruly_passengers/

FAA airport digital signage (2022). Airport digital signage. *Federal Aviation Administration.* https://www.faa.gov/data_research/passengers_cargo/unruly_passengers/toolkit/digital_signage/.

IATA (2021, Nov. 9). Unruly passenger incidents on the increase. *International Air Transport Association.* https://airlines.iata.org/analysis/unruly-passenger-incidents-on-the-increase

ICAO (2019). Doc 10117: Manual on the legal aspects of unruly and disruptive passengers. *International Civil Aviation Organization.* https://www.icao.int/MID/Documents/RPTF%20Stream%203/Manual%20on%20the%20Legal%20Aspects%20of%20Unruly%20and%20Disruptive%20Passengers%20(Doc%2010117).pdf

Keithley, G. (2022). The Federal Powers to Fight Back Against Unruly Airline Passengers. *The Air and Space Lawyer*, *34*(3), 6-9. https://www.americanbar.org/content/dam/aba/publications/air_space_lawyer/winter2022/v034n03keithley.pdf

Sampson, H. (2022, Feb. 10). The 'no-fly' list and unruly passengers, explained. *Washington Post.* https://www.washingtonpost.com/travel/2022/02/10/no-fly-list-delta-ceo/.

Schengenvisainfo News. (2021). IATA calls on govts to review aviation laws on unruly passengers due to increasing numbers of incidents. *Schengenvisainfo.* https://www.schengenvisainfo.com/news/iata-calls-on-govts-to-review-aviation-laws-on-unruly-passengers-due-to-increasing-numbers-of-incidents/

Shankar, V. (2021, Nov. 22). Eight alcohol-fueled unruly passengers face $161,823 in fines. *Seattle Times.* *https://www.seattletimes.com/business/eight-alcohol-fueled-unruly-passengers-face-161823-in-fines/*

Shepardson, D. (2022, Feb. 4). Delta CEO wants U.S. to put convicted unruly passengers on 'no fly' list. *Reuters.* https://www.reuters.com/business/aerospace-defense/delta-ceo-wants-us-place-convicted-unruly-passengers-no-fly-list-2022-02-04/.

U.S. Department of Transportation (2021). National policy order 2150.3C. *U.S. Department of Transportation.* https://www.faa.gov/documentLibrary/media/Order/FAA_Order_2150.3C_CHG_7.pdf

Wood, D. (2019, Dec. 5). New international legislation makes it easier to punish unruly passengers. *Travel Pulse.* https://www.travelpulse.com/news/airlines/new-international-legislation-makes-it-easier-to-punish-unruly-passengers.html

Amy, this is absolutely a great paper and a well-researched topic. It was a pleasure to read as I had my coffee this morning.

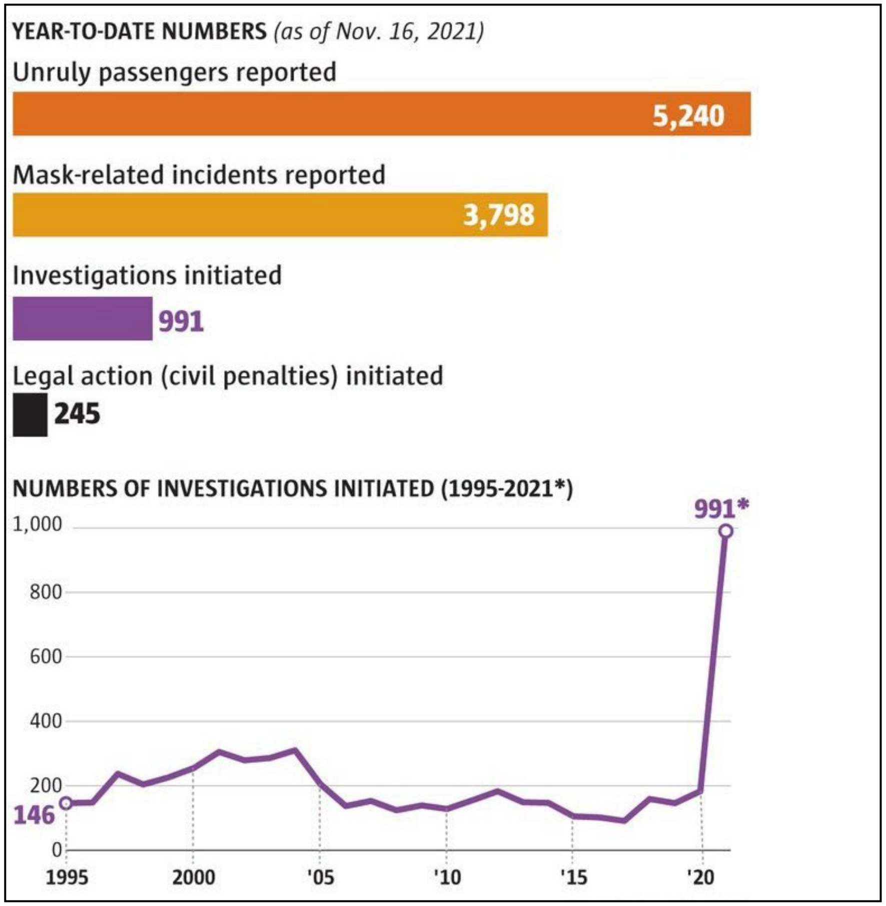
Grade: 59/60

It is always nice to see what a few revisions can do to strengthen what was already a good paper. That is certainly the case with your revisions and additions to this paper. With a couple of tweaks, you should definitely include this in your portfolio.

I love the figures! I encourage you to include at least one in papers since some people absorb information from images and figures more easily than text, plus it lends credibility to your work. APA 7th made big changes in how figures are presented (See Purdue OWL APA Student Sample Paper). I've modified your figure below as an example you can use to make changes for future papers.

Figure 1 *[2nd level heading, flush left, bold, and title case]*

Unruly Airline Passengers *[Title of Figure, italicized]*



Note. Reproduced from Nowlin (2021, November 22) as published in *The Seattle Times*. The data depicts all cases the FAA investigated that referred to one or more violations of regulations, or federal laws, by unruly passengers. The FAA's database includes only the incidents reported to the FAA and does not incorporate security violations that are handled by the Transportation Security Administration (para. 4).

Notice that I cropped out much of the text and paraphrased it on the note at the bottom, hence the "para. 4." This allows you to increase the size of the image to more closely match the paper's text font. Think of 10 as the minimum font size for readers that like to print papers.

*I put in a basic black border so the figure stands out from the paper's white background. In the note, I clearly state that the image is "reproduced" and cite the **artist**, Nowlin, not the author of the article. You'll need to change the reference to Nowlin as well. Adjust both figures to this format before including the paper in your portfolio.*

Now is the time to decide on your final paper topic and get started doing the research. Keep up the great work in the class.

Jan

SLO 4: Articulate arguments or explanations to both a disciplinary or professional aviation audience and to a general audience, in both oral and written forms.

ASSIGNMENT SLO 4

Mod 3 DB: The U.S. and E.U. Regulatory Environment: Government Regulation of the Airline Industry

Janice McCall

Chose **two questions** to answer from the list below. Limit your answers to 2-4 paragraphs. Responses and replies to others are due by the end of the module on 27 FEB and are worth a total of 60 points. Please use weblinks for source citation in lieu of references.

Post early enough to allow time for others to review and respond. The best approach is to post early and then spend time discussing the topics with the class. Take time to review and engage peers on their responses.

- What are a few of the differences between the US and EU rulemaking processes and implications for the aviation industry?
- How do nations work together to create the regulatory environment by setting regional or global standards in a particular area (choose something like environmental, health, free trade, etc.)?
- Imagine what aviation would be today without ICAO, then describe how aviation coordination between nations might occur.
- Over the past few years, the accidents surrounding the Boeing 7373 Max beg the question of how nations determine the airworthiness of commercial aircraft. Explain the process that ensures an aircraft certified in one country meets the requirements of another.
- How are crew standards developed and incorporated to provide one level of safety worldwide? Consider differences in training standards, medical standards, age, abilities, etc..

STUDENT SAMPLE SLO 4

Amy Preis (Q1)

Feb 25, 2022

What are a few of the differences between the US and EU rulemaking process and implications for the aviation industry?

One of the most notable differences between the US and EU's aviation rulemaking process is where each body derives its authority. In the US, the Federal Aviation Administration is charged with ensuring the safety of civil aviation in the United States through the Federal Aviation Act of 1958 (Public Law 85-726, 1958 (Links to an external site.)). The FAA's Administrator's authority to issue rules regarding use of airspace is found in 49 U.S.C. 40103. It is through the United States legislative branch that the FAA is granted authority to oversee rulemaking in the United States. Conversely, the European Union is a cooperation of 27 member states, and through this agreement of nations, established the European Aviation Safety Administration (EASA) to oversee its aviation rulemaking and works with member nations to implement regulations (EASA, 2022 (Links to an external site.)). EASA replaced the Joint Aviation Authority and member states regulating their own aviation regulations, due to varying interpretations and differences in rules across member states. With the establishment of EASA, instead of deriving its authority from one country or government, EASA derives its rulemaking authority from the conglomerate agreement of nations within the European Union. In the aviation industry, that may present complications given language barriers, different governments' interests, and the bureaucracy of regulating on behalf of numerous countries. Even with the establishment of a singular aviation regulatory body, the EASA represents 27 countries while the FAA serves one.

Often, in the US, the Aviation Rulemaking Advisory Committee (ARAC), a standing committee, offers recommendations for potential rulemaking actions to address perceived problems and specific areas of concern (14 CFR Part 11.27 (Links to an external site.)). Meanwhile, EASA establishes a 5-year rulemaking priorities list that drives its rulemaking process over the subsequent years and establishes the various rulemaking projects that the agency will undertake (European Aviation Safety Agency, 2015 (Links to an external site.)). Referencing back to the numerous countries that EASA represents, establishing a 5-year "to do" list for rulemaking likely makes the endeavor organized and keeps all members of the EU on the same page–but that may also mean that opportunities to undertake differing rulemaking projects may have to wait until the next five year cycle.

In the US, once a rulemaking project is determined by the Administrator, The FAA relies on input from ARAC and other established committees in various rulemaking projects (Advisory and Rulemaking Committees, n.d (Links to an external site.) & Advisory and Rulemaking Committees List, n.d (Links to an external site.).) Conversely, EASA will assemble a rulemaking group based on the specifications of its rulemaking project, determined by the Executive Director (EASA Management Board Decision, 2015 (Links to an external site.), Article 4.4). Thus, in the US, the committee involved in one rulemaking project could contribute to another project, while EASA assembles a new committee based on the project–and at the discretion of the Executive Director. ARAC, meanwhile, is also able to bring a rulemaking project to the attention of the Administrator and be a part of the rulemaking project itself. The differences between the way each regulatory body assembles and utilizes committees of stakeholders has the opportunity to change the way the regulatory body and the industry itself interacts with those committees.

- Janice McCall

  Feb 26, 2022Feb 26 at 2:39am

  Wonderful Amy. I see you really spent time researching the differences.

  Do you think the ARAC brings the same expertise compared to the EU assembly of various experts when proposing new or rule changes?

  Jan

Amy Preis

Feb 26, 2022Feb 26 at 5pm

Thank you, Jan. I found myself in the weeds a few times, so I'm glad it made sense.

I imagine that the FAA's ARAC is especially tuned into the rule making process; the committee exists for that purpose. Compared to the EU assembled groups, that would have an advantage of familiarity of standing regulations and the possibilities to adopt future regulations. Conversely, the EU assembled group likely involves more experts in the relevant field, since they are assembled explicitly for that rule making project. The EU assembled group, I imagine, would have more of a practical knowledge of how those regulations play out in industry.

I'm viewing the comparison as 'career politicians' vs. 'grassroots-elected politicians'--though I may be completely wrong. If that is the case, however, the FAA's method probably makes for a smoother rule-making process; EASA's method may bring people to a committee who have not worked in rule making before (and bring a whole different working perspective to it).

- Janice McCall

  Feb 26, 2022Feb 26 at 7:18pm

  Amy, I like your analogy of career politician vs grassroots. The ARAC may have the rulemaking process down but could lack some of the expertise and familiarity with real-world implications.

  I’m not sure how or what role lobbyists play in EU rulemaking. In the US, lobbyists for airlines, trade unions, aviation orgs, etc., play a prominent role in rulemaking.

  Jan

Amy Preis

Feb 27, 2022Feb 27 at 4:33pm

Ah! Yes, cannot forget our lobbyists' power. Side tangent, but I was just talking with someone about the possibility of a hyperlink rail system between St. Louis and Chicago, and the power of the airline lobby that killed it about 6-7 years ago. I expect that is still the case with that specific project.

Amy

Amy Preis (Q2)

Feb 26, 2022Feb 26 at 4:53pm

How do nations work together to create the regulatory environment by setting regional or global standards in a particular area (choose something like, environmental, health, free trade, etc.)?
The global aviation system maintains a similar standard of safety and impact globally through guidance from the International Civil Aviation Organization (ICAO). ICAO provides Standards and Recommended Procedures as guidance, and recommends that member states have a national level organization to oversee aviation safety oversight within each country. SARPs (or amendments) are implemented following ⅔ of Member States' support, meaning that these standards are agreed to by a majority of member states. ICAO also utilizes Resolutions adopted by its member states to agree upon global standards in a particular area. Resolutions aren't quite 'rules' for civil aviation with actionable consequences, but are instead agreed-upon goals. When the ICAO Assembly of 193 member states meets every three years, resolutions may be adopted to guide future amendment actions that all member states may pursue (United Nations, 2021 (Links to an external site.)).

Recently through ICAO, member states have agreed that one of three main areas of collaboration will be climate change and aviation admissions. In 2019 at its 40th ICAO Assembly Session, member states voted to adopt Resolution A40-18 that (ICAO Environmental Protection, 2021 (Links to an external site.) and Resolution A40-18, 2019 (Links to an external site.)). Resolution A40-18 re-established previously stated and agreed upon resolutions surrounding the role that aviation plays in climate change, necessary limits on harmful emissions, as well as recognizing that sustainable growth of the industry globally will require a "comprehensive approach, consisting of a basket of measures including technology and standards, sustainable aviation fuels, operational improvements and market-based measures to reduce emissions" (Resolution A40-18, 2019 (Links to an external site.), page 2, paragraph 5). The Resolution, as well as environmentally-related Resolutions A40-17 and A40-18, requests that ICAO study policy options to reduce aircraft engine emissions and develop proposals that encompass solutions for member states to adopt (Resolution A40-18, 2019 (Links to an external site.), page 4, Section 2.b).

With this resolution as guidance, or as a goal, member states may tailor their own actions, research and development, and national resources to meet the agreed-upon benchmarks. For example, the ECAC/EU Emissions Reduction Task Group (including representatives from EASA and EU member states) has publicized a commitment to create an action plan related to the Resolution that will ensure Europe's compliance (ECAC News, 2020 (Links to an external site.)). Similarly, in the US, NASA was found to have used the carbon reduction goals of Resolution A40-18 as guidance for its

sustainable aviation strategy (Kenyon, 2021 (Links to an external site.)). With the agreed upon Resolution, member states set a goal that the industry around the globe is working toward in tandem.
Setting these goals establishes a blueprint for future ICAO Standards and Procedures to be developed. There already exists Annex 16 Volume IV, effective October 22, 2018, that encompasses the global Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) (ICAO Environment Annex 16 Volume IV, n.d. (Links to an external site.)). The future opportunity exists for ICAO Member States to include strategies and policy that result from Resolution A40-18 into Annex 16 as well.

- Janice McCall
  Feb 27, 2022Feb 27 at 6:32am
  Amy, COVID gave us a brief glimpse of how air quality improves with reduced emissions from aircraft, and of course other sources. Not only, do I appreciate the comprehensive and agreed upon goals laid out by ICAO, I also see hope in recent research. Just last year, Grewe et al. (2021, June 22 (Links to an external site.)) found that "ICAO's offsetting scheme, CORSIA, will surpass the climate target set to support the 1.5 °C goal between 2025 and 2064 with a 90% likelihood."

  When I was a kid in Southern California, in the 1970s, there was a joke that told the scary state of air quality back then. "What is the difference between San Bernardino and Los Angles? In San Bernardino, you can see what you are breathing, and in Los Angles you can walk on it." From the mountains, you could see a thick brown layer of smog covering the valleys.

  Over the years, beginning as early as 1966, California began introducing control strategies that have worked. In 2011. I returned to California and was relieved to see the change. As I drove around the mountains, the sky was beautifully clear and the buildings and farms in the valley were in full view. Having seen the change implementing controls made in California, I am hopeful for the direction aviation has chosen towards protecting the environment and a sustainable future.

  Jan
- Amy Preis
  Feb 27, 2022Feb 27 at 4:38pm

That is very promising research surrounding CORSIA! I am sad to say that researching this question was the first time I'd heard of CORSIA and the actionable climate goals set through ICAO.
Your California example speaks to the optimist side of me. There is a lot of power in aligning policy and resources with effective goal-setting, that in the long run can pay off. I hope that every country that stated verbal agreement to these goals in the Resolution are sincerely invested in effecting change as well.

Amy