Program-Level Assessment: Annual Report

Program Name (no acronyms): Master's in Aviation	Department: Oliver L. Parks Department of Aviation Science
Degree or Certificate Level: Masters	College/School: School of Science and Engineering
Date (Month/Year): June 2022	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 2023	
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 – Analyze and interpret data at the master's level.

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 5220 Aviation Safety Programs
ASCI 5230 Professional Ethics and Standards
ASCI 6020 Flight Operations Business and Administration
ASCI 6030 – Aviation and Public Policy
ASCI 6070 – Aviation Training Methods

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 are able to analyze and interpret data at the master's level.

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 05/24/2023 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

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 5220 Aviation Safety Programs	None.	The next assessment of this course will be after the Fall 2023 semester.
ASCI 5230 Professional Ethics and Standards	None.	The next assessment of this course will be after the Spring 2024 semester.
ASCI 6020 Flight Operations Business and Administration	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.

ASCI 6030 – Aviation and Public Policy	Develop a list of module follow-up questions be developed for each discussion thread to improve discussion thread content and consistency year over year, especially when discussion is more limited with small course section sizes.	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 6070 – Aviation Training Methods	Continue to develop the expectations and rubric for the term paper. Continue to evaluate weekly topics for suitability of the discussion boards.	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 2025 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.

If no changes are being made, please explain why.

N/A.

7. Closing the Loop: Review of <u>Previous</u> 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.

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, Analyze and interpret data at the master's level.

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.

Department of Aviation Science

Assessment of M.S. in Aviation Student Learning Outcomes

Student Learning Outcome 2 – Analyze and interpret data at the master's level.

Date of this assessment: 05-24-2023

The following assessment is based on prior coursework of students and graduates and surveys of graduates. See Appendix A.

Performance Indicator Assesses	**Do not Meet**	**Meet**
Students and graduates interpret research findings published in peer-reviewed journals and technical reports.		**X**
Students and graduates report statistical findings in the APA format.		**X**
Students and graduates assess contemporary issues in aviation and interpret the outcomes.		**X**

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

- The faculty of the department determined that in the ASCI 5010 Introduction to Aviation Research Methods course, a term paper would be required to raise the level of rigor in the course.

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

- The ASCI 5010 Introduction to Aviation Research Methods course was not taught during the AY 2022-2023 and department faculty did not have the opportunity to assess the recommendation.

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 level of rigor by requiring a term paper.
- In the ASCI 6030 Aviation and Public Policy course, it is recommended to develop a list of module follow-up questions be developed for each discussion thread to improve the discussion thread content and consistency year over year, especially when discussion is more limited with small course section sizes.
- In the ASCI 6070 Aviation Training Methods course, it is recommended to continue to develop the expectations and rubric for the term paper, and to continue to evaluate weekly topics for suitability of the discussion boards.

Department of Aviation Science

Graduate Program Assessment – MS in Aviation

SLO 2 – Analyze and interpret data at the master's level.

Continuous Improvement Items

06-24-2023

Course	Action Item
ASCI 5010 Introduction to Aviation Research Methods	Raise level of rigor by requiring a term paper.
ASCI 6030 – Aviation and Public Policy	Develop a list of module follow-up questions be developed for each discussion thread to improve the discussion thread content and consistency year over year, especially when discussion is more limited with small course section sizes.
ASCI 6070 – Aviation Training Methods	Continue to develop the expectations and rubric for the term paper. Continue to evaluate weekly topics for suitability of the discussion boards.

SAINT LOUIS UNIVERSITY

OLIVER L. PARKS DEPARTMENT OF AVIATION SCIENCE

Appendix A

M.S. in Aviation

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

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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

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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.

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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).

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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.

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Post 2

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.

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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 ashigh.

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.

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

Post 2

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.

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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

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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.

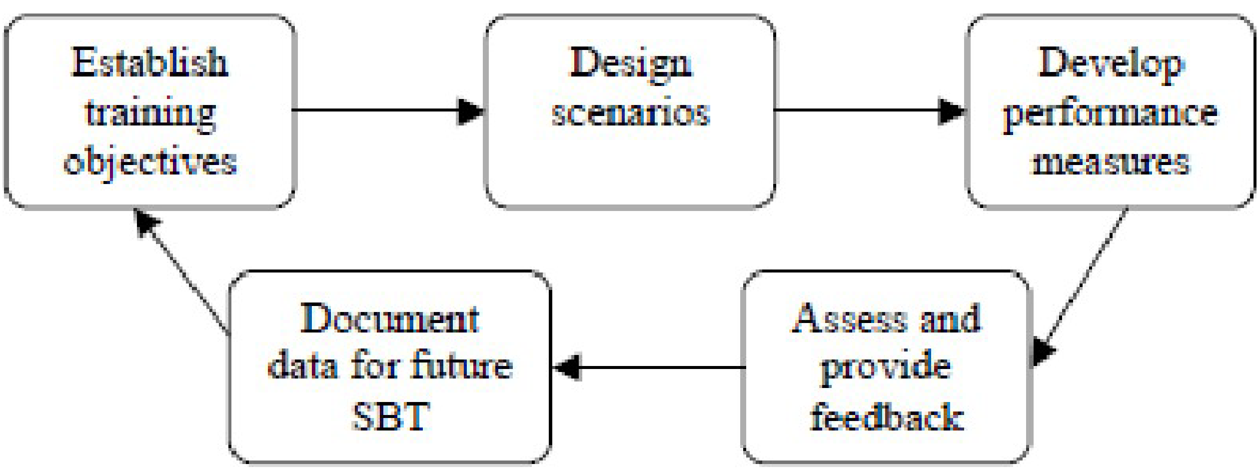

Figure 1

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.

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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

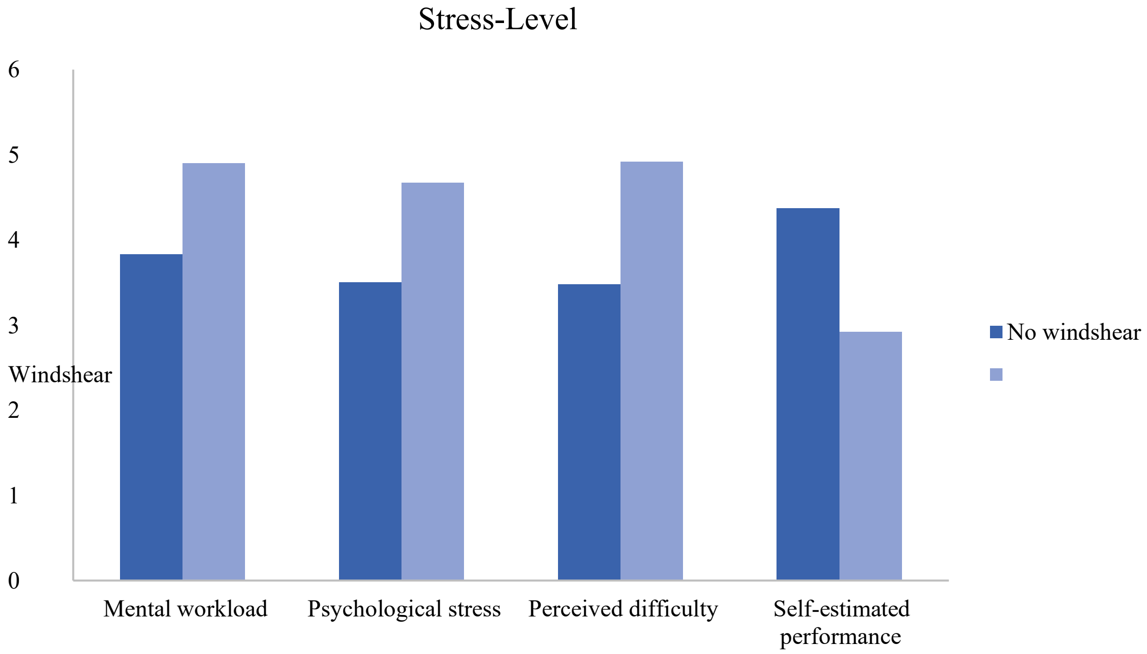
It would have been desirable to include statistical data in this report, showing, for example, the frequency of occurrence of certain behavior patterns of pilots in the cockpit and, in the best case, even a connection to certain incidents. To do this, the pilots would always have to be monitored, which, 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.

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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.

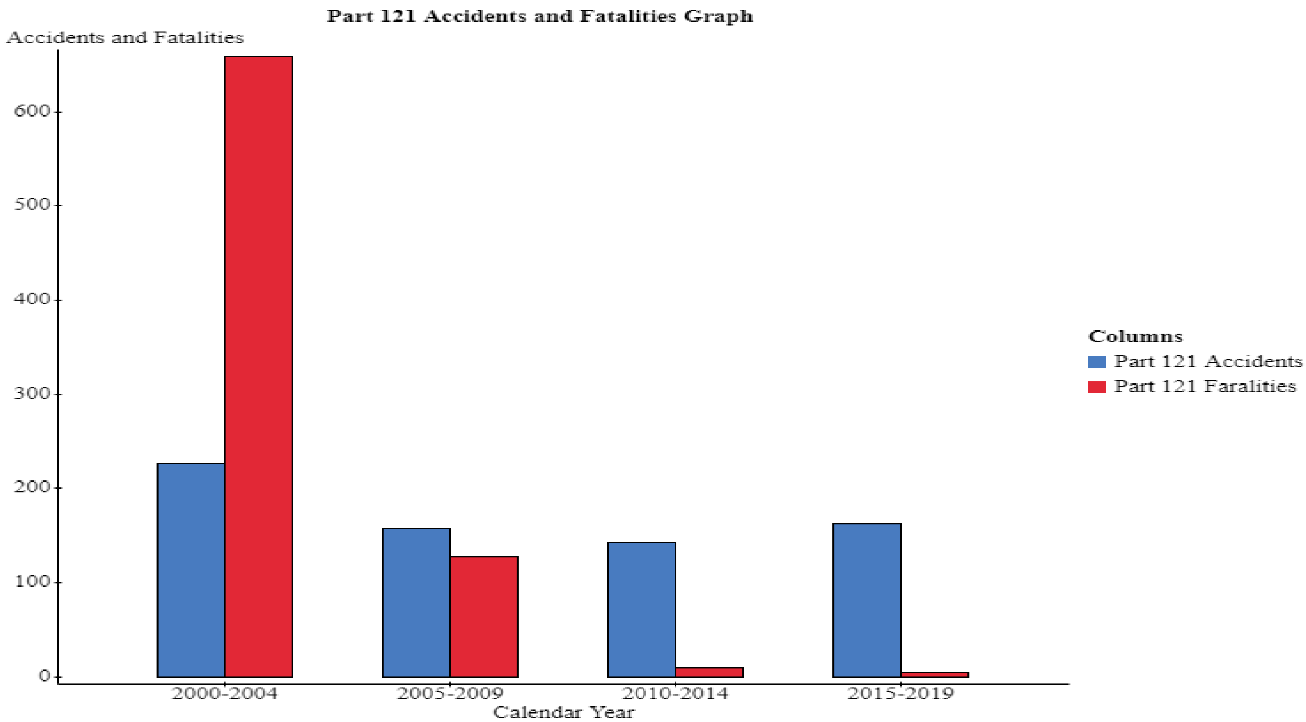
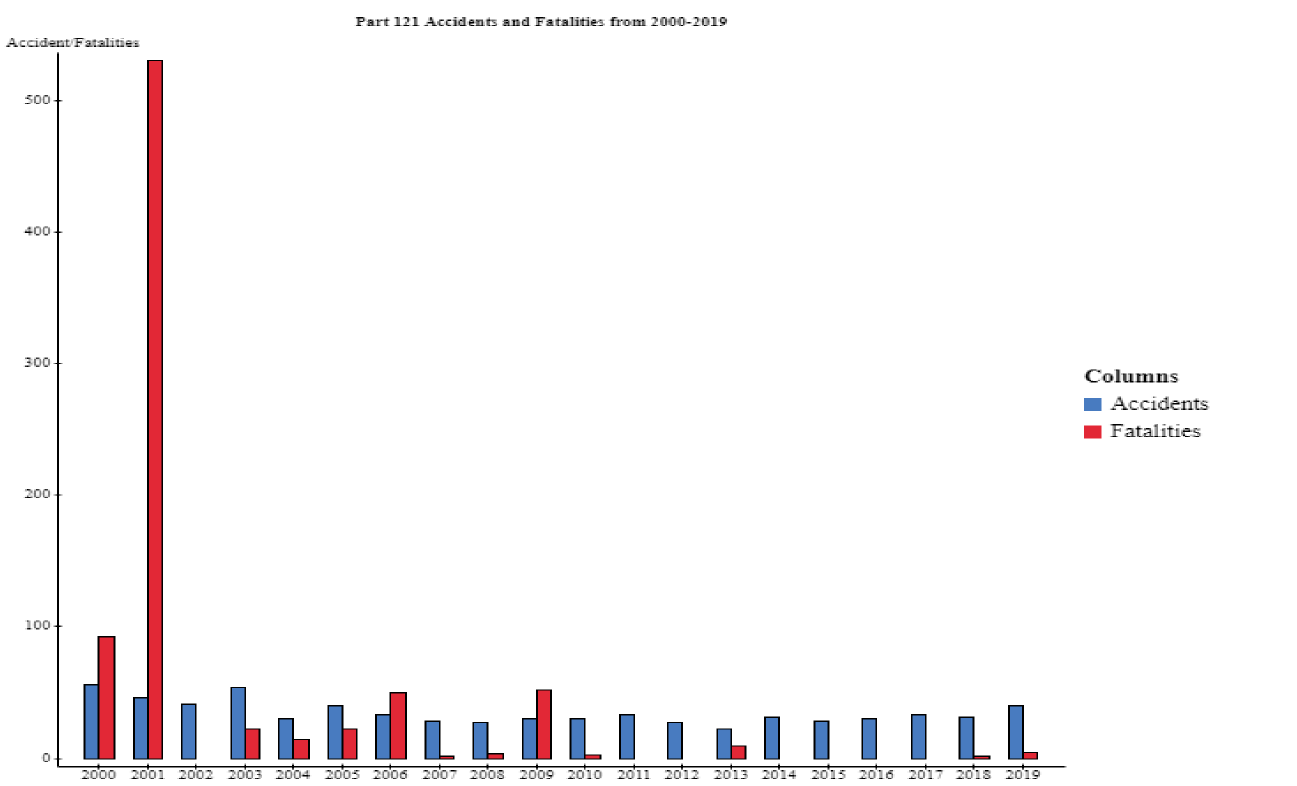


Figure 2: Yearly Part 121 Accidents and Fatalities Graph



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

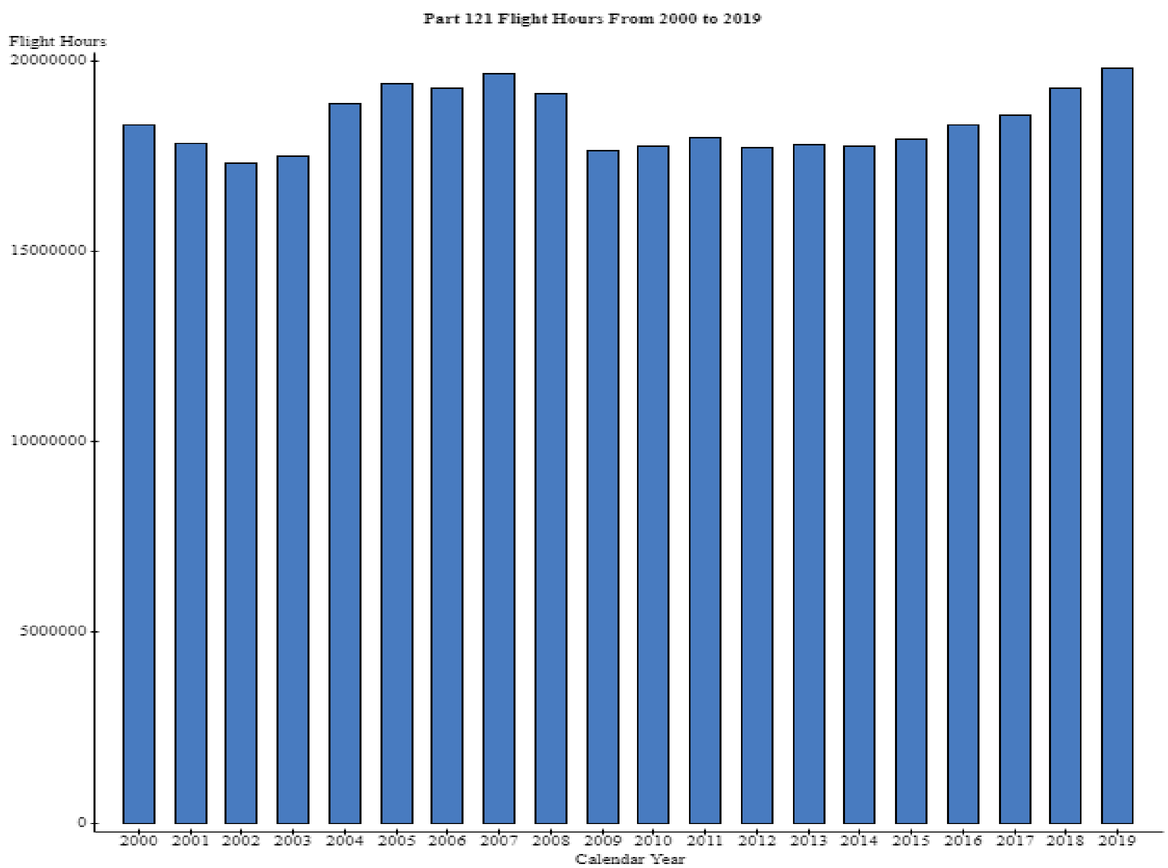
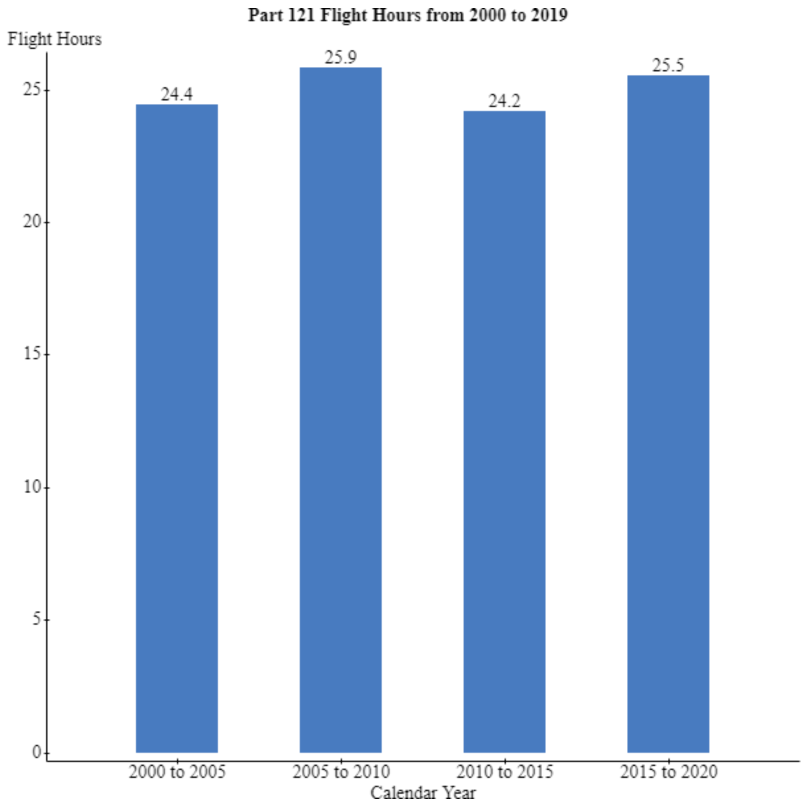


Figure 4: Percentage of Part 121 Flight Hours from 2000-2019 in five years intervals



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

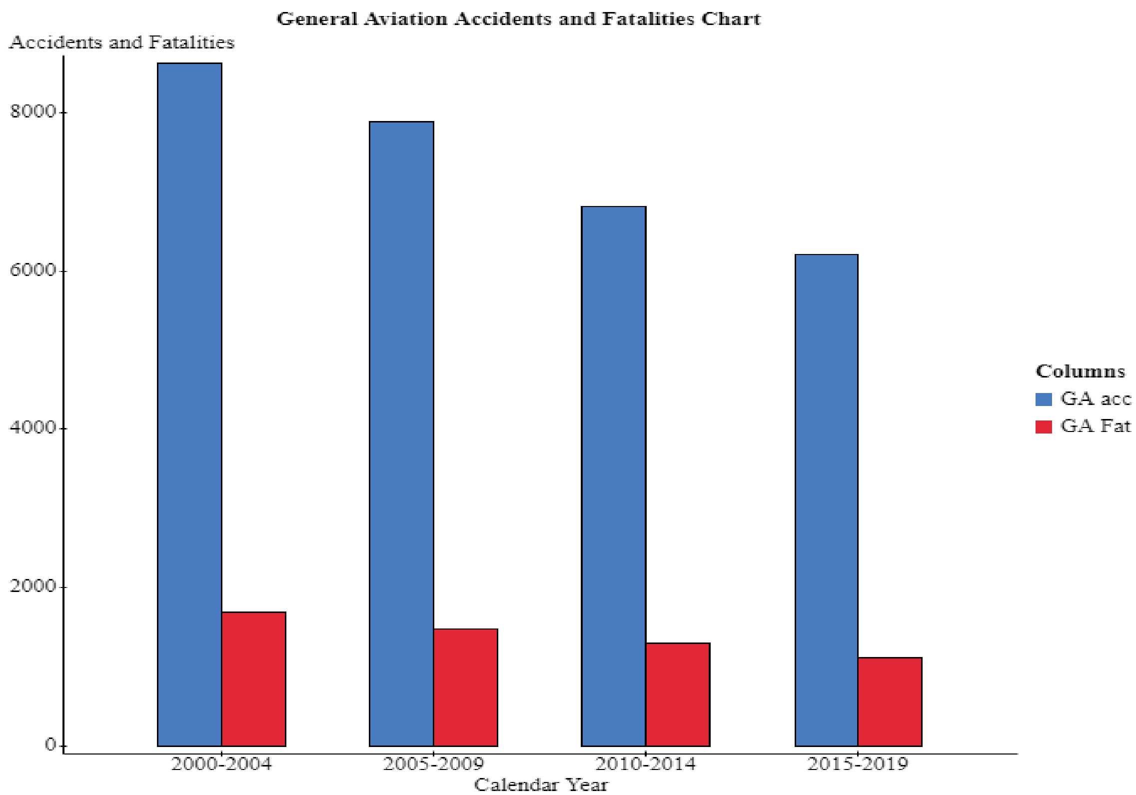
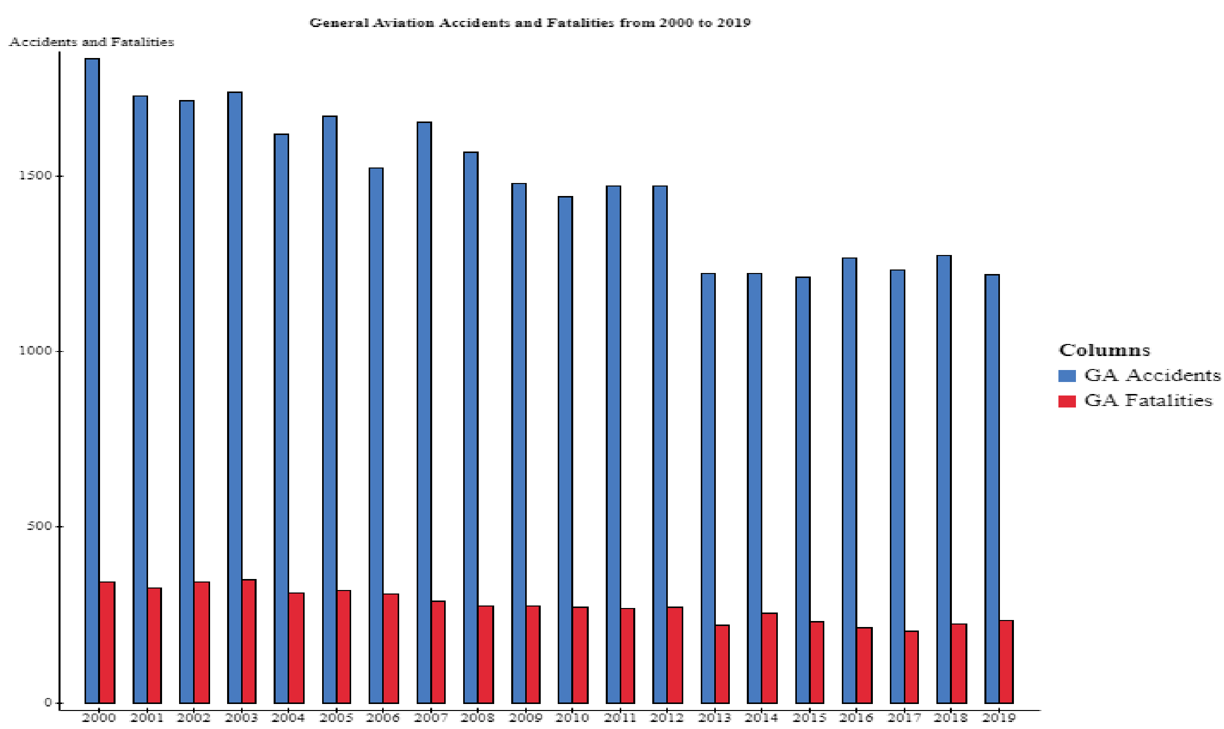
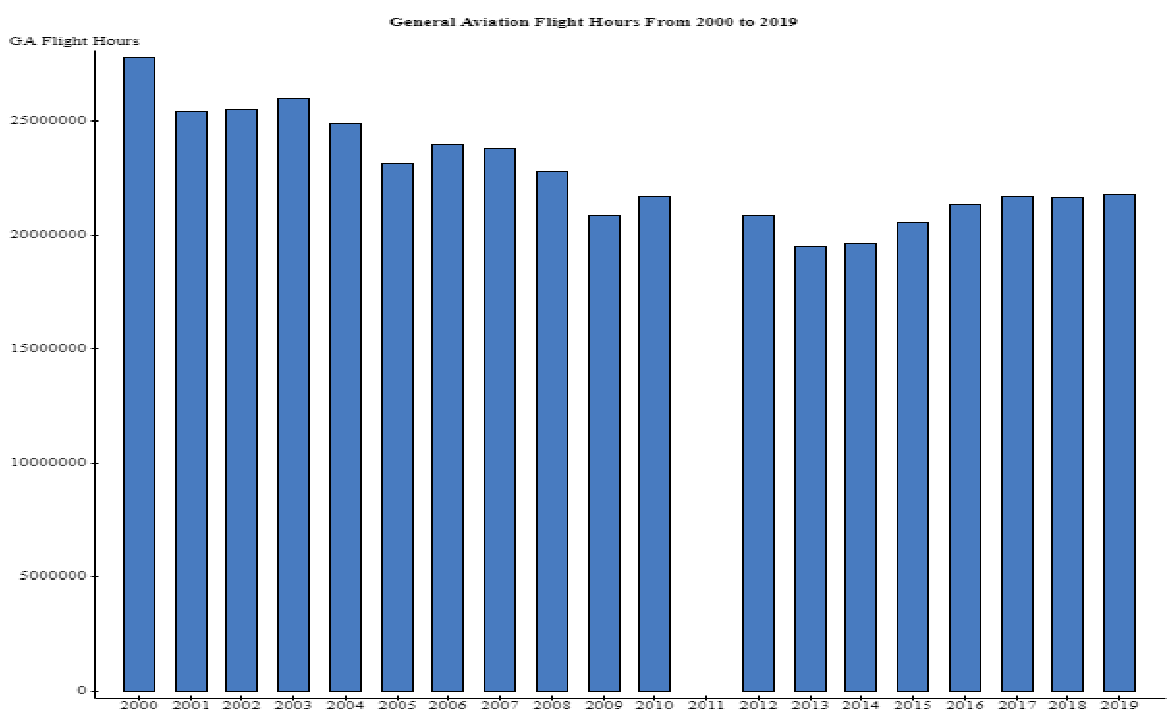


Figure 6: Yearly General Aviation Accidents and Fatalities Graph



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

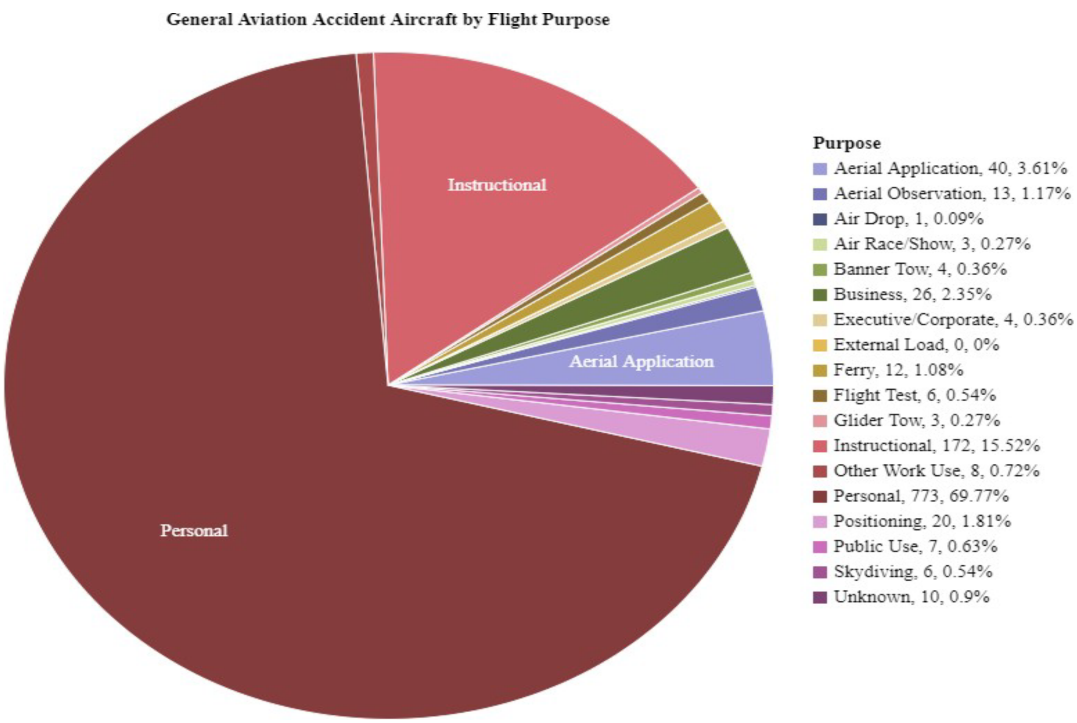


Table 1

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.

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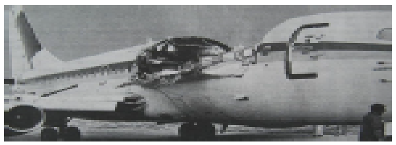
SAINT LOUIS UNIVERSITY

Aviation Safety Data Analysis

Human Error In The Cockpit Of An Aircraft

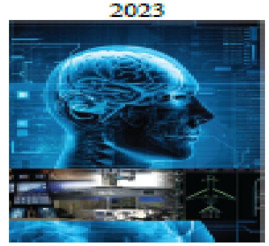
Rationale:

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:

Human-Machine Interaction (Schutte, 2017)

Inattentional Deafness (Dehais et al., 2014)

Inattentional Blindness (Dill & Young, 2015)

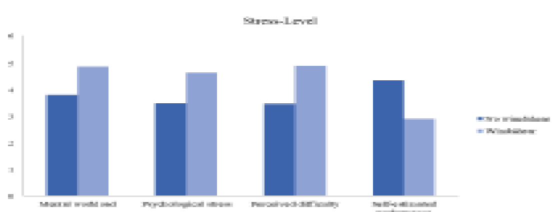
Fatigue (Naeeri et al., 2021)

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 unconcsious 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	

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ASCI 5020: Aviation Safety Data Analysis
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Graduate Course Performance Indicator Rubric

Assess Student Learning Outcomes

Course: ASCI 5210 Aviation Organization Theory and Management Course Instructor: Bill Irwin

Semester Taught: Fall 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 4: Articulate arguments or explanations to both a disciplinary or professional aviation audience and to a general audience, in both oral and written forms.	75% of the students in the course (3 of 4) achieved a minimum score of 80% on the final course term paper which is intended to be of sufficient quality for the student's graduate portfolio and of an initial draft for a peer review publication. The fourth student did not submit a final course term paper, resulting in a grade of "0" for the course term paper.	The benchmark was conditionally achieved as 100% of students who submitted a final course term paper obtained a grade of 80% or higher. Oral presentation skills were not evaluated in this course, but methods of including oral presentations will be considered for future semesters.

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.

Course improvements for consideration for future semesters include 1) adding an oral presentation component to the course requirements in the form of a brief presentation or defense of their course term paper; 2) adjusting the online discussion board grading rubric to include separate components for initial postings to each discussion board question and follow up postings within the discussion board questions (intended to foster greater engagement and follow up postings on the discussion board rather than "drive by" answers); 3) The increased use of aviation peer review examples within each "school" of organization theory. Reflection questions were added to each discussion module in the current semester.

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

An Organizational Review of Delta Air Lines’ Safety and Performance

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ASCI5210: Aviation Organization and Theory Dr. William Irwin

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An Organizational Review of Delta Air Lines' Safety and Performance

Once a small agricultural flying company, Delta Air Lines is now regarded as "the most profitable [airline] in the world and North America" (Aeroclass.org, 2022). The Atlanta-based airline has over 880 commercial aircraft and nine hubs across the United States, including Los Angeles, CA (LAX), and Minneapolis, MN (MSP). They operate over 5400 flights daily and serve 325 destinations across 52 countries (Organimi, 2022). Delta Air Lines is one of the three most popular legacy carriers, along with American and United, meaning that it is an airline with "established interstate routes before the beginning of route liberalisation" (Alternative Airlines), that is, they were in existence prior to the emergence of the 1978 Airline Deregulation act. A legacy carrier is "an airline that typically offers scheduled flights to major domestic and international routes (directly or through membership in an alliance) and serves numerous smaller cities, operates mainly through a "hub-and-spoke" network route system and has higher cost structures than low-cost carriers due to higher labor costs, flight crew and aircraft scheduling inefficiencies, concentration of operations in higher cost airports and multiple classes of services" (Law Insider).

Delta's reputation as a world-renowned airline has been built over the past century through their responses to setbacks and focus on customer satisfaction. However, their success does not equate to perfection and there is plenty of room for improvement in many facets of the airline. The purpose of this paper is to provide an overview of the airline origin and structure, delve into the factors behind their success, and explain the various ways that the airline can improve safety, efficiency, employee morale, and more through the application of aviation organization theory.

Timeline and Overview

To understand their current success, we need to take a look at their history. Delta Air Lines was founded in 1925 by airline entrepreneur Collette E. Woolman, and its predecessor was Huff-Daland Dusters, a commercial agricultural flying company based out of Monroe, La (Delta News Hub). The Huff-Daland Duster Company, whose fleet contained 18 planes, became the largest privately-owned fleet in the world. Upon Woolman’s purchase of the Huff-Daland Dusters, he renamed it Delta Air Service and began operating mail and passenger routes, moving its base to Atlanta, GA. In 1940, Delta introduced the Douglas DC-2 and DC-3 to their fleet and became an active contributor to war efforts through Army pilot and mechanic training. In 1947, they received the National Safety Award for more than one-half billion passenger miles without a fatality, which they go on to receive multiple times throughout their existence. Six years later, they embarked on their first international route to the Caribbean upon merging with Chicago and Southern Airlines, shortly thereafter creating the hub and spoke system. Fast-forward to the seventies, when Delta becomes the first airline to offer its own air express service, named Delta Air Express.

Thus far, it seemed as if Delta Air Lines’ success was on the rise with no major setbacks, but they were not immune to financial loss. According to the New York Times, Delta Air Lines experienced a heavy operating loss of $45.7 million in 1982 (Apulkas, 1982). However, in a turn of events, employees rallied around and collectively raised $30 million in payroll deductions to purchase Delta’s first Boeing 767, naming it “The Spirit of Delta”. The plane is now displayed in Delta’s Flight Museum located in Atlanta, GA (Delta News Hub). The purchase of the B767 is a prime example of teamwork and camaraderie which speaks to the culture of Delta Air Lines at the time. Almost a decade after this display of high employee morale, Delta became a global carrier through the purchase of all of Pan Am's trans-Atlantic routes and the Pan Am Shuttle, making it the largest acquisition of flights in airline history. In 1999, Aviation Technology and Space Week magazine named Delta Air Lines as the "Best Managed Major Airline".

Delta ends the 20th century on a positive note through their launch of SkyTeam, a global alliance with Aeromexico, Air France, and Korean Air (Delta News Hub). Soon thereafter, they experienced another financial loss, as did other airlines, when US airspace closed for two days following the terrorist attacks of 9/11. Once again, Delta was able to recover from this loss and in 2005, began "Operation Clockwork, the largest single-day schedule redesign in aviation history. This led to better on-time departures and reduced airport congestion. Three years later, Delta acquired Northwest Airlines, introduced profit sharing to employees, and announced Wi-Fi for the domestic mainline fleet. In 2010, Delta announced major upgrades to improve customer experience such as full-flat beds and in-seat video, and became the first airline to provide mobile baggage tracking. Their attention to passenger experience and satisfaction is one of the greatest contributing factors of their success.

Current Culture

Delta was a pioneer in many regards, making headlines as the first US carrier to voluntarily ban smoking on all of their flights, the first to offer their own air express service, and the first airline to provide mobile bag tracking. They are often commended for the extent of their airline route network, their in-flight entertainment, customer service, and even passenger food (Kask, 2022). Employees of Delta Air Lines are behind their success and considering that performance is often dependent on employee satisfaction, Delta is clearly treating their employees well. In fact, Delta is considered "the gold standard in profit sharing" (Sahadi, 2020) after they paid employees $1.5 billion in profit sharing, the most in US history. It was also the only airline starring on Fortune's Best Companies to Work For list (Delta News Hub). According to their website, Delta's core values are honesty, integrity, respect, perseverance, and servant leadership (Delta Propel). These values are reflected in their Rules of the Road handbook, which outlines their employee expectations to "live out [Delta's] values and leadership behaviors every day" (Delta Rules of the Road). The handbook goes on to detail the importance of setting clear goals and following through, encouraging employee involvement and demanding and accepting responsibility, as well as listening attentively, speaking openly, debating constructively, and supporting actively. Woolman is quoted on the last page of the handbook stating "no one individual can create an airline…an airline is a team…it must be a friendly, courteous, cooperative, and efficient team, bound as closely as a devoted family" (Delta Rules of the Road, p. 14). The values stated in the handbook, rooted in those of the founder, promote team-oriented culture in which members feel free to express their concerns and have a sense of accountability. The aforementioned values also contribute to a just culture. In such a culture "front line operators or others are not punished for actions, omissions or decisions taken by them that are commensurate with their experience and training, but where gross negligence, willful violations, and destructive acts are not tolerated" (Dekker, 2012, pp. 15-16). A just culture requires that management create a non-punitive culture in which employees do not fear managerial backlash, yet are also held accountable for their actions. This may denote the implementation of a confidential, voluntary safety reporting program in which employees can report safety concerns. Such a program exists at Delta Air Lines called the Aviation Safety Acting Program (ASAP). ASAP programs are "authorized by the FAA to enhance the safety of the airline industry and the flying public through cooperative safety partnerships with the airlines, the labor union and the FAA" (Air Line Pilots Association International (ALPA)). According to their website, Delta has six voluntary reporting systems in place; one for each major department such as Technical Operations, Crew Resource Planning, dispatchers, pilots, and are currently working on implementing one for the Training/Planning department (Delta News Hub). The information gathered through these programs is "analyzed in order to develop corrective action to help solve safety issues and possibly eliminate deviations from Federal Aviation Rules" (ALPA International).

Despite Delta's apparent commitment to safety, there have been recent allegations that may suggest otherwise. In 2018, Delta pilot Karlene Petitt filed an AIR 21 complaint against the airline with the Occupational Safety and Health Administration (OSHA) within the US Department of Transportation (DOT). According to an article in NewsNation, in 2016, Petitt presented vice-president and senior vice-president of flight operations, Steve Dickson and Jim Graham, with a 43-page report detailing safety concerns. In response, the airline brought an outside auditor to look into the claims and they changed their policies and training manuals according to DOT records (Smith, 2022, para. 4). Soon thereafter, Petitt was referred to a mandatory health evaluation conducted by a doctor chosen by the airline. The doctor determined that she "was manic and suffered from bipolar disorder" (para. 6). The diagnosis affected her employment given that it affected her FAA medical certificate, a document providing "acceptable evidence of physical fitness on a form prescribed by the Administrator" (Federal Aviation Administration). Petitt went to the Mayo Clinic for a second opinion from a panel of doctors as well as a neutral medical examiner, all who determined that she had no mental health issues (Smith, 2022, para. 8). She then filed the complaint in which she claimed that upon raising safety concerns regarding falsified training records, retaliatory line checks, and disparate treatment of employees to company executives, "the airline ordered her to undergo a psychiatric exam and barred her from flying in retaliation" (Segar, 2022). Although OSHA dismissed Petitt's complaint due to insufficient evidence, she requested a hearing before an Administrative Law Judge (ALJ), who ruled in her favor, awarding Petitt damages on June 6th, 2022. Part of the damages awarded required that Delta Air Lines "post a copy of the Tribunal's decision and to disseminate it via email to certain of its employees and to display it at other locations where employment law matters are posted" (Petitt v. Delta Air Lines, 2022). Delta immediately appealed the decision and their appeal was denied on September 26th, 2022.

The situation involving Petitt and Delta is just one example that demonstrates a disparity between the supposed values of Delta Air Lines according to page six of their Rules of the Road Handbook, specifically the section regarding "listening attentively and speaking openly" (Delta Rules of the Road, p. 6). The actions taken against Petitt after her complaints were presented are not aligned with a just culture based on safety because employees may now be discouraged from reporting safety concerns in fear of retaliation. Retaliation being anything from employee termination, to tarnishing their reputation affecting any future employment at another company. In the words of a former Delta flight operations employee, "they tried to make [Petitt] seem crazy" (M. Shekari, personal communication, December 14, 2022). If Petitt had not sought out a second opinion regarding the bipolar diagnosis, her medical certificate may have been rendered invalid, thereby compromising her career as a pilot.

Human Resource Theory

One of the many ways that Delta Air Lines can improve safety is through the application of the theories encompassed in Human Resource Theory (HRT). HRT focuses on "people, groups, and the relationships among them and the organizational environment" (Shafritz et. al, 2016, p. 126). This kind of theory revolves around viewing employees as people rather than components of an organization. The framework for HRT is rooted in the Hawthorne studies conducted in 1924 by the National Academy of Sciences' National Research Council (p. 128). Researchers were sent to the Hawthorne plant of the Western Electric Company to study ways to improve productivity. From this study, the following assumptions were developed:

1. Organizations exist to serve human needs (not the reverse).
2. Organizations and people need each other. Organizations need ideas, energy, and talent; people need careers, salaries, and work opportunities.
3. When the fit between the individual and the organization is poor, one or both suffer. Individuals will be exploited, or will seek to exploit the organization, or both.
4. A good fit between individual and organization benefits both. Humans find meaningful and satisfying work, and organizations get the human talent and energy that they need (Bolman & Deal, 2013, as cited in Shafritz et. al, 2016, p. 127).

The services and products offered by an organization are meant to serve human needs. In this case, we are referring to an airline in which flying services are provided to people. Passengers are at the forefront of an airline's purpose and mission. However, the people working within the organization may also be consumers of the very services they help bring about. In other words, employees are also passengers. For this reason, an organization needs to acknowledge their human capital, the valuable skills and knowledge that affect employee productivity and denote potential. As consumers of the services they help provide, employees may hold important insight and ideas that can help company development. However, in order to promote the flow of ideas and creativity, organizations need to create an environment in which employees feel free to express them. Or in the very least, organizations should shy away from taking any action that may stifle ideas and/or discourage employees from being creative. In fact, I believe that organizations may find it useful at times to ask for decision-making input from employees outside of the apparent departmental scope. For example, when debating an issue regarding the flight operations department, perhaps the opinion of those working in the finance department should also be taken into account before coming to a particular decision. The ideas of another department may prove to be better than those already being weighed, because they provide input from a different perspective.

HRT emphasizes the importance of maintaining a good relationship between an organization and the employees within it. It touches on the topics of leadership, motivation, team dynamics, the work environment, power and influence, and organizational change (Shafritz et. al, 2016, p. 127). Theories X and Y developed by Douglas McGregor may help explain the different perspectives of workers that may drive the culture behind an organization. Theory X "holds that human beings inherently dislike work and will avoid it if possible…people must be coerced, controlled, directed, or threatened with punishment to get them to work…[they] prefer to be directed and to avoid responsibility" (p. 130). This theory views workers as cattle rather than people, meaning that employee morale is not believed to affect productivity. It also focuses on maintaining control of workers through punitive practices. Theory Y holds the complete opposite of Theory X. Theory Y holds that people can find work to be a source of satisfaction, are willing to seek and accept responsibility, and have high intellectual capabilities. This theory assumes that avoidance of responsibility is unnatural and a result of negative experiences. It places the blame of lower productivity on poor management that disregards the needs of employees.

The needs of employees range from physiological to ego-centered. The higher needs arise as the lower needs are met. To begin, employees need the basics to survive such as shelter and food. Fulfillment of such needs can be achieved via working to gain money to ultimately provide oneself with the sustenance necessary for one's survival. This need is referred to as the carrot-and-stick method because it drives people to seek employment in the first place. However, there are other, intangible needs that are important as well. Focusing on these needs can affect productivity. Social needs come after the physiological ones and relate to the need for "belonging, for association, for acceptance by his fellows, for giving and receiving friendship and love" (Shafritz et. al, 2016, p. 156). According to the *Classics of Organization Theory,* when these needs are not met, an employee may behave in ways contrary to organizational goals. Such a person then becomes "resistant, antagonistic, and uncooperative" (p. 156). Next in priority are ego needs, in which there are two kinds. The first is the need for independence, achievement, and knowledge. The second being the need for status, recognition and respect. Ego needs are rarely met and most industrial organizations offer few opportunities for lower-level employees to satisfy them. The need after this one is that of self-fulfillment. This need involves "realizing one's own potentialities, for continued self-development, for being creative" (p. 156). Self- fulfillment is the ultimate need and therefore, the hardest to achieve.

Delta Air Lines is addressing many of these needs already. In terms of physiological needs, we need to compare the cost of living at the location in which the Delta employee is based, as well as their salaries or wages. The average cost of living for a family of four in Atlanta, GA is $45,108 (Numbeo, 2019). Delta is considered "the highest paying airline in the world for pilots…which pays an average salary of $173,785 per year" (EGScholars.com, 2022) and according to Indeed, the "average Delta General Manager yearly pay in Atlanta is approximately $161,305, which is 185% above the national average" (Indeed, 2021). Delta pilots and managers are high paying positions whose salaries are well-above their cost of living.

However, the average salary of a Delta ramp agent is $37,736 in Atlanta, GA (Glassdoor, 2022). Assuming the ramp agent is the sole breadwinner in a family of four, their Delta salary may be insufficient to meet their physiological needs. If Delta were to ensure they are meeting their employees' physiological needs, they may need to raise the salaries and wages of the employees whose pay does not meet their cost of living.

In terms of addressing the social needs of employees, Delta may benefit from focusing on diversity and inclusion efforts. As aforementioned, employees seeking to fulfill their social needs look for a sense of belonging, association and acceptance, all of which can be achieved through diversity and inclusion efforts. Furthermore "diverse organizations with culturally competent employees and managers increase organizational effectiveness and thereby improve communities and societies overall—and positively affect the organization's environment" (Shafritz, et. al, 2016, p. 413). Efforts to break the glass ceiling and increase employee representation may help improve employee engagement and morale. Delta Air Lines is not as diverse as its competitors and can improve in this area. The current ethnic demographics of Delta Air Line's 83,000 employees are 58% White, 16% Black or African-American, and 14% Hispanic or Latino (Zippia The Career Expert). In 2020, Delta CEO Ed Bastien stated that Delta "would double the percentage of Black senior executives and board directors by 2025, from 7% to at least 14%"

(Yamanouchi, 2020, para. 1). According to the Simple Flying magazine, Delta Air Lines’ executive board is 91% white and 91% male, whereas the most diverse board of directors in the airline industry is that of United Airlines, which is 23% People of Color (POC) and 16% women (Simple Flying, 2020). When employees at any company see their race and gender being represented in management, they may feel more at ease, in an environment free of discrimination, and hopeful of climbing the corporate ladder.

Diversity efforts have to be coupled with efforts at inclusivity, in which underrepresented groups’ differences are not cast aside but acknowledged and valued. It is important that organizations not only claim to focus on diversity and inclusion, but that they demonstrate their commitment to bringing it about through their actions. Delta Air Lines has undergone scrutiny in the past few years for their lack of cultural sensitivity. In 2020, Delta Air Lines was accused of violating 49 U.S.C. §§ 40127(a) and 41310 after two incidents of seemingly discriminatory behavior (Delta Air Lines Order 2020-1-9). In 2020, a Muslim couple boarded Flight 229 departing from Paris, France with destination to Cincinnati, Ohio. They were removed shortly thereafter upon a passenger complaint and a flight attendant witnessing religious texts on the phone of one of the passengers in question. The Captain discussed the situation with Delta’s Corporate Security who deemed the Muslim couple to not pose a safety risk. However, the Captain had the couple removed from the flight and rebooked on another set for later that day.

The Captain failed to follow Delta’s required security protocol, prior to making the decision of removal. Similarly in 2016, a Muslim passenger boarded Flight 49 departing from Amsterdam to New York. He was seen making eye contact with someone of his same ethnicity who also gave them a small package. The flight attendants claimed that the passenger was breathing heavily and was constantly peering out the window. The Captain spoke to Delta’s Corporate Security who told him that the Muslim passenger's record did not show any "red flags". The Captain decided to continue with the flight but returned to the gate and had the passenger removed due to the flight attendants' discomfort. The Captain failed to follow Delta's security protocol and the DOT determined that both instances were discriminatory, ordering Delta pay a fine of $50,000 and provide their crew with cultural sensitivity training. Scandals like these have long-lasting effects on the reputation of an airline that caters to the public, a public composed of passengers of different ethnic and cultural backgrounds.

As for ego needs, these are being addressed through a Delta program set in place to help employees become pilots. Through the Delta Propel Company Pathway Program, Delta employees, regardless of their position in the company, have the opportunity to pursue a pilot career if they wish to do so. Once employees submit their applications, undergo the various required interviews, and are accepted into the program, they are granted a Qualified Job Offer in which they are guaranteed employment upon the completion of flight training and the ATP flight hour requirement (Delta Propel). Propel participants are to choose a partner flight school and are given a Leave of Absence (LOA) to complete flight training. This program allows employees that wish to become pilots to chase that career path, thereby fulfilling their ego need for achievement. However, this opportunity is not uniformly accessible to all Delta employees despite its claims; only to those who can afford to not work and finance their entire flight training as Delta does not offer any kind of financial assistance for Propel participant training. It is important to note that Delta is not the only airline addressing the ego needs of employees through the existence of such a program. In fact, most major airlines have their own pilot company pathways at this point, such as United Airlines and American Airlines. Each of these programs is unique to their respective airline in accordance with their values. They are all similar in the sense that they provide a pilot mentor for every participant to help guide them throughout their pilot journey, but they differ when it comes to financing participants' education. American Airlines' Cadet Program does not provide direct financial assistance, but they offer loans through lender partnerships (American Airlines Cadet Academy). United Airlines' Aviate program offers to pay for their participants' flight training up to their Private Pilot License (PPL) (United Airlines Aviate Academy). United's Aviate program is making the pilot dream for their employees more within their reach by alleviating the financial burden of acquiring a PPL. Delta Air Lines would benefit from doing the same. I suggest a model similar to that of Aviate, with the main difference being that Delta finance training beyond the PPL. This way, employees pay out-of-pocket for the initial phase of training, thus demonstrating their commitment to achieving their pilot goals, yet they can rest assured that their efforts will be rewarded. Providing some sort of financial assistance for Propel participants would make it easier for employees to finance the remainder of their training and demonstrate that the company cares about their workers. It would also motivate more people to apply to Propel, thereby contributing to the overall purpose of the programs; to counteract the worsening pilot shortage (Silk, 2018). More applicants could mean more people going through the program and successfully becoming Delta pilots.

Power and Politics Theory

The application of theories found under the scope of Power and Politics Theory may prove useful to an organization such as Delta. The definition of power in this context is the ability to "organize resources (human and material) to get things done…and cooperation in doing what is necessary" (Shafritz et. al, 2016, p. 274). Management tends to hold this kind of power and the dynamic between them and employees has been studied extensively to bring about the following assumptions:

1. Powerful managers empower employees (Theory Y)
2. Powerless managers are doubtful of employee capabilities (Theory X)

Powerless management tends to have antiquated views of employees more aligned with a conventional view as described in Theory X as a result of their own perception of being powerless. When they do not receive the respect, cooperation, and resources necessary to carry out managerial tasks, they will resort to dominance, control, and oppression. They may think workers lack intellect and are a threat to their authority, prompting them to use punishment as a means of maintaining control. The positions most susceptible to powerlessness are first-line supervisors, staff professionals, and top executives (Kanter, 1979, as cited in Shafritz et. al, 2016, p. 248). This is due to the fact that first-line supervisors are caught between higher management and workers, often not not perceived as part of the leadership circle. They have to enforce and explain policies they cannot shape, lack the resources necessary to reward, and turnover rates tend to be high, leading employees to believe that they can "outwait and outwit any boss" (p. 277). Staff professionals work in small teams which puts them in a position in which they cannot develop others or pass power on to them and they are seen as inessential in day-to-day operations. As a result, they refuse to take risks and resist people's innovative proposals. Top executives also face powerlessness, but for reasons different from the former two positions, as their worth lies mainly in their image. They may focus on short-term results rather than long-term goals in order to receive immediate gratification. However, the more they neglect long-term goals, the more powerless they will be when they attempt to make up for this neglect at the very last minute. They are often so far removed from lower-level workers that they are unaware of what subordinates are thinking and doing, making them unable to predict their own downfall. Their insecurity may lead them to become competitive to the point of turning against each other in order to protect their authority. Their actions lead them to be even more powerless as employees lose respect and begin resenting their manager. One example of this is Robert Crandall, former CEO of American Airlines. The way he addressed employees was often highly disrespectful and dismissive, calling them "incompetent and lazy" (Gittell, 2004, p. 76). As a result, many American Airlines employees, despite acknowledging his intellect and extensive knowledge about the airline industry, began harboring resentment towards Randall, calling him "militant and scary" (p. 77). Powerless situations affect the powerless, employees, and the company in a negative manner overall. Organizations should ensure that these situations do not occur.

On the other hand, powerful management ideals align with Theory Y, in which they understand their roles in employee motivation and productivity. They have faith in their employees, are innovative and open to employee input and creativity. It is important for upper management to take into consideration the opinions of those being affected by a decision before making it. When upper management makes a decision that affects lower-level employees without the input of said employees, this can lead to disgruntlement amongst those lower-level employees. Employees may believe that management does not care about how a decision will affect them, regardless of whether or not that is the case. One such decision can be detrimental to employee morale and their loyalty to the company. However, upper management's constant disregard for employee opinion, may lead employees to slowly harbor ill-will towards that company, which can have negative implications such as strikes. In the very least, such actions will affect productivity as it is directly affected by employee engagement, "employees who are engaged with their job are more focused and more motivated than their disengaged counterparts…[meaning] they work more efficiently and with the success of the organisation in mind" (Insync Surveys, para. 1). Powerful management can help make the organization more efficient as they delegate and share power with their employees. Powerful management is influential and highly motivated which motivates employees. Rather than displaying insecurity, they ensure that their "new policies do not render any other level of the organization powerless" (Shafritz et. al, 2016, p. 283). They understand the concept of the organization working together as a team to bring about the final product. One example of powerful management is former SWA CEO Herb Kelleher. According to Forbes Magazine, Kelleher "treated [workers] with dignity and respect…empathized with their failures and grief…celebrated their victories…showed them how much he admired them, valued them and loved them as people, not just workers" (Freiberg, 2019). Kelleher was considered "the force behind Southwest's success" (Gittell, 2004, p. 79). His attitude towards employees, by motivating them and acknowledging their value, in turn, made him a powerful leader and an important asset to the company.

Another contributing factor of Southwest Airlines' success and employee satisfaction is the freedom and voice they give their employees. Eighty-three percent of their workforce is represented by a labor union "to maintain collective bargaining agreements that take care of [their] employees" (Southwest Media). They pride themselves in the unionization of their employees because they view labor unions as their "partners, not adversaries" (Gittell, 2004, p. 161). Only about twenty-percent of Delta's workforce is unionized (Sainato, 2022). According to *Ethical Issues in Aviation,* "the effort by Delta management to defeat organization of its flight attendants is legendary" (Hoppe, 2019, p. 118). Flight attendant efforts at unionization have been prevalent for decades and Delta's infamy is rooted in their unethical, anti-unionization tactics. In the 2008 attempt, a bulletin was posted in the flight attendant crew room advising attendants that they "should just rip up and toss away their ballots" (p. 118). Delta has also launched a webpage called "One Future. One Delta", whose sole purpose is to prevent flight attendant unionization. The webpage states that unionization is a threat to Delta's culture. According to the website, Flight attendants are advised "don't risk it…don't sign it" when it comes to casting votes for unionization. In an article by The Guardian, the flight attendants quoted are referred to by their first names only "for fear of retaliation as Delta prohibits employees from speaking to the media about the company without approval" (Sainato, 2022). Delta Air Lines is infamous for stifling the union efforts of their employees, an act that is contrary to their Rules of the Road and power and politics theories of management, which encourage employees to express themselves and have a voice.

Conclusion

There is no doubt that Delta Air Lines is a very successful airline. It is reputable in the eyes of both the public and employees. However, their success does not mean that there is no room for improvement in the areas of safety and performance. The creation and enforcement of a just culture is beneficial to a company in a high-risk environment such as aviation, in which the service provided is the safe transportation of passengers. Employees should feel free to express safety concerns via a non-punitive platform. Furthermore, a focus on employee empowerment and needs, physiological/social/ego, can improve employee engagement and morale, thereby increasing productivity and profitability. Delta may be able to improve in this area through the implementation of practices found in rival organizations. Finally, it is important that an organization not make unsubstantiated claims they believe will boost their image, but that their actions reflect their supposed values.

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Assessing the Effects of Organizational Culture on Flight Training

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Abstract

Objectives: The objective of this study was to evaluate the effects of organizational culture on collegiate aviation operations and flight safety and the change that occurs due to organizational culture.

Background: The accident and incident rates in general aviation are on the rise due to the fact that general aviation 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" (Shelnutt, Childs, Prophet, & Spears, 1980. p.6, para 2). However, collegiate aviation pilots have proven to be safety cautious due to the organizational and safety culture of collegiate aviation. This necessitates the need to explore the organization and safety culture of collegiate aviation using Embry-Riddle Aeronautical University (ERAU) as a case study.

Methods: An analysis of the data and information synthesis was done qualitatively to arrive at results, and conclusions.

Results and Conclusions: The exploration of ERAU organizational and safety culture revealed that collegiate aviation implement safety assurance to overcome the shortcomings of single pilot resource management designed to enhance the safety of general aviation.

1.0 Introduction

The organizational culture of an organization directly affects the entire operations, the image, and the achievement of the declared goals of the organization (Shafritz, Ott, & Jang, 2015). It's widely believed that Organizational cultures are intangible phenomena, such as values, beliefs, norms, assumptions, and behavioral patterns within an organization to achieve common goals (Shafritz, Ott, & Jang, 2015). As a result, building a strong culture enhances reliability, guides actions, and directions, and determines the quality of outputs of the organization (Shafritz, Ott, & Jang, 2015). In addition, the effectiveness and efficiency of organizational cultures are determined by how best the organization's purposes are achieved (Shafritz, Ott, & Jang, 2015).

In the aviation industry, the goal of flight education that every flight training organization is expected to highly regard is to produce professional pilots who adhere to risk management principles and safety procedures in the national airspace system (NAS) (Wischmeyer, 2005). One of the ways to achieve this goal is for flight training institutions to develop organizational cultures that revolve around intangible phenomena, such as values, beliefs, norms, assumptions, and behavioral patterns of flight safety (Mihai & Ciuica, 2015).

Flight education is being conducted by many arms of training institutions, of which collegiate aviation is considered efficient in producing professional pilots who adhere to risk management principles and safety procedures in the national airspace system (Wischmeyer, 2005). In addition, collegiate aviation has proven to produce quality pilots in the aviation workforce, which is why the Federal Aviation Administration (FAA) grants pilots from collegiate aviation a reduced airline transport pilot (ATP) minimum (Christensen & Card, 2014).

One of the reasons for efficient and quality education in collegiate aviation can be traced to organizational cultures because research revealed that organizational culture has positive effects on aviation safety (Wischmeyer, 2005). Besides, one of the goals of the FAA is to ensure that the pilots being produced are professional and hold on to risk management principles (Christensen & Card, 2014). However, the number of collegiate aviation universities and colleges worldwide is relatively low compared to regular flight training institutions. Therefore, to ensure all flight training institutions produce quality pilots like those of collegiate aviation, the organizational cultures of collegiate aviation need to be explored, and ways in which these cultures can be implemented in other flight training institutions need to be examined.

2.0 Intent Statement

This study intends to evaluate the effects of organizational culture on collegiate aviation operations and flight safety and the change that occurs due to organizational culture Embry-Riddle Aeronautical University as a case study.

3.0 Research Question

- What impact does organizational culture have on the quality of flight training and flight safety in collegiate aviation?

4.0 Literature Reviews:

Organization theory embodies the study of the structure and functioning of organizations and the behavior of groups and individuals within them (Pugh, 1966). Organizational theory can also be referred to as the study of how organizations function and how they affect or are affected by their environment (Pugh, 1966). It's generally believed that the organizational culture of an organization is rooted in the values and beliefs shared by the personnel within the organization (Sun, 2008). Since the early 1980s, the concept of organizational culture has occupied a prominent position in multidisciplinary publications, and the years of its conceptualization, comparison, and assessment have led to an evolving consensus on the appropriate definition (Bellot, 2011).

Many themes exist regarding organizational culture (Alvesson, 2011). For example, a school believes that cultures are fundamentally fuzzy because they combine contradictions, paradoxes, ambiguities, and confusion (Bellot, 2011). Bellot (2011) also stated that "culture is not a surface phenomenon; instead, it is "infused with symbols and symbolism that is undetectable most of the time" (p2. Para 7). Another theme states that organizational culture is socially constructed based on shared experiences, which provides a framework for understanding work environments (Bellot, 2011). Furthermore, it is also believed that organizational culture is relatively unique to each organization and is flexible and subject to continual change (Bellot, 2011).

Organizational theory is based on two main schools, Classical and Neo-classical (Sarker & Khan, 2013). Ferdous (2016) stated that "the studies made by the classical scholars of organization concentrated their devotion upon the laying down of the organizational ideologies and upon the official features of the organization" (p1). Classical school is a set of homogeneous ideas that evolved in the late 19th and early 20th centuries. It focused on centralized authority and viewed an organization as a machine and employees as the various parts of that machine (Sarker & Khan, 2013). The classical approach to management significantly contributed to the development of management theories by incorporating scientific management, administrative theory, and Bureaucratic management into management culture (Sarker & Khan, 2013). On the other hand, neoclassical theory is a modification, addition, and somewhat extended version of the classical theory (Shafritz, Ott, & Jang, 2015). Neoclassical theory incorporates behavioral sciences into the classical theory to solve problems caused by classical practices. The neoclassical approach to management incorporates social and psychological satisfaction into the organizational culture to better satisfy the needs of the employees (Sarker & Khan, 2013).

The theories of classical and neoclassical organizational culture establish organizations as rational entities (Shafritz, Ott, & Jang, 2015). In classical organization theory, four tenets confirm that organizations are rational entities (Shafritz, Ott, & Jang, 2015). These tenets are (1) organizations exist to accomplish production-related and economic goals, (2) there is one best way to organize for productions, and that way can be found through systematic, scientific inquiry, (3) production is maximized through specialization, and division of labor, and (4) people and organizations act in accordance with rational economic principles (Shafritz, Ott, & Jang, 2015). Furthermore, organizations adopt scientific inquiry because it is a rational way of getting things done (Shafritz, Ott, & Jang, 2015). It's *a form of problem-solving and questioning that helps people better understand observable phenomena* (Shafritz, Ott, & Jang, 2015). In addition, appreciative inquiry, which is a model that creates positive revolutions in organization development and change management, is a rational way of effecting change (Shafritz, Ott, & Jang, 2015).

Implementing organizational change comes with many obstacles that must be overcome (Hatch & Zilber, 2012). These obstacles include individual change resistance, ineffective communication, lack of clarity, change resistance culture, and many more (Hoag, Ritschard, & Cooper, 2002). However, the greatest obstacle is ineffective communication (Hoag, Ritschard, & Cooper, 2002). Communication is key to effective change in an organization. It eases the process and generates a synergy that promotes a better understanding of what needs to be achieved when individuals work together (Hoag, Ritschard, & Cooper, 2002). In addition, effective communication is a tool in the hands of the Managers to buy team members' loyalty to effect organizational change (Shafritz, Ott, & Jang, 2015).

5.0 Methodology

The method used for the study is a qualitative approach because it provided a means of exploring an existing aviation organization whose safety culture significantly affects flight operations. The data were derived from the Embry-Riddle Aeronautical University Safety Management System.

The qualitative research design used in this study is a case study analysis. The flight operations of Embry-Riddle Aeronautical University were analyzed to evaluate the effect of organizational safety culture on collegiate aviation operations and the change that occurs due to having a safety culture. The analysis begins with a summary of ERAU's organizational culture, followed by an in-depth exploration of the safety management system culture.

6.0 ERAU Organizational Culture

The Embry-Riddle Aeronautical University operates a neo-classical organizational theory. That is, ERAU is an organization that considers not only physical and economic needs but also needs like job satisfaction and career development (ERAUc, n.d). The theory is based on the leadership culture of the institution. The leadership culture was established to provide programs and services that strengthen the leadership knowledge, abilities, talent, and career potential of ERAU faculty and staff. This enables professional staff to collaborate with campus and community stakeholders to host monthly and semi-annual leadership workshops for employees to learn ideal leadership traits and behaviors requisite for leading groups on and off campus and professional development. The leadership workshop has Tiers I, II, and III for scholars (ERAUc, n.d).

Tier I scholars learn the fundamentals of individual and corporate leadership behaviors and traits. Global leadership practices are explored so that participants understand the elements of leader/member exchanges which translates to effective leading and following. Topics cover leadership in history so that participants can examine the evolution of power and control and its effect on current leader/member roles (ERAUc, n.d).

Tier II prepares scholars to move others to action and build preferred futures aligned with ERAU's mission, vision, and values. Scholars engage in real-time activities to learn how to maximize their leadership and people power for the advancement of their department and the university. Leader communication and influence are explored with emphasis on the viability of creating collaborative relationships, tools for conflict management, and managing an organizational and political landscape (ERAUc, n.d).

Tier III scholars learn theories and practices of organizational socialization, culture, ethics, and corporate social responsibility internally and externally as a strategy for the health and sustainability of an organization and the local community (ERAUc, n.d). They learn to distinguish between symbolic and substantive leadership actions for shaping organizational culture. The validity of authentic leadership rooted in moral and ethical leadership theory is explored as a key factor in embracing employee value and fostering a diverse and inclusive work environment (ERAUc, n.d). Scholars complete a scholarly project that meets ERAU's mission, vision, and values. Scholars are also assigned to a committee within the community to work on a project that will optimize return on stakeholder investments, facilitate stewardship and corporate social responsibility, or assist in advancing human capital (ERAUa, n.d).

As part of the effort to take care of employees' social and psychological needs, ERAU has retirement plans for employees, of which the university contributes 6% of the employee's regular base pay into the employee's retirement plan as a gift (ERAUb, n.d). The tuition waiver program is another program that the university has made available to employees upon hire. Staff and full-time faculty can take up to six classes per fiscal year, while their spouses also can receive a 100% tuition waiver for up to six classes per year (ERAUb, n.d). The university also introduced a career development program to enhance employees' careers. Another social and psychological provision is the health and wellness benefit which takes care of medical, dental, and vision plans. In addition, life insurance, disability insurance, discount and perks, parental leave, and personal leave are part of the university's social and psychological provisions (ERAUb, n.d).

Since ERAU is an institution, the leadership culture revolves around the entire operations of the institution, especially the safety culture. The leadership culture helped the institution to develop a robust safety management system that uses a neoclassical approach.

6.1 ERAU Safety Culture

ERAU's leadership culture is reflected in its safety culture. The leadership culture gave birth to a robust safety management system, which is a comprehensive and preventive approach to managing safety for all flight departments. ERAU's safety culture incorporates the four pillars of the safety management system: safety management policy and objectives, safety risk management, safety assurance, and safety promotion (ERAUa, n.d). The safety management system assists ERAU's leadership, management teams, and employees in making effective and informed safety decisions (ERAUa, n.d).

6.2 SAFETY MANAGEMENT POLICY AND OBJECTIVES.

The safety management policy and objectives deal with the management's commitment to improving safety by defining methods, processes, and organizational structure that will meet the safety goals (ERAUa, n.d). The safety culture of ERAU aims to support the education and promotion of safety throughout every function of the University (ERAUa, n.d). This will continue to result in a strong safety culture that fosters safe practices, encourages effective safety reporting and communication; keep the event reporting system vibrant so that all near misses are reported and mitigation strategies are implemented to prevent potential accidents; promote the safety risk management process so that safety reviews will be conducted on all operations that involve hazardous risks and; measure the effectiveness of the ERAU Safety culture auditing every year (ERAUa, n.d).

To ensure the effectiveness of the safety culture of the institution, senior leadership mitigates related safety risks by setting the organizational priorities and tasks; establishing and maintaining a positive safety culture, prescribing procedures on how to perform activities or processes; using the skills of personnel; and allocating the necessary resources (ERAUa, n.d). In addition, the senior leadership incorporates safety risk management, which provides a decision- making process for identifying hazards and mitigating risks based on a thorough understanding of the University's systems and operating environment (ERAUa, n.d). ERAU safety risk management is a design process that incorporates risk controls into processes and/or redesigns controls where existing ones are not meeting the organization's needs (ERAUa, n.d). The initial process for risk assessment begins with an Initial Review Committee (IRC). The IRC University Risk Manager, University Legal Counsel, and University Insurance Manager are responsible for determining if the risk is legal and insurable and if the reward outweighs the risk (ERAUa, n.d). If the IRC determines that the risk requires more in-depth analysis, then a Safety Review Board (SRB) will be formed (ERAUa, n.d). A qualified individual whom the Associate Vice President approves for Safety/Risk will chair the SRB. The approved individual will convene a group of subject matter experts (SMEs) to assist in the risk assessment process to determine if the risk proposed can meet an Acceptable Level of Safety (ALoS) (ERAUa, n.d).

The SRB's purpose is to perform a Safety Risk Assessment (SRA) to decide on the acceptability of operation in the presence of an identified hazard. The safety risk assessment Identifies the risks and hazards associated with the proposed UAS operation, Identifies the likelihood and severity levels of risks and mitigates them to acceptable levels, and identifies appropriate levels of risk authority for the planned activity (ERAUa, n.d).

6.3 Safety Risk Management

The safety risk management process begins with a System Analysis, which may include people, hardware, software, information, procedures, facilities, or services directly related to aviation safety activities (ERAUa, n.d). Next, ERAU employs the Safety Review Board (SRB) to analyze all hazards associated with any new operation to develop controls to mitigate the risks.

Safety risk management aims to provide a foundation for a balanced allocation of resources between all assessed safety risks (ERAUa, n.d).

ERAU operates a non-punitive reporting system and near-miss reporting that allows any student, employee, or contract personnel observing an accident or incident to notify the duty Flight Supervisor. However, certain intentional acts are not protected under the ERAU Safety program (ERAUa, n.d). This includes reports involving a violation that is not inadvertent or that involves an intentional disregard for safety; reports that appear to involve possible criminal activity, substance abuse, controlled substances, alcohol, or intentional falsification and reports of events that occurred when not acting under an approved curriculum by ERAU (ERAUa, n.d). Upon receiving notification of a potentially hazardous situation, the corresponding department verifies the hazard and tasks the appropriate personnel for investigation and resolution (ERAUa, n.d). All reports are de-identified and classified using the Human Factors Analysis and Classification System (HFACS) taxonomy (ERAUa, n.d).

ERAU operates an aviation safety action program (ASAP). The program's objective is to encourage any flight instructor or ERAU flight student to voluntarily report safety information that may be critical to identifying potential precursors to accidents (ERAUa, n.d). ASAP provides for the collection, analysis, and retention of the obtained safety data. Information obtained from these programs permits ASAP participants to identify actual or potential risks throughout their operations (ERAUa, n.d). The Event Review Committee (ERC) reviews and analyzes reports submitted under the ASAP, determines whether such reports qualify for inclusion, identifies actual or potential problems from the information contained in the reports, and proposes solutions for those problems (ERAUa, n.d).

6.4 SAFETY ASSURANCE

As part of the safety assurance, ERAU audits the overall program to ensure compliance with governmental regulations and to review the climate of the Safety Culture (ERAUa, n.d). The types of audits conducted yearly are external audits which is usually conducted by a qualified aviation organization using the request for proposal (RFP) process; self-audits conducted by the director of aviation safety; advisory committee audits conducted by a team comprised of members of the advisory council; insurance audits conducted by the university insurance carrier; FAA audits conducted twice per year (ERAUa, n.d). The audit plan contains a structured and planned series of audits that are designed to improve the safety and quality of all operations and functions within Embry-Riddle's Flight Program (ERAUa, n.d). The aviation safety director is responsible for the administration of the Safety program, while the responsibility for correcting identified deficiencies in the program lies with the department manager exercising authority over the affected area (ERAUa, n.d).

6.5 SAFETY PROMOTION

ERAU safety promotion includes training new hires and new students during the initial safety orientation. Training includes understanding one's role in the safety culture, reporting a safety concern, understanding the Safety management system, understanding the aviation safety action program (ASAP), and Professional and responsible behavior (ERAUa, n.d). The director of aviation safety provides or facilitates aviation safety training for team safety leaders and accident investigation members (ERAUa, n.d). Also, the director of aviation safety obtains and distributes pertinent flight safety information. Instructors are tasked with passing all safety-related information to students (ERAUa, n.d). Aviation safety staff maintains a safety bulletin board where safety information will be displayed. The bulletin board is regularly updated and contains information to raise instructor/student safety awareness (ERAUa, n.d). The University also promotes safety by holding a safety day where important safety information is shared. In the case of significant change to procedures or SMS, a stand down can be held to ensure that all members have been educated (ERAUa, n.d).

ERAU safety promotion includes aviation safety awards. Employees and students who contribute significantly to the Aviation Safety Program are recognized. The contribution may be a single act that prevented injury or damage, or it may be in the form of a hazard resolution, service on a safety committee, or anything that significantly enhances flight safety (ERAUa, n.d).

7.0 Discussion

ERAU's organizational culture uses the principles of scientific management. The University brings together the science of flying with trained workmen and prioritizes the scientific selection of the workers and their progressive development (ERAUc, n.d). The essence of the leadership workshop is to ensure all employees are equipped with relevant knowledge to carry out their assignments, assist managers in creating a vision for their team, and inspire team members to achieve the goals set for the team. Besides, leadership workshops transform organizations, enhance value creation, create efficiencies, and engage employees to deliver better results. ERAU successfully achieved this, which has tremendously impacted the organization's safety (ERAUc, n.d).

Under scientific management, the management has to deliberately study the workers under them in the most careful, thorough, and meticulous way; and not just leave it to the poor, overworked foreman (Shafritz, Ott, & Jang, 2015). ERAU's safety culture ensures that the management directly oversees the safety goals of the University. For instance, the director of aviation safety is responsible for the safety program's administration, and the responsibility for correcting identified deficiencies observed in the safety program lies with the Department Manager exercising authority over the affected area

ERAU safety promotion provides safety training to every new hire and new student during the initial safety orientation. In addition, the director of aviation Safety provides or facilitates aviation safety training for team safety leaders and accident investigation members. This is one of the principles of scientific management principles. The principle ensures that the workmen are deliberately trained to perform efficiently and still be paid higher wages than ever before (Shafritz, Ott, & Jang, 2015).

ERAU culture embraces teamwork. Flight instructors, along with the flight safety manager and director of safety, work together to achieve safety goals. Instructors are responsible for ensuring students adhere to safety goals, while the director of safety is responsible for providing adequate training for instructors and informing them of the latest safety updates.

Most importantly, ERAU safety culture overcomes the deficiency of single pilot resource management (SRM) in general aviation by adopting safety assurance (Raus, Kwasi, Keller, Antonio, Anderson, Tellmann, ... & Shogbonyo, 2022). SRM is a variation of CRM to reduce the accident rates caused by human errors by teaching pilots about human limitations and how individual performance can be maximized (Im, Kim, & Hong, 2021). 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 (Im, Kim, & Hong, 2021). 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 (Im, Kim, & Hong, 2021). However, SRM has not yielded positive results compared to CRM since SRM lacks quality safety assurance. (Raus, Kwasi, Keller, Antonio, Anderson, Tellmann, ... & Shogbonyo, 2022). However, ERAU safety assurance ensures safety audits of the overall safety program to determine the effectiveness of the safety management system and the safety culture of the University.

ERAU's safety culture is identical to other universities like Purdue University, University of North Dakota, Middle Tennessee State University, and Saint Louis University. So, the safety culture being practiced in collegiate aviation has become the main reason why collegiate pilots are seen as the most safely cultured pilots (Adjekum, 2017).

8.0 Conclusions

Organizational culture has tremendous effects on collegiate aviation operations and the quality of flight training in terms of safety. An organizational culture that embraces the four pillars of a safety management system produces desired result simply because it focuses on creating safety policies, developing risk management strategies, ensuring quality control (safety assurance), and promoting safety (Stolzer & Goglia, 2016).

The organizational culture of ERAU has led to having robust safety culture designed to mitigate risk associated with flight operations. If a similar safety culture can be embraced in all general aviation operations, safety will improve. Currently, “GA holds a lackluster safety record, accounting for 94% of civil aviation fatalities" (Boyd, 2017,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 regarding 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. Research revealed that the concept of single pilot resource management (SRM) designed to enhance general aviation safety is ineffective because SRM is not customized and structured to reflect the specific needs of general aviation pilots, SRM has no quality control procedures to ensure its effectiveness, and SRM is not a structured training program that ensures recurrent practice and feedback. However, the safety assurance procedures of ERAU and other collegiate aviation overcome the shortcomings of SRM, making collegiate aviation pilots safer. Therefore, having an organizational safety culture will produce quality flight training education in general aviation.

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A Bureaucratic Analysis: The University and the Pilot School

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Abstract

The literature highlights various issues experienced by collegiate aviation programs within academia. This paper examines the issues of collegiate aviation through a bureaucratic lens and attempts to identify possible solutions. This investigation revealed that the primary issue contributing to the resistance of the pilot school to fully integrate into a university is fundamentally a bureaucratic issue rooted in the difference in organizational oversight. Findings included the benefits of the credentialing of collegiate aviation faculty and the development of a boundary spanner mindset could help both new and existing programs.

Keywords: collegiate aviation, bureaucracy, professional bureaucracy, machine bureaucracy, academic credentials, boundary spanner

A Bureaucratic Analysis: The University and the Pilot School Introduction

Metaphor

It is a simple experiment. All one needs is a container that can be capped or sealed, cooking oil, water, and a small amount of dish detergent. The purpose of the experiment is to observe the characteristics of oil and water in a glass with and without a small amount of dish detergent. When one adds water to a glass partially filled with oil, one will observe the water immediately separating from the oil and displacing the oil upward. The two substances will not mix. Even when one agitates the two substances in a sealed container, the oil will quickly divide into small droplets within the water but will eventually collect and re-separate into two distinct layers. One may ask, "what is happening?" When compared to the oil molecule, the water molecule is much more dense and possesses a slight polar charge due to the bonding of the two hydrogen and one oxygen atoms (Arnett, 2018). On the other hand, the oil molecule is much less dense and does not possess this polar charge that is characteristic of the water molecule. As a result, the oil molecule is repelled by the water molecule. This repelling characteristic is what provides us with the distinct layer of separation one observes when looking at these two substances in a glass or bottle. An interesting step in this experiment is to add a small amount of dish detergent into the container holding the oil and water substances. Dish detergent has the unique characteristic of being amphiphilic: partly polar and partly nonpolar. As a result of this characteristic, detergents can bind to both water and oil molecules (Arnett, 2018). When one agitates this substance mixing takes place. The oil and water molecules are no longer clearly separated. Instead, one will observe a cloudy mixture, resulting from the oil, soap and water chains created by adding the dish detergent (Arnett, 2018).

Problem Statement

It has been observed and noticed by those within and without collegiate aviation. It has been written about. It is talked about often. The mixing of the university and the pilot school appears to have forces that inhibit its full integration.

Purpose Statement

The purpose of this paper is to gain insights into the dynamic relationship between the university and the pilot school by using the bureaucratic lens of organizational theory. At this stage in the research university will be defined as an academic institution offering four-year degree programs. Pilot school will be defined as a 14 CFR Part 141: Pilot School program, approved by the Federal Aviation Administration (FAA). Collegiate aviation will be defined as the inclusion of a Part 141 Pilot School into the course offerings of a university. Also, bureaucratic lens refers to the longitudinal consideration of ideas beginning with the definition of bureaucracy by contributors like Henri Fayol and Max Weber and then developing into concrete frameworks developed by Henry Mintzberg. I plan to gain insights into this topic by asking the following question: What are the more obvious issues visible when looking at the collegiate aviation program through a bureaucratic lens?

Literature Review

There were no primary resources identified covering the idea of organizational similarities of and or differences of the pilot school and university combination. Several searches were performed combining the ideas of the pilot school and the university. Searches were conducted using a variety of words to improve the scope of the search. Words like “collegiate aviation”, “organizational theory”, and “structure” were used due to term acceptance within the literature. What did appear in the literature was the acceptance of these ideas independently. The scope of this literature review will focus primarily on the development of ideas around organizational structure. Application of organizational theory will primarily be discussed as it relates to the university. Consideration will then be given to a limited number of sources that provide some insight into the connection between the pilot school and the university.

Foundations of Bureaucratic Theory

Bureaucratic theory came out of the ideas developed and championed by Henri Fayol (1841—1925). Fayol was a French executive and mining engineer who theorized the ideas of the formal organization. He developed ideas around the various roles and responsibilities of those who managed the organization (Shafritz et al., 2016, p. 36). It was these ideas, rooted in the industrial revolution of the 1700s, that saw a period of refining by the 1930s and formed the basis of management practice in the United States. Some of the classical organizational theory ideas available at this time, and that Fayol built upon, included: 1) Organizations exist to accomplish stated goals, 2) there is a best way to organize, 3) production is maximized by the specialization and division of labor, and 4) actions within the organization should be rational and follow economic principles (Shafritz et al., 2016, p. 33). These foundational ideas were developed from ideas of men like Adam Smith and Frederick Winslow Taylor and formed a rigid and objective system for implementation. The nature of the organization had shifted and moved in the direction of being more accepted as a specialized structure. From here, Fayol focused on the manager. He paid particular interest in developing his ideas around management principles.

In his culminating work, *"General Principles of Management,"* Fayol continued to sharpen the ideas of scientific management by developing such areas as division of work, authority and responsibility, discipline, unity of direction, and unity of command—just to name a few (Shafritz et al., 2016, p. 36).

The concept of the bureaucratic organization began to take a more formal shape by the contributions made by a scientist named Max Weber (1864—1920). This German scientist has been credited as one of the early thinkers in the discipline of analytical sociology and he used this lens to study bureaucratic organizations. Fayol and Taylor focused more on the formal and more rigid structure, but Weber saw the bureaucratic organization as having specific patterns of behavior. Therefore, a key idea developed by Weber was the idea that the bureaucracy is not only a specific set of organizational structural arrangements but that the bureaucracy also refers to patterns of behavior within those structures (Shafritz et al., 2016, p. 37). He coined and defined the term bureaucracy as an organizational structure that is characterized by processes, procedures and requirements, number of desks, meticulous division of labor and responsibility, clear hierarchies and professional, almost impersonal interactions between employees (Mulder, 2017). Unlike today where the term bureaucracy has a negative connotation, Weber saw the idea of the bureaucracy as a necessity and that it should be used to characterize government agencies and large organizations. His definition of bureaucracy focused on how organizations were developed and how those structures affected organizational performance. He touted its benefits for large organizations with many hierarchical layers. Possible drawbacks to the idea of the bureaucracy included the ideas of red tape, paperwork, communication issues, and the development of a poor organizational culture (Mulder, 2017). A possible counter that Weber offered to some of these negative aspects of bureaucracy was an emphasis on a formal process of employee selection. He very much viewed a haphazard approach to hiring as negative. Weber included the idea of the "formal selection" in his six bureaucracy characteristics because of its importance (Mulder, 2017). He mentioned that the formal selection process should be used to identify potential employees that possess not only the desired skills and competences but who also understand the nature of the work and necessity of working within the bureaucracy. It is interesting to note that one of Weber's selection criteria was based skills and competences acquired through training and education (Mulder, 2017). Academia was beginning to be seen as a significant contributor in this process.

Bureaucracy and the University

Before a closer application of bureaucratic structure is made to university structure, consideration should be given to the connection between bureaucracy and the university. Merriam-Webster defines the university as an institution of higher learning providing facilities for teaching and research and authorized to grant academic degrees (Merriam-Webster, n.d.). The formal structuring and bureaucracies of the university evolved with the demands of the industrial revolution. As a result, the nuances of the definition of university have changed. Early universities were much more individual and decentralized, where students and masters would engage in debate and study deeply topics like theology and philosophy. By the end of the eighteenth century, most universities offered a core curriculum based on the seven liberal arts: grammar, logic, rhetoric, geometry, arithmetic, astronomy, and music (Britannica, 2022). In most of these cases, the university was chartered by a government and or a religious institution and overseen by a headmaster. It was also during this period that the communal component of the university flourished. Students and teachers enjoyed similar food and accommodations and thrived in a protective environment (Barratt, 1998). As a result, the bureaucracy of the university began to expand and accommodate a growing enrollment, the preferred community environment, and expanding curriculum offerings (Barratt, 1998).

Social pressures changed the bureaucracy of the university. Britannica (2022) online highlights the period of time as being around the mid-to-late nineteenth century, but Barrett

(1998) highlights the scope of the shift by the university as it attempts to align with enlightenment thinking and to meet the demands of the exponential expansion of production as a result of the industrial revolution. Scientific management was already well established in the manufacturing sectors and influenced greatly how the university would deal with these new demands. Barrett (1998) highlights how the university adjusted and made relatively sudden shifts from these foundational characteristics: 1) Select and narrow enrollments, 2) dependence upon the imbibing of the campus environment, 3) dependence upon the impact of the personal relationship between teacher and student, and 4) the importance and relevance of the experience throughout the whole of the graduate's life. Emphasis of the university was then placed on the structure and bureaucracy changes needed to meet the growing priority placed on efficiency of production and of thinking. The "pressure of numbers" greatly influenced the implementation of the bureaucratic system (Spring, 2001). The university system was once a system reserved for a relatively small population and was now growing too large for the decentralized method of education. By the beginning of the twentieth century the university seemed to make this shift flawlessly by promoting social conformity in an increasingly complex society brought on by the industrial revolution. It was during this period bureaucracy expanded as modern languages were added and the disciplines of chemistry, biology, engineering, economics, political science, psychology, and sociology were developed and taught (Britannica, 2022).

In preparation for connecting the idea of the university with the training of aviators, it is important to note the various Schools of Military Aeronautics (SMA) the Department of War established at several universities in the early twentieth century within the United States. Although these schools were short-lived and dependent upon the war effort, it is interesting to note the connection of this new technology and emerging discipline to academia. As a result of the bureaucratic changes within the university, the university had become the ideal medium for producing workers, or soldiers in this case, with the correct skills and attitudes. This sentiment was supported by the three main objectives published for the School of Military Aeronautics at the University of Illinois: 1) Teach candidates military duties and develop soldierly qualities, 2) eliminate mentally or morally unfit individuals as officer material, and 3) provide necessary preliminary training in the use of machines guns, wireless telegraphy, the operation and care of aeronautical motors, airplane maintenance, principles of aerial tactics, cooperations with other branches of the service, and the fundamental principles of cross-country and general. The War Department selected Texas, MIT, Cornell, Ohio State, California, and Illinois as aviation school sites and courses began in the spring of 1917 (UIA, 2014).

Bureaucratic Structure

The evolution of ideas around the bureaucratic structure continued well into the twentieth century. Henry Mintzberg has been instrumental in synthesizing many of these early works and has spent a significant amount of effort compiling them into comprehensive theories of management and organizational structures (Shafritz et al., 2016, p. 171). For example, Mintzberg's 1979 book titled, *The Structuring of Organizations*, offers the researcher several new ideas synthesized from previous works by providing detailed frameworks through which to consider structure and system flows.

An idea introduced and developed in *The Structuring of Organizations*, and germane to the purpose of this paper, is the idea of the five basic parts of the organization. Identifying these five parts are important in understanding and mapping of operating workflow, regulated control flow, regulated staff information flow, informal communication, work constellations, and ad-hoc decision processes (Mintzberg, 1979). These five basic parts of the organization include: 1) The operating core, where the operators carry out the basic work of the organization; 2) the middle line, which transforms strategic decisions into operational actions for the operating core; 3) the strategic apex, where the strategic decisions of the organization are made; 4) the technostructure, where the analysts standardize the work of the others, and 5) the support staff, which supports the operating core (Mintzberg, 1979). A popular graphic was created and used to help illustrate relationships between these five basic parts and the corresponding flows of work that moved between them.

A second idea presented in Mintzberg's book were his five types of organizational structures. Alfred Kieser, in his published book review of Mintzberg's book, highlights that these five organizational structures went beyond the abstract of previous intellectuals and provided concrete forms of organizations which can be easily identified (Kieser, 1981). These organizational structures were also illustrated by the graphic Mintzberg popularized. Mintzberg mentioned in a 1981 Harvard Business Review article that the central purpose of structure is to coordinate work. He goes on to say how coordination is achieved, and how this coordination dictates what the organization will look like (Mintzberg, 1981). His five organizational structures included: 1) The simple structure, 2) machine bureaucracy, 3) professional bureaucracy, 4) devisionalized form, and 5) adhocracy. For this paper, discussions will primarily focus on the definition of and development of ideas around the machine and professional bureaucracies.

Machine Bureaucracy

The machine bureaucracy is much like the structures described by early theorists. Max Weber's ideal type of organization was an efficient machine with standardized responsibilities, qualifications, communication channels, and work rules (Mintzberg, 1979; Moulder, 2017). The emphasis in this bureaucratic structure is at the level of the operating core and its design to function well. This type of structure was ideal for organizations emerging from the industrial revolution. Mintzberg expanded these ideas to include not only the idea of mass-production but also that of mass-service. Mintzberg saw the standardization of work as being the common structural characteristic of the machine bureaucracy (Mintzberg, 1979).

Professional Bureaucracy

This bureaucratic configuration relies on the standardization of skills rather than processes or outputs for its coordination (Mintzberg, 1981). The operating core within this organizational structure consists of carefully selected and trained individuals. These individuals are your professionals and specialists. This arrangement then provides the operating core with considerable control over their own work. This level of control can be seen as the professional works relatively independent of colleagues, but closely with the clients they serve. It is also important to note that the coordination of work within the professional bureaucracy is derived from the professional skills and knowledge within their field. In other words, generally accepted standards within their field. (Mintzberg, 1979).

Bureaucratic Structure and the University

Mintzberg is quick to point out that the university as an example of a professional bureaucracy (Mintzberg, 1979). However, most of the literature on the subject of bureaucratic structure and the university is heavily weighted toward addressing issues within the apex or executive levels of academic organizations. Larsen et al. (1998) observed, what they called, “concerning” growth of administrative positions in European universities. It wasn’t the operating core that was expanding and flourishing, it was that of the technostructure and support staff. It was the administrative functions that were growing. They speculated this growing emphasis on the middle line was taking away from quality of the student’s academic experience. Scott (2015) observes how public colleges and universities in the United States have also grown in size and complexity. He highlights that many universities are adding professional schools and added research components to their respective programs. Berger (2002) discusses the impact of bureaucracy complexity on student learning. He highlights the lack of attention paid to the relationship between organizational structure and student outcomes. A particularly interesting finding in this study highlighted that as colleges become more oriented toward external connections and influences the less connected executive management become to faculty and student (market) needs, and more likely there will be a negative effect on aspects of student learning. This is outstanding resource on this topic and highlights an apparent disconnect that may occur between university administrators and curriculum deliverers and recipients.

In contrast to the emphasis upon the executive parts of the organization, there were two sources identified that provided insights on the effects of bureaucratic structures of a university upon the operating core. The article written by Barrett (1998) focused on the evolution of university bureaucracies within law schools in Europe. Although context of this article focused on law schools and the future demands placed on these institutions of higher learning and as a result of policy changes in the United Kingdom, the majority of his comments were general and applicable to the twentieth century university. His comments primarily focused on the negative effects of the growing university bureaucracy on the development of the student as a person. First, he observed the shift of the modern and bureaucratic university from character and leadership development of a small percentage of eighteen-year-olds to providing an emphasis of lifelong learning to the majority of the population. Here he questioned the limit of bureaucracy. Second, he saw the gradual shift from on-campus life to off-campus, and even virtual, attendance as a negative aspect of the growing bureaucracy. Here he questioned the effect of bureaucracy on the mission and goals of the university. Much like the second, the third area identifies the growing disconnect between teacher and student interaction. Barrett saw this interaction as critical in student development. The last observation was the identification of a system which was intended to provide an experience which would be of relevance throughout the whole of the graduate's life had become one in which the student seeks currently relevant information for immediate and possible short-term purposes (1998). Mohammadi (2000) highlights the allure of convenience bureaucracy provides. Over the years bureaucracy has moved the student to the bottom of the pyramid by placing more emphasis on the goal of the system rather than the needs of the individual. Mohammadi asserts that the notions of evaluation and assessment are decisive parts of the successfully implemented bureaucracy. They are coordinated elements of making the relational aspect of education transactional. Mohammadi suggests the restructuring of the university bureaucracy as a step toward amending pressing problems within universities today.

Collegiate Aviation

Collegiate aviation is a direct result of the bureaucratization of the university. Spring (2001) and Murphy (2013) both highlight the willingness on the part of higher education to accept the systematic bureaucratization of the university in exchange for public money and the promise of seemingly unlimited growth. The timing could not have been any better. Early twentieth century advances in technology brought the airplane to market and the geo-political pressures of war brought the need for well trained professional aviators. The bureaucratized university was the ideal medium for standardization and social conformity (Mohammadi, 2000). Both Ohio State University and the University of Illinois historical archives corroborate these conclusions based on archive contents. Both programs saw their first students in the Spring of 1917, both with the express purpose of developing skills, knowledge, and soldierly qualities

(OSU, n.d.; UIA, 2014). It is important to note that these early Schools of Military Aeronautics were subsidized by the federal government, and all schools were disbanded after World War I. Only a few schools reemerged prior to World War II. For example, in the middle World War II (1942), Ohio State's Board of Trustees voted to formally create the School of Aviation with undergraduate curricula in five fields: aeronautical engineering, meteorology, air transport, photogrammetry, and aviation psychology and physiology (OSU, n.d.). It is important to briefly mention here, that just fourteen years later the School of Aviation was transferred into the College of Engineering. Although the reasoning is unknown, this shift from School of Aviation to Department of Aviation helps provide a glimpse into the bureaucracy of the university and the placement of collegiate aviation within the academic bureaucracy. Regardless, this was the beginning of collegiate aviation.

The literature reveals that fifty years after collegiate aviation had its beginnings, there remains forces that impede the amalgamating of the university and pilot school. Lehrer (1992) highlights the differences and demands placed on the two entities. He mentions the pilot school must be organizationally designed and operated around a strict set of regulations enforced by the Federal Aviation Administration (FAA). While the university on the other hand has structures and programs influenced by outside forces like regional accreditation associations. Smith (2002) discusses additional demands placed upon universities when it comes to the hiring and promoting of faculty by these accreditation groups. Smith specifically mentioned the Southern Association of Colleges and Schools (SACS). Smith also discusses the difficulty of finding experienced aviators with advanced degrees that meet university requirements to fill the ranks of current collegiate aviation programs. Johnson (2005), on the other hand, provides insights on the slow acceptance of collegiate aviation by traditional academicians. He points out the suspicion and outright skepticism present in academia. He points out that the primary reason for this lack of acceptance is due to the commonly held view among academicians that the collegiate aviation program is more aligned with a "trades" program. Quotes from the late John Odegard, of the University of North Dakota, and Steven Sliwa, of Embry-Riddle Aeronautical University, both reveal common frustrations they experienced championing collegiate aviation with higher education. It is important to note here that each source mentioned saw department administrators and faculty, within their respective collegiate aviation programs, as being the nexus for changing perceptions. From constructing innovative processes that align both with the FAA and SACS, to the encouragement of lifelong learning and the earning of terminal degrees, and to reaching across barriers formed by misguided perceptions, the faculty member within collegiate aviation continues to strengthen the legitimacy of this relatively new discipline.

Discussion

Much like the opening metaphor and decades after the first collegiate aviation program was started, the college and pilot school struggle to mix well. There appears to be aspects of the university and aspects of the aviation program that inhibit this mixing. An examination of the literature helped to show that the forces within the phenomenon of collegiate aviation are both historical and contemporary in nature. Further, using the bureaucratic lens to analyze this phenomenon has provided a better understanding of these issues and revealed a possible solution for current and aspiring collegiate aviation programs.

It was interesting to see the allure bureaucratic expansion offered the college in the eighteenth and nineteenth centuries. It was equally interesting to see how these bureaucratic expansions affected the university and provided an ideal environment for the mixing of the college and pilot school in the early twentieth century. Mohammadi (2000) seemed to really grasp the details of this historical shift by recognizing physical changes of the university during this developmental period. On one hand, there was a desire to expand the course catalog of the university to include a broad offering thereby enlarging enrollments and creating a more centralized model of education for the purpose of societal change. And on the other hand, the affects of such changes distanced the teacher and student relationship, created a bureaucratic system of assessment objectivity, and provided concrete obstructions to the personal aspects and intimacy of education. This seemed to be choice for the early academy here in the United States. As mentioned earlier in the paper, the timing and purpose of the Schools of Military Aeronautics help to illustrate how the university became an appropriate environment for early aviation education. Even today one will find it difficult to identify a four-year institution of higher education that does not offer a wide assortment of degree programs as a result of this early bureaucratization. Programs like nursing, communications, journalism, video production, and sports medicine are a few of the colleges attempts to expand offerings for the purpose of increasing enrollments and only preparing students for the first few years of their career.

The lens of bureaucratic structures provided additional insights into the differences between the college and the pilot school. Mintzberg (1979) was helpful mentioning that the college is an example of the professional bureaucracy. He mentions that a lot of power over the operating work lies at the base of the structure, with the operating core professional. Within the university, the professor and department managers have much say in how their work is accomplished. In many cases the administration assigns the courses to the professor, and the professor is given little guidance on how to accomplish this work. Another characteristic of the professional is that skills and knowledge are expected, and the bureaucracy struggles when the professional is incompetent (Mintzberg, 1981). This is certainly true within institutions that have become highly specialized, like institutions with medicine, law, or aviation. In contrast, Mintzberg (1979) describes the machine bureaucracy as a structure with standardized responsibilities, qualifications, communication channels, work rules, and clearly defined hierarchy of authority. This type of structure is helpful for the organization that is involved in production or service at any scale. The machine bureaucracy puts an emphasis on standardization. Rules and possible regulations permeate the entire machine. There are clear lines of responsibilities and sharp divisions of labor. The emphasis is operational.

Although the pilot school doesn't align perfectly with the scope of the definition, there are surprising similarities between the pilot school and the machine bureaucratic structure. First, the operating core is trained for a specific job and there is little freedom or creative rights on the part of the flight instructor. The flight instructor is guided by the Federal Aviation Regulations (FARs) for both content and time of instruction. In addition, the flight instructor is expected to maintain proficiency on the knowledge and skill areas for the specific tasks they are expected to teach. The FAA accomplishes this task by required annual assessments, not to mention biennial assessments for the Certified Flight Instructor (CFI) certificate itself. Second, qualifications are key for organizational function. Regulations guide this aspect of the operation by requiring various types of training for employment (Flight School Security Awareness training) and the type of work accomplished (instrument or multiengine instructor certification). Third, and unlike the classroom, the flight school is much more operationally focused. Managers of the pilot school must balance the demands placed on aircraft and instructors with student enrollment. It is important to note the relationship and dependence between these three elements. If there are plenty of students and instructors but no aircraft available, instruction will not progress. Likewise, if there are plenty of students and aircraft but no flight instructor available, instruction again will not progress. This type of dependency and operational emphasis is not present in traditional higher education schools and departments and offers a source of frustration on the part of academicians who in many cases are faced with managing heavy operational programs like aviation.

It is also worth commenting on the collegiate aviation issues highlighted in the literature and connecting them to bureaucratic structures. Smith (2002) highlights the source of governing differences as being the causal factor for many of the issues within collegiate aviation. Although he doesn't mention bureaucratic structures specifically, the division between a professional bureaucracy and machine bureaucracy can easily be inferred. The division here is most notable from the point of oversight. The university is directed by regional accreditation boards and the pilot school is directed by the FAA. In some cases, this is the cause that often spurs collegiate aviation managers to consider deeply how to best integrate flight operations with the academy, when there is not one way to fully integrate the two. Much like how the difference in polarization between the water and oil molecules will keep the two substances from mixing, this one aspect alone seems to be the most influential force for keeping these two organizational functions from mixing well. What appears to be needed is an aspect of the organization, singular or plural, that will act much like the dish detergent in the opening metaphor. Some thing or things are needed to act as an amphiphilic and to help create linking chains between these two entities. Regardless, the differences in this operating emphasis or structure creates several common points of frustration. First, the FAA not only mandates curriculum content but also mandates the amount of training time given. This level of guidance often interrupts and extends instruction outside of ideal semester model of the university. This type of interruption of instruction often struggles to find adequate accommodations within the professional bureaucracy of the university. Although the grade of "Incomplete" is issued, the volume of these issued marks usually raises attention in such bureaucratic offices like, the Registrar's Office. It is interesting to note the recent changes in the 14 CFR Part 147 regulations that govern aviation technician schools. These changes minimize the differences between the two bureaucratic structures and allows the mechanic school to better align its curriculum and operation with regional accreditation boards. It will be very interesting to see the impact of these changes on program throughput over these next several years. Second, the natures between the operations are different. The university is a professional bureaucracy and managed by those who have developed professionally in this environment. The pilot school is operational in nature and requires extensive understanding of the management of resources, including money. However, the issue here can go both ways. Institutional academicians can struggle when not understanding the relationship between resources, efficiency, and costs. However, those managing a flight school may struggle similarly by being so operationally focused they are not able to explain ideas like return on asset, break-even points, opportunity costs, and discounted cash flows. In addition, employees within a collegiate aviation program may struggle to identify adequate assessments for a variety of program and course learning outcomes. In many ways the manager of the collegiate aviation program has to fully understand these limitations and act. Not only must they understand the business and justification side of asset management, but they much also understand the vocabulary and responsibilities of the academy. Third, communication between departments is critical. Building off the previous points, a collegiate aviation program must have leadership that is not only experienced in the field of aviation but are also credentialed in academia. This experience and credentialling are important to the mixing of the college and pilot school. Johnson (2005) highlights that although aviation is not a "pure" academic subject, the single most important element bringing the two entities together is the credentialling of the employees. In addition, at the time of his article he observed the terminal degree in the field aviation as being a master's degree and not the coveted doctorate. Johnson defended his idea by arguing that the elevation of the doctorate as being the terminal degree within the field of aviation would help to expand research and publication and to improve communication across organizational differences. In one of his concluding thoughts, he mentioned that the credentialing of collegiate aviation staff may not bridge the gap of acceptance entirely but would at least provide a more common basis for communication. Credentialing of experienced aviation professionals seems to be one of those "amphiphilic" elements.

Implications

The overall findings from this paper have important implications for collegiate aviation programs. The demand for well-trained aviation professionals does not appear to be lessoning for the foreseeable future. Whether a collegiate aviation program already exists, or a university is considering a new aviation program, it would be good to consider these findings. Insights made from this type of inquiry may help collegiate aviation programs better understand the environment in which they operate and help new programs understand the internal processes necessary for a relatively smooth development. First, it is important to note that there are differences between the university and the pilot school. These differences often contribute to the inability to mix well in an institutional setting. University support staff and technostructures are designed to support the whole professional bureaucracy of the university and often fall short or fail to adequately support the pilot school. Second, a possible solution for helping the university and pilot school combination could be the recognition of the importance of boundary spanners.

These would be credentialed individuals within the collegiate aviation program that make an effort within the organization to actively aim at bridging one or more recognized organizational boundaries to facilitate workflow (Bhasin, 2021).

The scope of this paper was limited to the initial observed findings of the collegiate aviation program when considered through the bureaucratic lens. Further study could be done on the relationship of the 14 CFR Part 147 Aviation Maintenance Technician School and its connections with universities and how these schools are navigating the rule changes that make their relationship with the university less dramatic. Insights gained in that analysis could cross over to the university setting incorporating a 14 CFR Part 141 Pilot School. Further study could be done on the role and function of collegiate aviation boundary spanner. Consideration could be given to the importance of credentialing and areas of importance a boundary spanner should focus. The idea of a dynamic and well-trained individual(s) who could provide the same result as the amphiphilic characteristics of detergent, could be promising in reducing the polarization one often sees between the university and the pilot school.

Conclusion

Looking at the phenomenon of collegiate aviation through the bureaucratic lens helped to add clarity on possible reasons why there is such resistance when a pilot school has been combined with the university. First, it was noticed how the early bureaucratic expansion of the university prepared a place for collegiate aviation. Second, one could see how differences in bureaucratic structures provide the areas of resistance for program integration. Moving forward, it was interesting to see that the credentialing of collegiate aviation faculty and the development of boundary spanners may provide the necessary qualities for improving program acceptance and success.

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Graduate Course Performance Indicator Rubric

Assess Student Learning Outcomes

Course: ASCI 5230 Professional Ethics and Standards Course Instructor: _____McCall_______________________________________

Semester Taught: ___Fall 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 5: Evidence of scholarly and/or professional integrity in the aviation field of study.	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 5: Evidence of scholarly and/or professional integrity in the aviation field of study.

Learning Module 1: Introduction to ethics and standards, terms, and decision making

Discussion Board Assignment: Q2 Ethical Decision Making (10 points)

Due 4 SEP

LM1-Q2:

What do you consider the most important step in the Seven-step Reasoning Process and which step would be difficult for you? Please explain why in your 1-2 paragraph response (EIIA, p. 24)

Student Post on Discussion Board in Response to LM1 Q2:

From the Seven-step Reasoning Process, what will you do, is the most important step. I chose this step because deciding ultimately leads to an outcome. The effects of that outcome stem from how the decision was derived. Simply using information that comes to mind quickly and easily does not equate to precise and moral judgment (Kahneman, 2011). When making decisions using logic and reason serves a greater purpose for goal achievement. For example, XYZ airlines experiences an engine fire shortly after takeoff. The crew has been trained to put out engine fires, however how they proceed affects the outcome of the flight. Does the crew address the engine fire immediately while flying away from the airport? Does the crew fly back towards the airport first and then put out the fire, or does the crew simultaneously address the engine fire while aviating back towards the airport? While morally obligated to put out the fire, the crew is also obligated to continue flying the aircraft safely.

What will you do is also the most difficult step. Without knowledge of the subject or some principal fundamentals, deciding maybe easily be attained by recall or using one's moral conscience. This type of decision can leave the person with perhaps low-quality information forming the basis of their decision (Kahneman, 2011). Availability suggests that singular memorable moments have an overwhelming influence on decisions. This last step allows for consideration and deliberation that can minimize short cuts leading to bad decision-making (Hoppe, 2019).

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Graduate Course Performance Indicator Rubric

Assess Student Learning Outcomes

Course: ASCI 6020 Flight Operations Business and Administration Course Instructor: ____Jan McCall____________________________

Semester Taught: ____Spring 2023_______________ 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 1: Assess relevant literature or scholarly contributions to the aviation field of study.	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 to the aviation field of study.

Recommendation: This semester I included tools in the Course Resources on evaluating sources such as the CRAAP TEST (Hopkins 2015) and "Top Six RED FLAGS that a 'News Story' Is: Unreliable, Disreputable, or Embarrassing for you to share" (Ad Fontes Media, 2020). The result was a marked improvement in students' use of sources. I encourage incorporating these tools in all of our classes to help students recognize the authority of the author/org and the accuracy of information necessary for establishing credibility in their research.

Student Sample

Essential Air Service: Contemporary Problems and Future Potential Solutions

Created in 1978 as a response to the Airline Deregulation Act, the Essential Air Service (EAS) program was established by the United States government to ensure continued access by small, rural communities to commercial air service. The program provides subsidies to airlines that operate between these underserved areas and small, medium, and large hubs. EAS is a vital socioeconomic driver in over 100 communities across the country today, ensuring residents living in these communities have access to the transportation, tools, and resources they need to support themselves. Benefits to stakeholders in each community and across the nation serve as evidence for continued congressional support, albeit with enhanced initiatives to promote continuous, quality service. Administered by the Department of Transportation (DOT), the program subsidizes air carriers of varying capabilities, covering the difference between the cost of providing air service to a particular community and the revenue generated by the airline for that service plus an allowance for five percent profit. The program remains important to the communities it serves and provides essential air service to areas that would otherwise not have access to commercial air service (Air Line Pilots Association, 2022). Over the last decade, the program has experienced a rapid increase in cost to subsidize air service with little change in the number of communities served. It is worth considering whether EAS could be used as a steppingstone before the implementation of these other programs which rely on increased fiscal independence.

EAS Costs and Contingencies

The EAS program is expensive, with costs increasing over the previous decade. In October 2012, the program's budget was $225 million, increasing to almost $394 million by May 2023 (DOT 2012; DOT, 2023). Over the decade between reports, the DOT reports a decrease in communities served from 120 in 2012 to 111 in 2023. Legislation passed by the U.S. government in 2012 authorizes only certain communities to retain eligibility for EAS subsidies. Many of the communities served by the EAS program have low passenger demand, making it difficult for airlines to operate profitably. Because of this, the airlines request higher subsidies, thereby increasing the subsidies awarded by the DOT. Due to greater capacity constraints as airlines recover from the coronavirus disease (COVID-19) pandemic, low-demand communities are also those who have experienced reduced or discontinued service, even when the route is subsidized.

Federal, state, and local governments are interested in the effectiveness of EAS, program successes, and needed improvements. Commissioned by the Federal Aviation Administration (FAA) Extension, Safety, and Security Act of 2016, the Working Group on Improving Air Service to Small Communities brought together 25 airline and airport managers, third-party consultants, and FAA subject matter experts (WGIASSC, 2017). After three months of collaboration, the Working Group determined "the EAS program is the backbone of small community air service in the United States and must be maintained and optimized" (2017 p. v). Evidence analyzed by the group shows that such service supported 31 full-time equivalent jobs and a $4.1 million contribution to local economic output across two communities.

The EAS program complements other modes of transportation such as buses and cars. Some argue that these alternative modes of transportation are more cost-effective and better suited to serve low-demand communities within 175 miles of a large- or medium-sized hub unless enplanements consistently average more than or equal to 10 passengers per day the airport received flight services (GAO, 2019). Data shows that communities within this distance from a hub will tend to drive to the larger airport, placing destination availability and departure time as a higher priority than driving distance to their airport of origin. In the fiscal year 2010, the EAS market between Macon and Atlanta, Georgia, an 80-mile flight, was utilized by 1,242 passengers (Grubesic & Wei, 2012.) In the same year, 36,295 passengers flew between Grand Island, Nebraska and Dallas-Fort Worth International Airport in Texas (City of Grand Island, 2010).

Congress mandates EAS communities must be more than 70 miles from the aforementioned large- or medium-sized hub airport. In general, the total subsidy provided in the previous fiscal year must not be in excess of $200 per passenger enplaned. This figure is computed by dividing the total subsidy awarded to the air carrier or operator by the number of actual passenger enplanements in the fiscal year in question. For example, Nashville-based Contour Airlines proposed a $5,609,670 subsidy for service between Kirksville, Missouri and Chicago O'Hare. To meet the less than $200 subsidy per passenger rule, the airline must enplane at least 28,048 passengers during the fiscal year for Kirksville to remain eligible for an EAS subsidy (Contour, n.d.) If a community is greater than 210 miles from the nearest hub, the subsidy maximum is $1,000 maximum per passenger (GAO, 2019). The distance and subsequent financial requirements to keep the EAS subsidy is the U.S. Congress' attempt to limit airlines taking advantage of the program; it is encouragement to follow through with the service promised in their proposal and contract with the DOT. In 2014, the DOT issued a Final Notice of Enforcement Policy regarding the $200 subsidy cap "on an annual basis based on data compiled at the end of every fiscal year" (DOT, 2014, p.1). Communities are also required to maintain enplanements at or above 10 passengers per day in addition to a load factor that will maintain an annual subsidy of less than or equal to $200 per passenger. If a community is in violation of the $200 or 10 passengers per day rule, it is allowed to petition the DOT to continue receiving subsidies in excess of $200 per passenger. The DOT has granted most waivers unless the community cannot show evidence that they expect enplanements to increase. The Secretary of Transportation is charged with granting waivers and has the authority to authorize excess spending "for a limited period of time, on a case-by-case basis, and subject to availability of funds" (DOT, 2014). From 2015 to 2019, the DOT published a series of reports regarding this enforcement. As of the latest $200 Per Passenger Compliance Status Report, 15 communities were in violation of this requirement.

Pilot Labor Shortage Affects Quality of Service

The Working Group on Small Community Air Service writes extensively on the effects of the 2013 First Officer Qualification (FOQ) Rule and the trickle-down negative impacts the Congressionally mandated rule is having on EAS communities (WGIASSC, 2017). The U.S. airline industry is experiencing a high turnover of professional pilots in the flight deck of major airlines that operate under 14 CFR Part 121. Since 2013, most aspiring professional pilots are required to log at least 1,500 hours of total flight time, plus obtain an Air Transport Pilot (ATP) certificate in order to fly for carriers such as American, Delta, and United Airlines. Many EAS carriers operate under 14 CFR Part 135 (with some exceptions) which requires notably fewer hours to be eligible for hire. These carriers had been relying on low total time commercial pilots to meet the needs of their operation. This was a mutually beneficial relationship: the commercial pilot earns their 1,500 hours of total time and the airline had pilot services to be used across EAS routes. Since 2016, the hiring needs of major U.S. air carriers have outpaced the production of pilots, presenting lucrative job opportunities to those pilots working for Part 135 carriers. Due to the hiring demand in a portion of the industry that many pilots see as their final and ideal employer, they have been successfully recruited away from on-demand air carriers such as those that provide EAS services. This means that carriers providing EAS to small communities are dealing with higher demand than they have crews to handle and are unable to provide service as contractually obligated.

As previously discussed, communities must see an average of at least 10 passenger enplanements per day, plus most must maintain a subsidy maximum of $200 per passenger. These requirements are increasingly difficult for communities to meet as air carriers struggle to meet their contractual air service commitments due to the shortage of pilots. As service frequency decreases at a community's local airport, air service users will tend to travel to the closest hub-sized airport to receive more reliable service, often at a cheaper cost and on a more convenient schedule (GAO, 2019). The GAO reports air carriers struggle to continue service with subsidy caps as they often must operate 50-seat aircraft to EAS communities, operated by pilots that are being paid 75 percent higher wages than years prior (2019). For such a service to be sustainable, the carrier needs forecasted revenue to meet the expectations in addition to receiving proposed subsidies from the DOT. As a carrier loses the confidence of passengers and enplanements decline, it may be replaced by a different airline. If the new airline does not see demand return to forecasted levels, it also may not be able to uphold its commitment and the community will become ineligible for subsidies as parameters will not be within the limitations of Congress' requirements for the EAS program.

Stakeholder Views on Program Sustainability

Continuing collaboration between local officials, the DOT, and air carriers is necessary to ensure the longevity and fiscal sustainability of connectivity to small communities across the nation. There are several potential enhancements to make to the EAS program, and a hybrid solution may be preferred in most, if not all, communities across the country. In interviews with 10 air carriers and 17 communities, the Government Accountability Office lists several potential options to improve the quality of service including increasing the subsidy cap, renegotiating EAS agreements, and changing EAS from a carrier subsidy program to a community grant program (2019).

To create a more predictable financial environment for the program, Congress ought to increase the allowable subsidy so that stakeholders can budget appropriately for the proposed service. The DOT and carriers that wish to operate on the routes should be able to anticipate a subsidy that is within a limit consistent with expenses today, not 23 years ago when the $200 subsidy was set. Communities and air carriers suggested to the GAO that statutory requirements allow the subsidy to be directly related to the rate of inflation or permit the DOT flexibility to increase the cap temporarily for communities where needed (2019). Researchers found that if the subsidy cap were tied to inflation, the upper limit would be $283. In 2018, 16 of 55 communities exceeded the $200 cap, but when adjusted to $283, only six were beyond the allowable subsidy (GAO, 2019). The $200 subsidy was intended as a limitation to the spending of taxpayer dollars toward EAS, but it may be time for the federal government to move the goalpost. With rising costs in labor and fuel, air carriers are left with little choice but to operate the flights at market value. Fuel suppliers and labor organizations generally make no concessions or discounts to carriers solely because they provide EAS flights.

Air carrier representatives voice their desire to be able to renegotiate EAS agreements with the DOT over the course of the contract (GAO, 2019). Doing so would allow flexibility in financial resources preventing the need for the carrier to file a Notice of Termination, the method where given 90 days' notice, a carrier can notify the Secretary of Transportation that it plans to terminate, suspend, or reduce the amount of service to an EAS community (Ending, suspending, and reducing basic essential air service, 2012). Though the ability to lock in a new contract seems appealing, there is a statutory provision that allows for compensation adjustment without expending legal and labor resources on contract negotiations. In the case that costs to the air carrier providing EAS exceed the contractual rate agreed to by the DOT, the airline has recourse to ensure the fiscal viability of its service. Title 49 United States Code 41737 allows the Secretary of Transportation to increase compensation to the air carrier without renegotiating EAS contracts at all (Adjustments to Account for Significantly Increased Costs, 2022). The DOT relies on the airline's internal audits to determine whether costs have increased more than 10 percent for at least two consecutive months. This could be a welcome reprieve to those carriers that struggle to continue service despite increases in fuel, labor, and facility charges across the operation and the duration of their agreement. Pursuing an adjustment is an unleveraged tool in the belt of the airlines providing EAS. "DOT officials said that to date no carrier has petitioned for such an increase," (GOA, 2019, p. 29).

Demands for EAS financial sustainability and less burden on U.S. taxpayers often call for the disbandment of the program altogether (Baldanza, 2022). Complete defunding is not a viable way to ensure small communities across the U.S. retain vital commercial air service that remains a gateway to larger hubs to prevent isolation of the communities which benefit. To completely remove government funding from EAS routes yet retain service, every carrier would need to operate exactly the right sized equipment to each airport on exactly the right days to ensure optimal load factor to ensure a breakeven, let alone profitable operation. For some communities, this type of service would mean trips only once or twice a week–a rate that would leave behind plenty of potential travelers simply because the service must sustain itself. Instead of withdrawing funds completely, the program ought to be shifted to incentivize independent financial responsibility for communities that have shown evidence of passenger enplanements that will sustain service with less subsidy.

Other Methods to Provide Commercial Air Service

The Alternative Essential Air Service program, established by the Bush administration in 2003, allows for funding to be allocated for control by each community in the form of a grant (DOT, 2004). The program allows for officials in communities currently receiving EAS service to submit an application to the DOT detailing alternative methods in which funding could be used to improve air service to the airport other than directly subsidizing 19-seat aircraft service which was, at the time, the requirement for EAS. The funding could be directed toward carriers operating aircraft less than 19-seat aircraft to provide more frequent service, on-demand flights, ground transportation from the community to a medium- or large-sized hub, or other improvements that must be approved by the DOT.

For those communities that are in more favorable passenger enplanement circumstances, consideration of the Small Community Air Service Development Program (SCASDP) may be more appropriate. The SCASDP is a separate program from EAS, though the two complement each other in purpose to bolster and support commercial air service at qualifying airports. Airfields classified by the Federal Aviation Administration as small-hub or non-hub qualify for the SCASDP. These funds are awarded by the DOT to those communities that seek to provide assistance to:

- A U.S. air carrier to subsidize service to and from an underserved airport for a period not to exceed 3 years;
- An underserved airport to obtain service to and from the underserved airport; and/or

- An underserved airport to implement such other measures as the Secretary, in consultation with such airport, considers appropriate to improve air service both in terms of the cost of such service to consumers and the availability of such service, including improving air service through marketing and promotion of air service and enhanced utilization of airport facilities. (DOT, 2023, p. 4)

Obtaining SCASDP funding can be helpful in securing service from airlines that do not have an outstation operational at the airport; funds may be used to offset start-up costs such as hiring ground staff, setting up facilities, etc. Some communities partner with air carriers to begin new or enhance existing services to and from their underserved airports by subsidizing the flights with funds generated by the local government or chamber of commerce. SCASDP funding can be lumped in with funding from local sources to subsidize air service to the community, called "minimum revenue guarantees" (Semuels, 2023). In Fiscal Year 2022, Eagle County Airport in Colorado was awarded $1 million as a revenue guarantee and marketing to support a new entrant to the competitive marketplace in addition to "a very high level of local funding" (DOT, 2022, p. 9). Experiencing high airfares, the community is seeking to attract a low-cost carrier to diversify travel options. Likewise, Branson, MO was granted $500,000 in a similar initiative to carriers to enhance options aside from its one destination of Denver, Colorado. Minneapolis-based Sun Country Airlines submitted letters of support for both airports. In an industry stakeholder report, airline, airport, and government subject matter experts encouraged Congress to increase funding for SCASDP from $5 million in 2017 to $20 million (WGIASSC, 2017). So far, Congress has appropriated $15 million as of the most recent fiscal year–a notable increase already being put to use in markets across the U.S. (DOT, 2023).

While SCASDP is no direct substitute for EAS, it is certainly an option for underserved communities that demonstrate demand. Ideally, communities utilize EAS to the extent necessary in partnership with air carriers that can meet the expectations of quality service on the routes served. After carriers and underserved communities show their partnership to be mutually beneficial, the community can pivot from utilizing EAS subsidies to leveraging SCASDP grants. These grants are generally awarded to communities that have "established robust public-private partnerships to enhance community participation and facilitate access to air services, [have] provided a specific plan and timetable for using their grant funds in a timely manner, and have provided a letter of support from an interested air carrier," (DOT, 2022, p. 5). Transitioning from the EAS program to SCASDP indicates the community is becoming more able to finance resources and infrastructure on its own, rather than solely on funding from the Federal government.

For those communities that do not immediately show signs of outgrowing the Essential Air Service program, another solution requiring systemic changes may be viable. As briefly discussed, EAS carriers utilize a patchwork of airframes to operate routes across the EAS so-called network. These aircraft vary in capacity and capability. Some airlines utilize nine-seat Cessna Caravans (e.g. Southern Airways Express), 30-seat ERJ-135s (e.g. Contour Airlines), ranging to 186-seat Boeing 737-800 aircraft (e.g. Sun Country Airlines.) Aircraft are often oversized for the routes they serve, even when making more than one stop on a trip from the carrier's connecting hub. The GAO reports that carriers often struggle to fill the seats on EAS routes. "If the carrier uses an aircraft with 50 or more seats, the carrier must have sufficient increasing demand to fill that plane on a regular basis to justify the capital expenditure and increased costs to operate" (GAO, 2019). Until the Consolidated and Further Continuing Appropriations Act of 2012, carriers were required to provide aircraft with at least 15 seats for passengers. Now, carriers may provide airframes with less than that requirement, with many carriers opting for nine-seat aircraft. Along with Southern Airways Express, the majority of Boutique Air and Cape Air flights utilize airframes certified for nine passenger seats.

Smaller aircraft require less financial investment by the operator and thus the U.S. taxpayer contribution to offset costs of EAS service. "Annual contract subsidy rates" provided by the DOT show EAS contracts will cost the department an average of $3,551,613 city pair during FY2023. On average, routes utilizing aircraft with more than nine passenger seats will cost $3,686,524 while those with less than or equal to nine seats will cost $3,176,964–a $509,560 difference. The most expensive subsidy tops out at $10,874,142 (i.e. GoJet D/B/A United Express two daily round trips between EWR and PQI airports utilizing a 50-seat CRJ-550) while the least expensive will cost $176,951 (i.e. Southern D/B/A Mokulele two daily round trips between HNM and OGG airports utilizing a nine-seat Cessna Caravan.) This data points to the economically viable solution: use aircraft with less passenger seating (DOT, 2023).

Purpose-Built Aircraft and Networks for Effective Program Spending

Air carriers previously complained of the lack of aircraft purpose-built for EAS-type flying (short routes, many legs per day) and the associated maintenance costs of subjectively overworking their aircraft, hence the broad shift to larger capacity aircraft (GAO, 2019). Just in time for our discussion, aircraft manufacturer Tecnam and EAS-focused airline Cape Air partnered to launch the P2012 Traveller which is type-certificated for operation with a single pilot (a second seat is available for a second pilot) and nine passengers (FAA, 2020). With service launched in 2020, the airframe has been flying successfully across the Cape Air network, connecting EAS airports with hubs and thus connecting communities across the nation.

Carriers operating EAS routes ought to pivot to a fleet largely focused on the nine-seat passenger aircraft such as the Tecnam Traveller, Cessna Caravan, and Pilatus PC-12 types. In regard to Federal Aviation Regulations, none of the aircraft require pilots obtain a type rating (Type rating requirements, 2018). All crew would need is their commercial pilot certificate appropriate to the aircraft being flown (airplane single engine vs multi engine), notwithstanding insurance requirements. This simplification in pilot certificates reduces the burden on flight crews, making pilot jobs flying these aircraft more attainable for aspiring industry professionals. All of these aircraft are certified for flight with a single pilot, reducing the burden on airlines to staff all airplanes with at least two pilots at all times, though consistent with safety, carriers ought to attempt always to staff two pilots when availability permits.

These aircraft have the ability to transform the fiscal integrity of Essential Air Service in the U.S. These aircraft could be dedicated to the mission of connecting users of underserved airports to medium and large hubs, thus connecting their passengers to the world. Airliners such as the CRJ-200 and Boeing 737 could be reallocated to more appropriate routes in their network, maximizing revenue for the companies which operate them. EAS routes would be left to airlines that specialize in that sector of the industry. Similar to their major airline counterparts, these airline networks could still be structured as a hub-and-spoke type, with crews flying to an outstation and then back to the hub multiple times per day (Belobaba et al., 2016.) Contingent on DOT approval, up to two outstations can be combined in one roundtrip trip; ideal for those routes that truly struggle to meet enplanement and load factor goals (Number of intermediate stops, 1987). EAS-focused air carriers could bolster their quality of service by negotiating interline agreements with all major carriers that share the hub airports which they utilize. Such agreements would make the passenger experience virtually seamless: no matter their origin, users could trust that their baggage will transfer to the major airline of their choice and continue to the final destination.

All things considered, the model above would require airlines operating the aforementioned nine-seat aircraft to increase their fleet sizes many times over and would be contingent on major airlines withdrawing from routes that increase their footprint, brand recognition, and revenue. Operating purpose-built aircraft on routes to underserved, small airports would likely align expenditures on the EAS program more consistently with their true demand. Air carrier service to rural communities provides global connectivity that is necessary for our nation to thrive. Industry incumbents and new entrants ought to consider what they can do to serve the greater good of their local communities and the broader nation. In the short term, stakeholders should leverage the air service assistance program that benefits the community most: EAS or SCASDP. Long term, it is necessary that the industry pivot to a route-appropriate model where major airlines focus on high-demand routes and EAS-specialized carriers focus on connecting lower-demand routes to the larger hubs and onto the major airlines, but without the egregious overspending required to subsidize large turbojets and pilot training costs associated with ATP and type rating training. By leveraging the strengths of each part of the industry, aviation infrastructure and resources will thrive, connecting people with that in their lives which matters most.

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Grade: 97/100

Chase, this was an absolute pleasure to read.

I was thrilled to see such current sources and strong data throughout to support your points. You did a wonderful job of quickly covering the history of EAS, problems, and proposed solutions. If I haven't mentioned it before, you have a nice writing style. The structure of the paper worked *well in defining the problem, the stakeholders, and implications for communities supported by EAS. I hope you will seek out an opportunity to publish this paper as it is such a hot topic in the industry now.*

Throughout the paper I identify minor formatting errors, word selection, and make recommendations for you to consider should you revise the paper for publication. Consider other universities for publishing but keep in mind you'll probably need to pair it down. I'm not sure what happened with the references missing the indent? Nonetheless, they were well formatted and certainly demonstrated the depth of research you conducted which truly lends to your credibility.

Truly excellent work and something you should be proud of completing. Thank you for the effort you put into the class. I wish you all the best and good luck on the CFI this summer. Please email or text me when you get it.

Jan

Graduate Course Performance Indicator Rubric

Assess Student Learning Outcomes

Course: ASCI 6070 Aviation Training Methods

Course Instructor: Stephen Belt

Semester Taught: Spring 2023

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”)
SLO 2: Apply the major practices, theories, or research methodologies in the aviation field of study.	Discussion: 100% Précis Assignments: 80% Term Paper: 80%	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.

- Continue to develop expectations and rubric for term paper
- Evaluate weekly topics for suitability

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