January 2022

Analysis Of Safety Event Reporting Behaviors And Attitudes Amongst USCG Aviators

Kevan Patrick Hanson

ANALYSIS OF SAFETY EVENT REPORTING BEHAVIORS AND ATTITUDES AMONGST USCG AVIATORS

by

Kevan Patrick Hanson
Bachelor of Science in Mechanical Engineering, United States Coast Guard Academy, 2007
Master of Military Operational Art and Science, Air Command and Staff College, 2020

A Thesis

Submitted to the Graduate Faculty

of the

University of North Dakota

in partial fulfillment of the requirements

for the degree of

Master of Science in Aviation

Grand Forks, North Dakota

May

2022

Name: Kevan Hanson

Degree: Master of Science

This document, submitted in partial fulfillment of the requirements for the degree from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work has been done and is hereby approved.

Shayne Daku, Ph.D., Chair

Mark Dusenbury, Ph.D.

Brandon Wild, Ph.D.

This document is being submitted by the appointed advisory committee as having met all the requirements of the School of Graduate Studies at the University of North Dakota and is hereby approved.

Chris Nelson
Dean of the School of Graduate Studies

4/22/2022

Date

PERMISSION

Title	ANALYSIS OF SAFETY EVENT REPORTING BEHAVIORS AND ATTITUDES AMONGST USCG AVIATORS
Department	Aviation
Degree	Master of Science

In presenting this thesis in partial fulfillment of the requirements for the graduate degree from the University of North Dakota, I agree that the library of this University shall make it freely available for inspection. I further agree that permission for extensive copying for scholarly purposes may be granted by the professor who supervised my thesis work or, in his absence, by the Chairperson of the department or the dean of the School of Graduate Studies. It is understood that any copying or publication or other use of this thesis or part thereof for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and to the University of North Dakota in any scholarly use which may be made of any material in my thesis.

Kevan Patrick Hanson

April 25, 2022

Table of Contents

ACKNOWLEDGEMENTS viii

ABSTRACT ix

Chapter I: Introduction 1

Safety Culture 2

USCG Aviation Safety 4

USCG Safety Reporting Process 5

Hazard Reporting Limitations 8

Problem Statement 8

Purpose of the Study 11

Literature Review 11

Research Question 18

Chapter II: Methodology 19

Institutional Review Board 20

Population 20

Sample 21

Instrument and Data Collection 23

Survey Development 24

Pilot Survey 25

Final Survey Instrument 25

Reliability 26

Factor Analysis 27

Chapter III: Results 29

Additional Findings 40

Chapter IV: Discussion 42

Further Research 51

Limitations 53

Conclusion 54

References 56

Appendix 60

ACKNOWLEDGEMENTS

To my mother and father, for somehow teaching me to enjoy doing hard things. To my wife and daughters, for giving me patience and grace when my focus needed to be on school. To my committee and the professors at the University of North Dakota, who were instrumental in guiding me through my research. Finally, to the United States Coast Guard, specifically the individuals who have gone before me to pave the way for aviation safety and those who created the opportunity for me to work on this research.

ABSTRACT

Safety event reporting is an essential component of Safety Management Systems (SMS) that help organizations identify and address hazards. USCG aviation has a robust safety reporting process, however subject matter expert review and academic studies suggest that underreporting occurs in the USCG and in similar organizations, and that certain barriers to reporting may exist. A survey was designed and distributed to active duty USCG aviators (151 valid responses received) to identify historical reporting behaviors, attitudes towards pre-identified barriers, qualitative perceptions of reporting barriers, and attitudes towards potential new reporting policy and processes. Statistical analysis of the results found that lack of perceived program value was the greatest barrier to reporting, followed closely by inconvenience. Lack of knowledge and fear of retribution were lesser concerns. Additionally, results showed that 21% of the respondents have knowingly underreported a safety event in the past. Demographic differences were studied, resulting in the observation that reporting barriers and underreporting appeared to be more prevalent for fixed-wing versus rotary-wing aviators, and that prior safety training significantly improved attitudes towards numerous constructs.

Chapter I: Introduction

Aviation safety has historically been a reactive process, with analysts studying catastrophic accidents that have occurred in order to identify what needs to be fixed to prevent the repeat of similar mistakes and undesirable outcomes. This reactive safety process requires undesirable safety outcomes which are then studied to identify the hazards that contributed to the event. In contrast, a proactive approach to safety risk management aims to identify safety concerns before dangerous events ever occur. From the 1950s to today, the commercial aviation hull loss rate has declined from nearly 41 per million flight hours to .2 per million flight hours (Boeing Aircraft Company, 2019). Given the extremely low hull loss and major accident rates that occur in modern aviation operations, and the relative absence of large data sets of would-be hazards derived from these major accidents, the pursuit of safe operations necessitates a proactive approach. Such an approach aims to identify the latent hazards that exist within aviation organizations before they result in catastrophe. Paramount to proactive hazard identification is the access to data acquired through safety reporting systems and flight data analysis programs (International Civil Aviation Organization, 2018, para. 2.12). The data acquired from these programs provide safety professionals the information needed to observe, study, and respond to the latent hazards that might contribute to a future catastrophic mishap before such an outcome can occur. The term "free-lessons" often appears when discussing this topic. It refers to the hazards that have been uncovered through safety event reporting tools, without a tragic prerequisite loss of life or aircraft to identify and address.

Most major air carrier organizations, as well as the Department of Defense (DoD) military aviation branches, have robust, well-developed programs designed to capture or draw out this proactively acquired data that is needed to search for hazards and unsafe trends. The United States Air Force (USAF), for example, employs tools such us Military Flight Operations Quality Assurance (MFOQA), Airman Safety Action Program (ASAP), and Line Operations Safety Audits (LOSA), among other programs, in order to create data streams to identify hazards, prevent mishaps, and execute the mission (United States Air Force, 2020, para. 7.3.6). These tools, along with their comparison to similar constructs in other organizations will be discussed further in subsequent sections. The United States Coast Guard (USCG), though in many ways comparable to the DoD organizations, does not possess the resources to maintain as diverse or robust programs to capture data. Nevertheless, it still requires consistent data of high quality and quantity in order pursue a proactive approach to safety. For this reason, and with these limitations, the USCG must rely heavily on operator submitted reports as the primary source of identifying hazards and adverse trends. A strong and effective safety culture is, above all else, essential in creating an environment and process where these voluntary safety reports are generated and submitted. Achieving a safety culture in which operators readily contribute these voluntary safety reports, as the existing literature shows in abundance, turns out to be quite the challenge. The aim of this research is to better understand and address some of these challenges specifically within USCG aviation.

Safety Culture

James Reason (1997) introduced the concept of five critical sub-components of a favorable safety culture within a high-consequence organization which is now engrained in USCG doctrine.

The USCG Safety and Environmental Health Manual describes these five sub-components as (United States Coast Guard, 2021, p. 1.5):

1. Reporting Culture. Reporting culture refers to a climate where people are encouraged, prepared and equipped to report hazards, errors and near-misses.

2. Learning Culture. Learning culture refers to using safety information systems to analyze and develop accurate conclusions regarding hazard exposure and safety.

3. Just Culture. Just culture refers to an atmosphere of trust where people willingly and freely provide safety-related information without fear of reprisal. Clear lines exist and are understood between acceptable and unacceptable behavior. Personnel by their human nature make errors. Just culture recognizes this fact and encourages appropriate responses to these human errors.

4. Informed Culture. Informed culture refers to safety system managers having accurate and current knowledge about factors (human, technical, organizational, and environmental) that determine safety of the system.

5. Flexible Culture. Flexible culture refers to the organization reconfiguring its hierarchy as necessary to adapt during high-tempo or extraordinary hazard exposure, and recognizing the hazard associated with normalized deviation.

Of these components, reporting culture and just culture are the two most important characteristics necessary for an organization to thrive at producing the much needed “free lessons” previously described. The prevailing concept in achieving a desirable just culture boils down to trust between the operators (those submitting the reports), the organizational leadership (those responsible for administering intervention or personnel discipline), and the safety professionals handling the information. In addition to having a just culture, a strong reporting culture requires that operators understand the importance of the reporting system, understand how and when to participate in it, and are trained in the specific organizational requirements and expectations. Furthermore, a strong reporting culture is dependent on the accessibility of the reporting process to operators, with a level of burden acceptably low enough for them to contribute. Learning, informed, and flexible culture (in the context purely of participant attitudes towards safety reporting) suggest that an operator must believe there is some value associated with their participation. If they are not convinced the organization will handle their input appropriately and use it to actually improve safety, then the learning, informed and flexible cultural elements are not perceived to be sufficient enough to justify the individual's efforts towards contributing a safety report.

USCG Aviation Safety

Assessing safety culture is a continuous and important element of understanding how those working with the organization perceive, comply, and contribute to the safety process. The USCG conducts an annual safety survey aimed at identifying hazard and mishap potential, adequacy of training, proficiency, standardization, effectiveness of quality control, adequacy of resources, and physiological and psychological safety aspects (United States Coast Guard, 2021). Cooley (2019) researched the relationship between the USCG annual safety survey and the number of aviation hazards reported and concluded that no correlations exist. Though his research was not designed to provide much explicit insight into the evaluation of USCG safety culture itself as evidenced by these surveys, he provided a detailed discussion of the importance of safety culture, how it is applied within the USCG, the relationship between safety culture and hazard reporting, and how the safety survey if designed and administered effectively can be used to contribute to a proactive safety culture. He surmised that inadequacies in the safety survey, as well as weaknesses within the USCG hazard reporting process, were among the primary factors contributing to this lack of correlation. Unpublished internal USCG data suggests that aviation safety culture is favorable. However, it is hypothesized, through subject matter expertise and literature review of comparable organizations, that despite a strong safety culture, underreporting of safety events is endemic with the USCG and warrants further analysis. This research aims to focus on understanding and improving the weaknesses within the USCG safety reporting, as perceived by those who participate (or elect not to) in the process.

USCG Safety Reporting Process

Mishap event and hazard reporting policy and guidance for all USCG aviation operations is detailed in the Safety and Environmental Health Manual, COMDTINST M5100.47D. A Coast Guard aviation mishap is defined as “any unplanned, unexpected or unintentional event that causes injury, occupational illness, death, material loss or damage” (United States Coast Guard, 2021, p. 3.6). Aviation mishap categories range in severity from A to D, depending on the cost of property damage or the extent of injury to personnel, as shown in Table 1. This taxonomy is consistent and nearly identical to the DoD military aviation branches, with one notable exception. These organizations set a lower limit on the Class D mishaps of $20,000, and do not include hazards, errors, or near misses in this category or even within this framework at all. For the DoD aviation branches — similar to the process employed by commercial air transport organizations — these lower-level safety event reports are bolstered in their simplicity by allowing operators a more direct, less rigorous path to communicating their mistakes or concerns to safety professionals and into a database for expert analysis. Conversely, the process for reporting and recording these lower severity (in terms of outcome) events in the USCG generally follows the same structure as the Class A-D mishaps (albeit with descending levels of organization action and oversight depending on the mishap Class.) For example, a mechanical and benign $49,000 propeller-induced failure will be reported and recorded the same way a USCG pilot might report a go-around after realizing the landing gear had not been lowered prior to an attempted landing. That, of course, assumes the pilot is willing to face the scrutiny, embarrassment, and additional time burden of reporting the mistake that could otherwise go unnoticed.

Table 1

USCG Mishap Reporting Categories

Mishap Class	Total Property Damage	Fatality/Injury
A	Damage to Coast Guard or non-Coast Guard property is $2,000,000 or greater.	An injury or occupational illness results in a fatality or permanent total disability.
B	Damage, to Coast Guard or non-Coast Guard property of $500,000 or greater, but less than $2,000,000.	Any injury or occupational illness that results in permanent partial disability.
C	Damage, to Coast Guard or non-Coast Guard property, is $50,000 or greater but less than $500,000.	An injury or occupational illness that results in one or more days away from work beyond the day or shift in which the mishap occurs.
D	Any damage to aviation property of less than $50,000. *Other reportable events described in Paragraph B.2 of COMDTINST M5100.47C	Any injury or occupational illness that requires treatment by a medical professional but does not result in any days away from work, or transfer to a different job, beyond the day or shift in which the mishap occurs.

The “other reportable events” that shall be reported as a Class D mishap include:

1. Aeromedical events

2. Precautionary landings

3. Power loss

4. Propeller, rotor, or engine wash

5. Weather-related mishaps

6. Jettison

7. Hoist shear

8. Equipment drops

9. Helicopter in-flight refueling emergency breakaway

10. Things falling off aircraft

11. Midair or near midair collisions

Additionally, the policy describes “high potential (HIPO)” events that can serve as a modifier added to a mishap class (United States Coast Guard, 2021). These events carry greater weight and reporting requirements, when labeled as such, in recognition that either sheer luck, quick action, or circumstance prevented the outcome from being catastrophic. This policy leaves significant discretion to the aircrew and unit Flight Safety Officer (FSO) in determining whether an event should be labeled HIPO.

Any occurrence that triggers a compulsory report as described above, is typically initiated either by the associated aircrew directly reporting the event to the Flight Safety Officer (FSO), or the FSO organically discovering the event through reviewing flight records. Either way, the FSO is the gatekeeper who has the access and responsibility of entering the event details into the USCG aviation mishap database. Though the final report will have personally identifiable information removed, the pilot wishing to submit the report generally has no means of remaining anonymous to the FSO.

USCG policy explains the importance of anonymous hazard reporting, and this method does exist at USCG air stations, typically via pen and paper entries into lockboxes accessed only by the FSO. This can be a great method for identifying and addressing local hazards or problems, however it is not particularly compatible with entry into the mishap database, and can often be misused as a complaint box for dissatisfied or distressed personnel.

Hazard Reporting Limitations

As Cooley (2019) points out in his research, there presently is no systematic distinction between a hazard report, such as an event with no quantifiable or compulsory adverse outcome, and a below $50,000 damage mishap report. As previously pointed out, this lack of distinction first presents a challenging barrier to reducing the simplicity of reporting and tracking the data. Second, as Cooley (2019) suggests, it makes it difficult if not impossible to assess the voluntary reporting habits of USCG personnel. Assessing the quantity of near miss reporting rates cannot exclude the obviously apparent material damage events. There is no clear, succinct ability to parse out the important, voluntary contributions of lessons learned, hazards observed, and disasters averted that contained no mandatory reportable outcome. The survey instrument designed for this research aims to better quantify the behavior and attitudes towards submitting these voluntary no-outcome events amongst USCG aviators. Gilbey, Tani, and Tsui reported from their extensive research of safety under-reporting that "bad outcomes were judged as more likely to be reported than identical acts with innocuous outcomes" (Gilbey et al., 2015, p. 141). The current USCG hazard reporting process does not support enough differentiation to assess reporting rates of the events with innocuous outcomes, despite their established value to the organization's safety performance.

Problem Statement

Despite the best efforts of organizations to establish an effective safety culture, innate human, social, and organizational factors pose barriers to the willingness of individuals to contribute to the essential hazard, near-miss, or other safety event narratives vital to data analysis and proactive safety. Within USCG aviation in particular, there is a noteworthy aforementioned dependence on the data derived from safety reporting, as well as particular policy and program design limitations that may be exacerbating the natural barriers to safety reporting. In order to establish and maintain a proactive safety culture, the barriers that exist to inhibit the generation, submission, and utilization of these safety reports must be better understood and addressed. As discussed above, the USCG safety reporting process is primarily a compulsory process, and predominantly oriented towards reporting events in which a tangible, undesirable outcome occurs. USCG safety managers possess an extensive database of mishaps involving damaged aircraft components and aborted missions that can be mined for trends and safety insights. There is a significant void, however, when it comes to reports of innocuous procedural errors, operational judgment errors, crew resource management (CRM) breakdowns, checklist deviations, policy and airspace violations, and other human errors that typically go unreported when not associated with tangible outcomes. Explicit hazard reporting does exist, but it is not entered into a database similar to the way that mandatory reportable mishaps are, and thus no framework exists for analysts to mine these reports for latent hazard trends.

The USCG favors decentralized execution, giving unit Commanding Officers and individual aircrews significant onsite responsibility, discretion, and authority. This offers great efficiencies and reduced bureaucracy in comparison to many similarly sized organizations. This ideology can also include the perception that hazards viewed as minor in nature should be addressed locally. Unfortunately, the localized fix and forget mentality generally results in an absence of data for cumulative analysis, an essential component of Safety Management Systems (SMS). Without useful data, there is a corresponding inability (or at least, reduced ability) to illuminate, identify, and address underlying safety issues.

In addition to these identified shortcomings of the reporting and hazard tracking framework, there may exist significant systemic, human-oriented social and cultural barriers that potentially inhibit the quantity and quantity of hazard and safety event reports within USCG aviation. For example, a pilot wishing to self-report an undesirable mistake, perceivably indicative of his or her own aptitude and skill as an aviator, must directly (without anonymity) report the event to the unit Flight Safety Officer (FSO). USCG FSOs and senior leaders go through a thorough screening, selection, and training process to comply with the tenets of safety culture. As fallible and social creatures, however, they are still prone to certain challenges of human nature that oppose the concept of just culture. Though policy and training demand that the results of a human error reported to them be used strictly for the purpose of safety and prevention of future mishaps (free of retribution), many factors convolute this process. The small social size, competitive and evaluative nature of USCG aviation, and the dual role of many FSOs as flight examiners and personnel supervisors, all contribute to creating an environment that the best policy and training struggle to overcome in maintaining a favorable reporting culture.

Lastly, the safety reporting process requires some level of individual commitment to initiate and complete, particularly in the absence of major external attention given to an occurrence. If an individual does not feel that the event was significant enough to spend their time and energy to report, the information will of course never be recorded. Similarly, if the reporting processes is perceived as inconvenient, misunderstood, or ineffective at actually improving safety, operators will likely not pursue the additional effort to submit a report. These factors have been observed as limitations to participation in safety reporting in research of similar organizations, including other aviation entities and the medical industry (Gilbey et al., 2015). Further research is necessary to specifically assess how these barriers are experienced and perceived amongst USCG aviators, given the design and process of reporting laid out thus far.

Purpose of the Study

This study aims to understand the barriers present throughout safety reporting systems, with a particular focus on how these barriers exist and manifest themselves within USCG aviation. Though the USCG already conducts an annual aviation safety survey to broadly assess culture and trends, Cooley (2019) detailed some of the limitations of this tool in truly assessing the state of USCG safety reporting. This study will more specifically and directly survey USCG aviators to determine their behaviors and attitudes towards safety event reporting. Numerous similar studies have been conducted in recent years to identify and understand safety reporting barriers within and amongst high-consequence industries, particularly within the medical field (Vrbnjak et al., 2016; Hewitt & Chreim, 2015) and in various subsets of the global aviation network (Whittemore, 2019; Darveau & Hannon, 2017; Gilbey et al., 2015; Adjekum et al., 2015). This study will build upon existing research of this topic by expanding the size and diversity of the sample of individuals within safety conscious organizations. Furthermore, the research intends to discover which barriers are most prevalent influences in whether or not a USCG aviator participates in reporting, and will identify what correlations exist between reporting barriers and certain demographics and subsets of USCG aviators. Finally, from this research, this study will offer recommendations for measures to overcome these barriers.

Literature Review

Existing research of barriers to safety reporting in high-consequence industries consists of both quantitative surveys to assess underreporting statistics, as well as qualitative studies derived from interviews. The prevailing factors resulting from these studies can be broadly categorized into shortcomings in participants' confidence with their organization's just culture, and insufficient tools and training to support the organization's reporting culture.

Darveau & Hannon (2017) conducted an extensive literature review and analysis of the barriers and facilitators to voluntary reporting systems. In this research, they point out the nuanced but very important distinctions between mandatory and voluntary reporting systems. Similar to the process of mandatory reporting described in this chapter, as prescribed by the USCG Safety and Environmental Health Manual (2021), there are numerous specific federal (NTSB) and international (ICAO) mandatory reporting requirements for certain accidents or incidents. Conversely, there are no specific regulatory requirements for defining reportable hazards or near miss events. These near miss events contain valuable insights into system weaknesses and latent hazards, however, are the most difficult to capture and analyze due to the voluntary nature of reporting systems to identify them. As Reason (1990) points out, these near misses contain both active and latent errors. The adverse consequences of latent errors "may lie dormant within the system for a long time, only becoming evident when they combine with other factors to breach the system's defenses" (Reason, 1990, p. 173). Darvuae and Hannon (2017) in describing the genesis and nature of the voluntary reporting systems (VRS) designed to illuminate these latent errors, suggest that the process is a joint venture amongst multiple stake holders (employer, regulatory body, employees). For this reason, numerous opportunities for barriers to participation may exist at multiple levels. From their literature review, Darvuae and Hannon (2017) identify and explain the following potential barriers:

(1) "Blindness" to human error and the impact of local perspective.

(2) Organizational commitment to safety culture.

(3) User trust in VRSs and in management.

(4) VRS training techniques.

(5) Personnel changes that influence voluntary reporting.

(6) VRS policy and procedure definition.

(7) Voluntary error reports and interviews.

(8) Analysis of error reports and development of corrective actions

These identified barriers share many commonalities with research and theories of safety reporting barriers found elsewhere. Taxonomies used to categorize VRS reporting barriers in other published research were often found to be more condense and concise, while still including the ideas and broader themes from this list of eight. For example, the primary sources used to develop the methodologies for this research have narrowed the barriers from this list to approximately four or five constructs. The smaller number of constructs reduces the granularity and specificity, but allows for a more practical assessment of individuals in an organization through a quantitative survey.

Vrbnjak et. al (2016) conducted a similar systemic literature review of barriers to participation in reporting medication error and near misses amongst nurses. Their search process produced over 3,000 sources of literature studying the issue, which they methodically reduced to 38 for their qualitative synthesis (Vrbnjak et al., 2016, para. 3.1). From these 38 sources, they were able to develop two major themes underlying all reporting barriers: organizational, and personal/professional barriers. Within these main themes, six secondary level themes were observed, including: (organizational) culture, reporting system, management behavior; and (personal/professional) fear, accountability, and characteristics of nurses (Vrbnjak et al., 2016, para. 3.4). The researchers suggest that management behavior is perhaps one of the most important barriers that influence nurses' reporting. Repeating ideas also emerge here in alignment with other literature: individuals do not perceive the events with low or no outcomes as significant enough to warrant a report; they perceive their role as practitioners (or operators, from an aviation standpoint) and not as contributors to systemic safety processes; they have significant fear of retribution, whether from a legal standpoint, employment standpoint, or even from the perspective of personal pride and social status; there is no clear definition or understanding of what events should be reported as near misses (Vrbnjak et al., 2016). Perhaps most interesting and paradoxical, was a conclusion that increased training and education was necessary to overcome many of the barriers, yet there was found to be a correlation between more experienced and educated nurses and a propensity to underreport errors and near misses. These experienced nurses were more confident and autonomous, and thus more likely to reformulate or reclassify their errors and deem them not significant enough to justify a report (Vrbnjak et al., 2016, para. 4).

One specific study of underreporting in the medical industry, conducted by Hewitt & Chreim (2015) focused on the propensity of individuals to just fix the hazards or errors themselves, with the perspective that taking the time to submit a report of the event was not warranted. This research, instead of meta-analysis or quantitative surveys, relied on a qualitative approach employing in-depth interviews with 40 healthcare practitioners spanning the range of medical positions. The general conclusions of this study revealed that employees did not see the value of reporting and the effort that it required, in comparison to simply fixing it themselves. Healthcare professionals studied generally did not prioritize reporting an event if the problem was able to be fixed (Hewitt & Chreim, 2015). This is akin to the previously used example of a pilot forgetting to lower the landing gear until receiving an alert on short final; as long as they successfully completed a go-around and did not actually touchdown with the landing gear retracted, they may not be apt to report (nor is there any explicit requirement) the occurrence.

Undoubtedly, the barriers interact with each other to develop a cumulative effect. However, some research focuses specifically on individual barriers to understand them better and develop remedies. Wiele (2016) focused on the impact of inconvenient or inefficient reporting tools or interfaces. A mixed-method approach in this research identified minor interface inconvenience issues in the hospital reporting system (such as hard to read menus and other usability concerns) as having a significant impact on underreporting. Interestingly, the sample studied for this research indicated that the safety culture within the organization was favorable, and not a particularly noteworthy barrier to reporting. Nonetheless, concerns about safety report punitive use, lack of feedback from reports, and the time-burden of submitting a report were all observed to be factors contributing to underreporting amongst the research participants (Wiele, 2016). This illustrates the idea that different organizations may have varying levels of prevalence amongst the various identified barrier constructs, and that underreporting may exist from multiple underlying causes.

Dillman et al., (2007), conducted a survey of safety reporting attitudes and behaviors amongst collegiate aviation students at Purdue University and Southern Illinois University Carbondale, and observed consistently similar outcomes. Particularly interesting was the influence of the level safety knowledge of the individuals, and the level of convenience in accessing the reporting system. Of the 157 respondents, 33 percent answered that they had underreported a safety occurrence, 18 percent answered that they reported safety events they experienced, and 55 percent who answered that they had never experienced a safety event worth reporting (there is overlap amongst the first two groups who either reported or underreported, depending on their behavior across multiple occurrences, which is why the total exceeds 100 percent) (Dillman et al., 2007). Considering the experience levels of the individuals and the inherent hazardous / error-prone nature of flight training, it is unlikely that such a large percentage never experienced a safety event, thus suggesting that lack of education or knowledge contributed to individuals possibly answering this question erroneously. Furthermore, amongst the qualitative responses of those who chose to underreport, there is a clear trend of individuals not reporting because they either forgot, it was inconvenient, or not an immediate priority for them. Other recurring themes of underreporting were present amongst the respondents, however this study suggests the importance of lack of knowledge, and again inconvenience, as critical barriers to reporting worthy of further research.

McMurtrie & Molesworth (2018), in their study of reporting behaviors and trust in just culture amongst Australian commercial aviation pilots, conclude that fear of reprisal is the biggest factor contributing to under and non-reporting of safety events. The researchers discuss the ICAO (International Civil Aviation Organization) safety management policies that explicitly detail the importance of safety-related information reporting and the non-punitive nature of voluntary safety reports, and compare it to the threats of both legal prosecutors and organization management attempting to use safety information in a punitive or reprisal based nature. Their methodology consisted of a survey of Australian aviators to explore their attitudes and behaviors towards safety event reporting with a sample of 270 commercial pilots across a wide range aircraft type. Over half of the participants (54%) stated that they had either partially reported, or not reported safety information using their organization's voluntary reporting system, owing to fear of reprisal from their employer, independent of whether or not they were confident in their organizations just culture (McMurtrie & Molesworth, 2018). This presents an interesting paradigm related for the research question described in this paper: despite the best attempts at creating policy to create a just culture, certain innate trust related barriers evidently still inhibit safety event reporting.

McMurtrie & Molesworth (2018) concluded that no statistically significant differences were observed between pilot license types or ranks. They point out the somewhat narrow scope, sample size (270 surveys received of 6,700 pilots in the population) and biases that may have existed to skew their results, and suggest further research to expand the size and demographics across other aviation industries and locations. Particularly, they suggest further research into studying why pilots do, in fact, submit reports, so that organizations can focus efforts on what does work, not just fighting what doesn't.

Whittemore (2019) conducted research into the influence of certain safety reporting barriers amongst USAF pilots. The methodology and issues specific to the military aviation community addressed in Whittemore's dissertation are very similar and influential in the methods and analysis conducted in this research of USCG safety reporting. The survey instrument Whittemore (2019) used was a modification of an ASAP (aviation safety action program) questionnaire created and tested for validity and reliability by Steckel (2014). Steckel's survey was specifically designed to quantify the influence of pre-identified (through literature review and subject matter expertise) factors influencing participation in ASAP reporting amongst commercial aviators. The five constructs developed in Steckel's survey consisted of: perception of ease of use, perception of value, perception of program trust, perception of risk, and perception of management trust (Steckel, 2014). Whittemore (2019) modified Steckel's survey to use terminology and jargon more appropriate to USAF pilots, and also adjusted the reporting barrier constructs based on his literature review and subject matter expertise. Whittemore designed the survey to analyze the following four factors: repercussion, inconvenience, significance of event, and program value. Whittemore (2019) concluded that the most dominant factors inhibiting the use of ASAP within the USAF were significance of event and program value. Whittemore (2019) determined that even though fear of retribution and a lack of trust of upper management existed among operators, they still tended to report events they perceived to be significant despite these barriers. The research concluded that, though just culture is important in facilitating the use of ASAP in gathering voluntary reports, the overarching barrier is more associated with the concepts of reporting and learning culture. This is indicated by the results showing that an individuals underreported events they deemed insignificant or unlikely to be used in a productive manner by USAF safety professionals. Whittemore (2019) did not conduct any extensive analysis into response outcomes as a function of various demographics or sub-categories amongst those surveyed, which could have been useful in developing recommendations for USAF safety practitioners.

These studies signify the range of challenging negative influences on safety event reporting and how they vary in significance depending on cultures and organizational factors. The studies all have suggested the need for further research into this topic to expand the sample size of operators surveyed to better understand the barriers, their causes, and potential remedies.

Research Question

Given the broad purpose of this research, and following from the existing literature, several specific research questions were developed. The four barriers to USCG safety reporting selected for further quantitative analysis, as developed from the literature review and subject matter expertise on behalf of the researcher and advisors, include: *insufficient knowledge* (of the safety reporting program), *perceived inconvenience* (of the safety reporting process), *fear of* *retribution, and perceived lack of value* (of the safety reporting program in actually improving safety). These constructs form the framework from which the following research questions will be addressed:

Q1: Have sampled USCG aviators abstained from reporting a safety event that was either compulsory, or that could have contributed to improving aviation safety within the organization? Are there any differences between various collected demographics and reporting behaviors?

Q2: Which factor(s), of the four constructs developed, present the greatest barrier or influence in a pilot's propensity to report a safety event? Are there any differences amongst various collected demographics and their attitudes towards these barriers?

Q3: Does a USCG pilot's total flight time predict their overall attitude towards barriers to reporting?

Q4: How do survey respondents feel about incorporating a mandatory safety event form after each flight, to include reporting "No Event" if none occurred? Do the attitudes towards such a program differ significantly between the ranks of pilots?

Chapter II: Methodology

With the purpose of the study to understand safety reporting behaviors and attitudes amongst USCG aviators, it was necessary to distribute a survey designed to address the research questions to the population of USCG pilots. The survey design originated from similar research conducted by Steckel (2014) and Whittemore (2019) but went through several modifications and iterations after pilot testing and review from subject matter experts. Furthermore, the survey was adapted to specifically address the research questions. The development process of the data collection tool is described here.

Institutional Review Board

The research topic was developed through communication and coordination with the USCG Office of Safety and Environmental Health (CG-113) periodically between October 2020 and November 2021. The Institutional Review Board of the University of North Dakota approved the study in December 2021, and the USCG Institutional Review Board approved the study in January 2022. Additionally, a Department of Homeland Security (DHS) Privacy Threshold Analysis was required, with approval granted in January 2022. Participants were informed of the nature and purpose of the study and each individual verified their consent prior to commencing the survey. No personally identifiable information was collected or used as part of the survey, thereby keeping the identities of the participants anonymous. Survey responses were not examined on an individual level except to review quantitative response statistics for those individuals that offered relevant qualitative feedback. Otherwise, the survey responses were only viewed from an aggregate statistical perspective.

Population

The population for this study consisted of active-duty pilots currently serving in the USCG. Theoretically, the population could have also encompassed all USCG aviators, including enlisted crew members. However, to narrow the scope of the research and to minimize the burden on the USCG aviation workforce, enlisted aircrew members were not included in the survey distribution and further analysis. Typically, it is the pilots (officers) who conduct the process of formally submitting a safety report. Enlisted aircrew members are vital in all elements of aviation safety and are capable of and encouraged to submit a safety report. However, organizational norms suggest that the process of reporting a shared flight safety event typically resides with the pilots. The population size consists of 1,200 pilots. The results, of course, are only inclusive and representative of this specific population. However, it can be inferred that the behaviors, attitudes, and responses towards safety reporting barriers closely represent those of the broader participating members of the organization. Similarly, the identified themes appear to have some level of consistency across various aviation, healthcare, and other high-reliability organizations.

Sample

Convenience sampling was used to gather participants in this research. Survey distribution was facilitated through the USCG flight safety officer (FSO) network. These representatives were requested to by the researcher to distribute the survey link via email to all pilots assigned to their unit. It is unknown precisely how many of the surveys were actually forwarded by the unit FSOs, but it can be assumed that not all 1,200 members of the total pilot population was provided access to the survey.

Participation in the survey was completely voluntary, and respondents were informed that their participation would have no personal benefit other than the potential to improve future policy and design of the USCG safety reporting system.

Demographics including gender, military rank, experience as a Flight Safety Officer (FSO), background of having received formal safety training or not, aircraft type (reduced in the table below to fixed-wing and rotary-wing), instructor pilot experience, and current pilot designation, were collected. Military rank was also recoded into a new variable to represent the demographic as either a junior officer (O1-O3) or a senior officer (O4-O6). This enabled another avenue to assess if any differences occurred broadly between junior and senior ranking officers. Similarly, the seven aircraft type options (C-130H, C-130J, C27, C37, C-144; H65, H60) were reduced to either fixed-wing or rotary-wing operators. The limited number of data points of individual ranks (O2 and O6) and of specific aircraft type (C-27, C37) constrained available analysis tools designed to compare results across each of the ranks or aircraft types. The decision to consolidate these variables enabled better broad comparison while sacrificing a specific assessment of some of the individual subgroups. Distributions across these demographics of the sample is shown in Table 2 below.

Table 2

Frequency Table of Participant's Demographics

Demographic	N	%
Male	122	83
Female	25	17
O2	4	3
O3	68	47
O4	50	35
O5	21	14
O6	2	1
Junior Officer	72	50
Senior Officer	73	50
FSO	56	38
Non-FSO	91	62
Formal Safety Training	98	67
No Safety Training	49	33
Fixed-Wing Operator	43	30
Rotary-Wing Operator	103	70
Instructor Pilot	95	64
Non-Instructor Pilot	53	36
Aircraft Commander	115	78
First Pilot / Copilot	33	22

Note. Frequencies of Valid Gender, Rank, FSO (Flight Safety Officer) Experience, Formal Safety Training Experience, Airframe Type, Instructor Pilot Experience, and Current Designation

Instrument and Data Collection

As previously described, the annual USCG Aviation Safety Survey addresses a multitude of important cultural and organizational safety constructs. The survey instrument for this research was specifically designed to assess the reporting culture construct and expand the understanding of potential barriers to pilot's contribution to the safety process. The existing

USCG safety survey briefly asks whether individuals feel motivated to report, are familiar with the reporting process, and whether they abstain from reporting out of fear. This survey instrument vastly expands with narrower yet more thorough questioning about the previously described potential barriers.

The questionnaire, found in Appendix A, primarily consisted of Likert scale (1-5) questions to address the four reporting barrier constructs, the respondent's likelihood to report low-outcome events, and several yes or no questions about their past reporting behavior. The survey also provided participants with the opportunity to share additional comments about their perception of the safety reporting system through a qualitative collection section.

Survey Development

The initial questionnaire was designed to utilize the established reliability and validity provided by Whittemore's (2019) adaptations to Steckel's (2014) survey of attitudes towards Aviation Safety Action Program (ASAP). However, it became clear that modifications were needed for several reasons. First and foremost, the jargon and unique process differences between commercial aviation, the USAF, and the USCG reporting processes required the rewording of certain questions. Additionally, analysis of the results from these surveys indicated that certain questions did not load well on exploratory factor analysis (EFA) models and did not contribute to the constructs as measured by Cronbach's alpha. Next, the knowledge barrier was not explicitly examined by either of these researchers. Finally, to improve the applicability to the USCG population and to bolster reliability and validity as judged from pre-testing the survey, numerous other modifications were made to these existing surveys.

Pilot Survey

In August 2021, a pilot survey was conducted at a single air station in which 110 aviators were provided the opportunity to participate, generating 39 usable responses. The particular unit that was selected did not produce a sufficient sample size or enough homogeneity of variance to generate any significant results on its own, however the research did help inform improvements to the survey questionnaire. While still addressing the same reporting barrier constructs, the final survey was redesigned for the full study to improve reliability and construct validity, while also making the questions more concise and clear for the respondents.

Final Survey Instrument

In order to develop the most accurate and useful survey, several steps were performed prior to final distribution. First, face validity assessment was performed by numerous USCG safety professionals, academic advisors, as well as lay person test subjects. Face validity is a subjective way of verifying that the survey is actually measuring what is intended (Nevo, 1985). Having observed test subjects completing the survey, receiving positive feedback, and editing certain questions for consistency and clarity, the final survey was then submitted for UND and USCG IRB, and DHS Privacy Analysis. After these approvals were received, the survey was distributed on February 11, 2022. The question sequence was randomized by Qualtrics, so that respondents were not answering all questions for each construct sequentially and thus gaming the survey or speculating to achieve a desired outcome. The use of reverse-coded questions also helped ensure that participant responses were earnest. The survey period remained open for two and a half weeks, with the final responses received on March 2, 2022. The final survey, as administered, can be found in Appendix A.

162 total responses were received, however incomplete submissions necessitated that 11 were removed, bringing the final sample size to 151 responses. No “straight-lining” (short duration, low-variance) responses were observed, suggesting that the remaining 151 responses consisted of genuine participation. Mean response time was approximately 13 minutes, however the median and mode suggested approximately 7 minutes for respondents to complete the survey through Qualtrics.

Once incomplete responses were removed, reverse coded questions were transformed to ensure consistent measure of the constructs.

Reliability

Each of the questions designed to assess the four constructs (barriers to reporting) and the participant’s propensity to report events were analyzed for inter-construct reliability by examining Chronbach’s alpha scores.

Knowledge (K): Six questions (K1, K3, K4, K5, K6, K7N) in this construct produced an $\alpha = .86$. Question K2 was removed as part of the EFA, shown next. This removal had minimal impact on the Chronbach’s alpha value.

Inconvenience (C): Six questions (C1, C2, C3, C4, C5, C6N) in this construct produced an $\alpha = .83$. These questions had been significantly modified from the pilot study due to low reliability; none had to be removed in this final version.

Fear of Retribution (R): Five questions (R1N, R2, R3, R4N, R5N) in this construct produced an $\alpha = .92$. No questions were removed from this construct.

Lack of Program Value (V): Five questions (V2, V3, V4, V6N) in this construct produced an $\alpha = .80$. Questions V1 and V5 were removed to improve the reliability, and as part of the EFA.

Participants Likelihood of Reporting (L): Six questions (L1N, L2N, L3, L4N, L5N, L6N) in this construct produced an $\alpha = .83$. No questions were removed from this construct.

Factor Analysis

An exploratory factor analysis (EFA) using principal axis factoring with Oblimin rotation was conducted to identify if the survey questions loaded appropriately onto the designed constructs. Three questions (K2, V1, and V5) did not load accurately onto existing constructs during the preliminary evaluation. Further review indicated a high potential for these specific questions to offer enough ambiguity that respondents might not answer them consistently with their attitude towards the constructs being measured. The initial analysis produced six factors, however only question K5 loaded on the sixth factor. SPSS was then manually limited to identify only five factors, which produced the resultant EFA shown below in Table 3.

Table 3

Barriers to Safety Reporting and Participant Likelihood of Reporting Factor Analysis

Question	Knowledge	Inconvenience	Retribution	Program Value	Likelihood
K1	.63				
K3	.73				
K4	.78				
K5	.58				
K6	.72				
K7N	.50				
C1		.76			
C2		.78			
C3		.40			
C4		.41			
C5		.64			
C6N		.67			
R1N			.79		
R2			.74		
R3			.77		
R4N			.82		
R5N			.73		
V2				.73	
V3				.49	
V4				.52	
V6N				.40	
L1N					.74
L2N					.72
L3					.57
L4N					.64
L5N					.55
L6N					.60

Note. Final EFA after K2, V1, V5 questions removed. See Appendix A for actual questions.

Having verified that the questions were valid and reliable in assessing the respondents' attitudes towards the individual constructs, new average variables were created for: (1) each of the constructs and (2) a participant's overall safety reporting attitude, using an average from their responses to all of the included 21 questions (the likelihood of reporting (L) construct was not included in this new variable). These new resultant averages are provided and assessed in the results section below.

Chapter III: Results

In addition to the 21 questions used to determine average attitudes towards the four primary barriers to safety reporting, and the six questions to determine an individual's likelihood of reporting a safety occurrence regardless of outcome severity, several additional questions were asked to more broadly understand the situation. These questions were used to study the relationships between the attitudes towards reporting, and the individual's actual reporting behavior. However, the additional questions also provided inherent independent value in assessing the broad objectives of this research.

Research Question #1: Have sampled USCG aviators abstained from reporting a safety event that was either compulsory, or that could have contributed to improving aviation safety within the organization? Are there any differences between various collected demographics and reporting behaviors?

Three questions were asked specifically to assess past reporting behaviors of the respondents, shown here in Table 4.

Table 4

USCG Aviator Past Reporting Behaviors

Question	Responses	Percent
1) Have you ever formally reported a safety event?		
Yes	129	85
No	22	15
2) Have you ever reported a safety event that had no tangible negative outcome (i.e. no components damaged, injury, mission abort, etc.)?		
Yes	116	77
No	35	23
3) Have you ever intentionally underreported a safety event (withheld certain details, or did not report at all)?		
Yes	31	21
No	120	79

The first two questions descriptively show that the overwhelming majority (85%) of respondents have participated in the USCG aviation safety reporting process at some point in their career. The percentage (77%) goes down for those who have reported events without a tangible outcome. The implications of the differing percentages between these two questions will be discussed further in the next chapter. Broadly though, these descriptive results provide a direct answer to the question, as well as establishing some credibility that the respondents are indeed engaged with the reporting process and their experience with the various barriers and questions asked in the survey are valid and worthy of consideration.

Finally, the third behavior question aims to explicitly answer the first question of this research. 21% of respondents indicated that they have knowingly and intentionally either underreported or abstained from reporting a safety event, presumably attributable to one or a combination of the barriers to reporting described and studied thus far. To determine if any specific demographic (of those collected) indicated a certain tendency to be among the underreporting group, several two-way chi-square analyses were performed. The results of these tests indicated that the proportion of fixed-wing (34%) operator respondents who answered that they had underreported was significantly greater than rotary-wing (15%) operators, $\chi^2(2, N = 146) = 7.67$, $p = .006$. Additionally, amongst aviators who have served as a unit Flight Safety Officer (FSO), a significant proportion of underreporting (32%) versus those not trained as FSOs (14%) was observed $\chi^2(2, N = 146) = 6.64$, $p = .010$. Comparison of all other available demographics (gender, aircraft type, safety training background, and rank) did not reveal any statistical differences in the proportions of groups that had underreported.

Research Question #2: Which factor(s), of the four constructs developed, present the greatest barrier or influence in a pilot's propensity to report a safety event? Are there any differences amongst various collected demographics and their attitudes towards these barriers?

To answer this question, average scores were produced to capture the questions from each construct, which are presented in Table 5 to analyze normality and a descriptive display of how the factors emerged in prominence.

Table 5

Variable Summary Table

Reporting Barrer Construct	N	Mean	SD	Minimum	Maximum	Skewness	Kurtosis
(K)	151	4.02	.84	1.17	5	-.97	.51
(C)	151	3.78	.78	1.17	5	-.54	.27
(R)	151	3.96	1.02	1	5	-.96	.06
(V)	151	3.75	.82	1.0	5	-.54	.28
(T)	151	3.89	.65	1.81	4.95	-.58	.06
(L)	151	3.61	.84	1.17	5	.44	.-.13

Note. L – Likelihood of Reporting, and T- Total Average Reporting Culture Attitude of 4 Constructs are included here, though not considered among the 4 primary constructs being compared.

Respondents' average scores were highest for the knowledge (K) questions, and the fear of retribution (R) questions, and lowest for the inconvenience (C) and perception of program value (V) questions. The way the questions were worded and organized, a higher average indicated they were satisfied with that element of reporting culture. For example, a high average (K) knowledge score indicates the respondent was confident in their level of knowledge and training of the how, when, why, etc. of safety reporting; thus it could be considered to be a minimal barrier to their contribution in reporting. Similarly, if a respondent's average score was low, it indicated that they were not satisfied with that element, suggesting that it may be a reporting barrier for them. A low average inconvenience (C) score, for example, indicated that the process was not convenient for them and that it may be a barrier to their participation in the safety reporting process. For the sake of clarity, it should be noted that i*nconvenience* is the barrier being assessed, but the construct was labeled (C) to assess the actual convenience of reporting. Hence, a higher score represented a convenient process, and vice versa.

To further understand how a respondent's attitude or perception of a reporting barrier construct may influence their propensity to report an event, their average scores for each construct was compared to their average scores for the questions regarding their likelihood of reporting safety events (as assessed by their likelihood of reporting a safety event, regardless of the outcome or external visibility). The correlation between the barriers and the likelihood of reporting is shown below in Table 6.

Table 6

Correlations Among Reporting Barrier Construct and Respondent's Likelihood of Reporting

	K	C	R	V
Likelihood of Reporting	.34*	.35*	.47*	.51*

Note. *Correlation is significant at the .01 level.

All four factors are positively and significantly correlated with average respondent's likelihood of reporting. Perceived lack of program value (V) had the highest correlation, suggesting that individuals who felt most favorably towards the value of the safety reporting program, were also those most likely to report an even regardless of the outcome or external visibility. Stated inversely, if an individual did not feel there was value in the process of submitting a safety report, the likelihood that they would report minor events went down. The other three factors (K, C, R) had a lesser influence or relationship on an individual's likelihood of reporting.

To study the first part of this research question (which barrier has the greatest impact on a pilot's propensity to report – or underreport, in this case) from one other angle, a comparison of average attitudes towards the reporting barriers and an individual's past underreporting behavior was designed. Table 7 shows the average response values of each reporting barrier construct amongst respondents that answered yes to having underreported a safety event in the past. Additionally, the table displays the t-test value and significance of the average response in comparison to the demographic that did not answer yes to having ever underreported in the past.

Table 7

t-test Results Comparing Reporting Barrier Attitudes of 31 Respondents Who Have Underreported a Safety Occurrence

	M	SD	*t*-test
K	4.2	.65	1.1
C	3.5	.91	-1.6
R	3.7	1.1	-1.6
V	3.3	.87	-3.6*
T	3.7	.56	-1.5
L	3.1	.79	-3.8*

Note. *Correlation is significant at the .01 level.

It is important to note that the average response to each reporting barrier construct was lower amongst those who underreported than those who did not, except for the knowledge (K) construct. What stands out more importantly, however, is the recurrence of (V) perceived lack of program value, as having the largest and most significant difference in average mean response between those who had and had not underreported amongst all of the four constructs.

Having assessed the first part of the question from three angles, the second part of the question required a comparison of demographics.

Several one-way ANOVA tests were performed to determine if there were any significant differences in attitudes between various ranks, aircraft types, and chosen/intended career path.

No significant differences between the total averages of the studied reporting barrier constructs (T), or the likelihood of reporting (L) measure were observed across these multi-option categorical groups. Additionally, comparison of means across other demographic categories showed no significant differences across the Inconvenience (C) factor, the Program Value (V) factor, or the Likelihood of Reporting (L) construct.

However, independent samples *t*-tests showed several significant differences between some demographic groupings and their attitudes towards the knowledge (K), fear of retribution (R), and total average reporting culture attitude (T) constructs. The knowledge (K) of the reporting system was much less of a factor for individuals who had received formal training at some point in their career (M = 4.2, SD = .73) over those not having received formal training (M = 3.6, SD = .85), $t(145)$ = 4.2, p = .000. Accordingly, senior officers (O4-O6) (M = 4.2, SD = .70) also reported knowledge (K) as a significantly lesser barrier than junior officers (O1-O3) (M = 3.8, SD = .89), *Welch's F*(2, 145) = 9.9, p <.05. Welch's ANOVA was used to compare the effect of safety training on responses to the Fear of Retribution (R) construct, *Welch's F*(2, 145) = 6.9, p <.05. Safety training corresponded with a favorable mean difference of .5 in reducing the Fear of Retribution (R) barrier in comparison to those with no training. Similarly, individuals with safety training also showed a significantly better overall attitude towards safety reporting (T) (mean difference of .4), *Welch's F*(2, 145) = 6.7, p <.05. Welch's ANOVA was required for these three analyses since Levene's test for homogeneity of variance was significant (p <.05), indicating a violation of the assumption of equal variance required for a *t*-test (Field, 2017).

As in research question 1, some of the most striking differences in attitudes occurred between fixed-wing and rotary-wing operators. Table 8 illustrates the significant differences between these two groups and their attitudes towards various constructs. Levene's test for homogeneity of variance was not significant (*p* >05), indicating that the assumption of equal variance required for a *t*-test was met for each comparison shown below.

Table 8

t-test Results Comparing Reporting Barrier Attitudes of F/W versus R/W Aviators

	Fixed Wing		Rotary Wing		
	Mean	SD	Mean	SD	*t*-test
K	3.9	.93	4.1	.78	-1.4
C	3.6	.82	3.8	.76	-1.6
R	3.8	1.0	4.0	1.0	-1.2
V	3.5	.85	3.8	.80	-2.2*
T	3.7	.64	4.0	.64	-2.0*
L	3.4	.80	3.7	.84	-2.2*

Note. * Indicates significance at $p<.05$. Levene's test was not significant for any comparison, indicating the assumption of homogeneity of variance assumption was met.

Program Value (V), total average reporting culture attitude (T), and likelihood of reporting (L) were all significantly lower for fixed-wing aviators than rotary-wing aviators. Knowledge (K), inconvenience (C), and fear of retribution (R) were also notably lower for fixed-wing aviators, however the t-test did not indicate statistical significance for these differences.

Research Question #3: Does a USCG pilot's total flight time predict their overall attitude towards barriers to reporting?

As a pilot gains experience (as indicated by total flight time) with a safety culture and reporting system, their attitudes towards perceived reporting barriers may change. In order to assess this, a linear regression analysis was performed to determine if flight time could significantly predict total average reporting culture attitude (T), or any of the other measured individual constructs (K, C, R, V, L).

Of the 143 respondents that provided their flight hours, the mean value was 2,369 hours with a minimum value of 320 and a maximum of 6,000 hours. The values were normally distributed, with a skewness of .47 and a kurtosis of -.08.

The results indicate that, from this sample, there is no significant correlation between flight time and the total average reporting culture attitude (T) variables $r(142) = .14$, $p > .05$, and thus a regression model was not developed. Further correlations were conducted between an aviator's flight time and their average responses to each construct (K, C, R, V) similarly indicated low r values at insignificant levels.

Considering that no statistically significant mean differences existed between junior and senior officers and their (T) average score, the lack of correlation between flight time and T is consistent.

Research Question #4: How do survey respondents feel about incorporating a mandatory safety event form after each flight, to include reporting "No Event" if none occurred? Do the attitudes towards such a program differ significantly between the ranks of pilots?

Two separate questions were used in the survey to identify the attitudes of USCG aviators towards a mandatory interface with a safety event reporting tool after each flight. The first question asked about the perceived value of such a process and its potential impact on safety reporting quality and quantity in the USCG, and the second question was designed to assess the perceived level of burden or acceptability of incorporating a new requirement such as this. Table 9 shows the average responses to these Likert (1-5) questions.

Table 9

Mandatory Safety Report Attitudes

Question	N	Mean	SD	Skewness	Kurtosis
I feel that including an electronic safety reporting tool as part of the required post flight process (to include "Nothing to report" when applicable) <u>would help improve the quantity and quality</u> of USCG aviation safety reports.	150	3.1	1.3	-.3	-1.0
I feel that including an electronic safety reporting tool as part of the required post flight process (to include "Nothing to report" when applicable) <u>is an unacceptable burden</u>, despite the positive benefits that may exist.	149	2.8	1.4	.1	-1.2

An average value of 2.5 on this 1-5 Likert scale would indicate a neutral score to the question, so the higher the value, the more the respondents agree with the question being asked. The average response to the first question from the survey resulted in a value of 3.1, slightly above neutral agreement that a mandatory reporting interface would improve the quality and quantity of USCG safety reporting. The average response to the second question of 2.8, suggests that there is almost no skewness (.1) towards respondents' opinions on whether a mandatory reporting tool would be an unacceptable burden, despite the positive benefits that may exist. To examine this a bit more deeply, a look at the frequencies of responses is helpful to understand how strongly the sampled aviators view this topic. For question 1, only 10% strongly disagreed that a mandatory reporting tool would be beneficial, whereas 23% strongly agreed. For question 2, only 12% strongly agreed that a mandatory reporting tool was an unacceptable burden, and 22% strongly disagreed. Although the average response for both questions was relatively centered, the polar options (strongly agree/disagree) were overweight in favor of the mandatory reporting tool (strongly agree: 23%; strongly disagree: 10%), and in support that it would not be an excessive burden (strongly disagree that it would be a burden: 21%; strongly agree that it would be a burden: 13%).

Assessing the demographic differences in response to these questions was performed by conducting multiple independent samples *t*-tests. No significant differences ($p<.05$) in response to these questions were observed across the gender demographic, instructor pilot experience, safety training experience, FSO experience, and pilot designation. However, when officer ranks were consolidated to junior officers (O1-O3) and senior officers (O4-O6) the independent samples *t*-tests revealed that senior officers ($M = 3.0$, $SD = 1.5$) considered mandatory reporting to be an unacceptable burden (Q2) at a significantly greater amount than junior officers ($M = 2.6$, $SD = 1.3$), $t(142) = -2.2$, $p < .05$. Due to the inequality of variance assumption being not met for the *t*-test, a Welch's ANOVA was used to illustrate that senior officers ($M = 3.1$, $SD = 1.5$) viewed mandatory reporting process (Q1) as less beneficial in improving reporting quality and quantity than junior officers ($M = 3.7$, $SD = 1.0$), *Welch's* $F(2, 145) = 6.6$, $p < .05$.

Again comparing fixed-wing versus rotary-wing pilot responses to these two questions, statistically significant differences emerge between the two groupings. The independent samples *t*-tests revealed that rotary-wing pilots ($M = 3.0$, $SD = 1.4$) considered mandatory reporting to be an unacceptable burden (Q2) at a significantly greater amount than fixed-wing pilots ($M = 2.4$, $SD = 1.3$), $t(143) = -2.3$, $p < .05$. Similarly, rotary-wing pilots ($M = 3.3$, $SD = 1.3$) viewed mandatory reporting process (Q1) as less beneficial in improving reporting quality and quantity than fixed-wing pilots ($M = 3.6$, $SD = 1.2$), however this observed mean difference was not statistically significant $t(143) = 1.4$, $p = .16$.

It should be noted that the fixed-wing and rotary-wing demographic was split almost perfectly with equal proportions of senior and junior officers between the two groups. 21 of the fixed-wing participants were junior officers, and 22 were senior officers. For rotary-wing participants, the split between junior and senior officers was precisely 51 and 51 for each group.

Additional Findings

In addition to asking survey participants to answer the predesigned questions for quantitative analysis, they were also provided the opportunity to write qualitative responses to provide freeform input and opinions about the USCG safety reporting process. These responses yielded some very useful suggestions specific to USCG aviation safety that were somewhat beyond the scope of this research. However, they also provided further insights into some of the themes that have been measured quantitatively thus far. 68 total qualitative comments were provided by the respondents. Each statement was then evaluated to see if any of the concerns discussed could be aligned with any of the existing constructs. Review and categorization of the comments produced the following frequencies, shown in Table 10:

Table 10

Qualitative Comment Themes

	Frequency Count
K	1
C	12
R	18
V	17

Note. Count of reporting barrier them found in qualitative comments

Program value, unsurprisingly, appeared among the most frequent issues associated with safety reporting. Interestingly, fear of retribution (R) was the single most frequent theme that emerged as an issue or concern for an individual participating in the USCG safety reporting process.

Additionally, relating to research question #4, numerous comments discussed respondents' opinions towards implementing a mandatory post-flight interface with a safety reporting tool. Comments categorized as favorable to the idea appeared 14 times, whereas 3 comments were categorized as clearly opposed to the idea. As inferred by the quantitative research of this question, the strength of favorable opinion towards the idea was greater not only in frequency, but also in magnitude, compared to opposition of the idea. Respondents demonstrated excitement towards the idea, particularly in its ability to mitigate knowledge (K) and inconvenience (C) barriers.

Chapter IV: Discussion

Results from this research indicate that, amongst the observed survey participants within USCG aviation, there are clear and significant distinctions between certain demographics and their attitudes and opinions towards important elements of aviation safety event reporting. Additionally, among the barriers to safety reporting that were selected for analysis in this research, there are two that definitively stood out amongst the four. Perceived lack of program value (V), and perceived inconvenience (C) of the safety reporting process stood out from lack of knowledge (K) and fear of retribution (R) as actual concerns or barriers for USCG aviators. Furthermore, there appears to be a significant distinction between fixed-wing and rotary-wing pilots' behaviors, attitudes, and opinions regarding aviation safety reporting. Anecdotal and stereotypical differences between fixed-wing and rotary-wing pilots are ubiquitous, though little academic or professional research supports any claims of differences. It is worth noting that the USCG fixed-wing aviation workforce is experiencing similar turbulence found across the aviation industry, associated with pilot workforce shortages. This can translate to burnout and apathy which may inhibit a desire to go the extra step to report a safety concern. Additionally, the situation may result in a priority issue for some aviators, in which considering future employment is perceived as more important than participation in current organizational functions, such as safety reporting. Both fixed-wing and rotary-wing aviators may be subject to these considerations, but the results may be magnified for the fixed-wing aviators. The difference in the typical flight duration between these two demographics, the aircrew dynamics, and the mission type differences also might play a role in explaining the differences in observed safety reporting behaviors and attitudes. The results found in this research comparing these groups can provide a foundation for further research into these potential differences.

A further review of the results from each research question allows for some further important insights and inferences.

Research Question #1: Have sampled USCG aviators abstained from reporting a safety event that was either compulsory, or that could have contributed to improving aviation safety within the organization? Are there any differences between various collected demographics and reporting behaviors?

As indicated in the results above, the finding that 21% of respondents knowingly or intentionally neglected to report a safety event indicates that the research into potential barriers to this process is warranted. This level of underreporting was much lower than the 54 percent found by the research of McMurtrie and Molesworth (2018) in Australian commercial flight crews, however any non-zero amount of underreporting is significant and concerning. It is important to recognize that this percentage of underreporting only includes conscious or intentional underreporting; presumably a much higher rate of underreporting occurs by operators who either forgot to report or were unaware of the need to report an occurrence that they may have encountered.

The decline of 8% between individuals who have formally reported an event (85%), versus those who have submitted a safety report for something that had no adverse outcome or external visibility (77%) is small in quantity, but still important. The likelihood that a USCG aviator (with the experience levels of those surveyed) has never witnessed a hazard, made a notable in-flight mistake, or experienced some other variant of a close call could be considered quite low. The difference in reporting rates of these two types of events (8%) suggests that the USCG may be achieving adequate reporting rates of innocuous mechanical failures but missing out on the truly impactful lessons to be learned by accounts of human error that may have resulted in a major event if not for circumstance. If some human intervention was the reason that the error did not become a major mishap, all the more important to capture that information in the form of a safety report.

In comparing the differences between demographics and past underreporting, underreporting was observed amongst a higher percentage of fixed-wing aviators than rotary-wing aviators, for potential reasons already discussed. Also observed, however, was the somewhat paradoxical finding that Flight Safety Officers (FSOs) had higher rates of underreporting than those with no FSO background. Though further research would be necessary to substantiate any explanation for this, one possible reason could be that FSOs are more aware of how extensive the list of reportable events really is (higher (K) score), are more conscientious of safety events, and also are more directly subject to the additional workload and potential inconveniences brought on by the additional reporting. Since there is no option for operators to submit a report directly to a database, all reports must go through the FSO to be added to the master USCG safety database. Interestingly, significantly expanding and increasing USCG aviation safety reporting rates could exceed reasonable workload expectations of unit FSOs. Further development of a direct to database reporting option, could simultaneously alleviate some of the burden on the FSO for minor incidents that are worth recording but don't require further necessary investigation, and improve tracking of events that were withheld for a desire to maintain some privacy or anonymity.

Research Question #2: Which factor(s), of the four constructs developed, present the greatest barrier or influence in a pilot's propensity to report a safety event? Are there any differences amongst various collected demographics and their attitudes towards these barriers?

Extensive statistical analysis, shown in the results section above, demonstrates that (V) perceived lack of program value, followed by (C) inconvenience of the reporting process are the most significant of the 4 barriers studied. Comparing the barriers across demographics resulted in some unanticipated findings, such as the difference in reporting attitudes between fixed-wing and rotary-wing aviators described above. As to be expected, significant differences were observed across various constructs (K, R, T) amongst individuals who had received formal training versus those who have not. Some demographic differences that had been anticipated after subject matter expert consultation, were not observed to be statistically significant. Considering that flight safety officers (FSOs) are responsible for collecting all the required information from a reporting individual, and must work with an antiquated reporting system, it was anticipated that these individuals would rate inconvenience as a significantly higher factor than non-FSOs. This was not observed at any significant level. A statistically significant difference in total reporting attitude between senior and junior pilots was also expected, but not observed. Lack of knowledge (K) was less of a factor for senior pilots, indicating that with time and experience they gain a better grasp of the system. However, their increased knowledge and experience with the safety reporting system did not noticeably change their attitude towards the remaining constructs (C, R, V, L, T). Considering this, in addition to increasing knowledge and training throughout the service, it appears that the only demographic differentiation requiring further attention is the lower safety reporting attitudes observed amongst fixed-wing aviators.

Four Reporting Barriers (K, C, R, V)

Briefly revisiting the identified barriers to reporting is useful given the context of the results found in this research. The knowledge (K) construct suggests that underreporting may be caused by either a lack of education and training, or a lack of memory and recall of participants as to the “when, how, what, and why” of safety reporting. The USCG Safety and Environmental Health Manual (2021) provides an extensive list detailing what events should and should not be reported. This is an important guide to standardize safety event data collection, but it can sometimes overcomplicate a simple idea that individuals should be trained and encouraged to report any abnormal occurrence or hazard that is experienced or observed. This potential barrier proved to be among the least prevalent amongst surveyed USCG aviators. USCG safety promotion and training is evidently doing a good job at ensuring individuals know when and how to report. The presence of unit FSOs (Flight Safety Officers) help bolster the local knowledge of the reporting process. Nonetheless, those who had not received formal safety training reported significantly lower knowledge scores. It is clear that training enhances knowledge, and thus helps reduce underreporting. The USCG should continue to focus efforts on training not only FSOs, but all aviators, on the importance of safety reporting and establishing an understanding of when, how, and why it should be done. As a final point, measuring actual knowledge versus perceived knowledge can be misleading. It is quite possible that some respondents don’t know what they don’t know. The 21 percent of the sample who admitted to having underreported is likely much higher, considering that some individuals have unknowingly underreported.

The inconvenience construct (C) suggests that at one or multiple levels of the reporting process, it is either too difficult to access, too untimely, cumbersome, or frustrating to participate. The USCG attempts to remove this barrier by allowing operators to report events to FSOs in freeform plain language communication, that is then converted by the FSO into standard formatting and database entry. Of course, this does present the FSO with an arguably inconvenient process. Some FSOs reported in the comments that the user interface was inconvenient, and that it was easy to become inundated with trivial reports at the expense of focusing on conducting more in-depth investigations. Whether realized and reported in this survey or not, the potential to forget or inadequately prioritize a safety report is undoubtedly present. Designing a mandatory post flight interface in which pilots input safety event data could help remove a few opportunities to forget or neglect to submit a report, while also freeing up some capacity for FSOs to conduct meaningful analysis where necessary. This barrier emerged as the second most prominent concern for USCG aviators. Considering the different processes required between FSOs and non-FSOs, it was speculated that a statistically significant difference would emerge between these two groups might appear, though none did. Perhaps further specific research questions aimed at identifying inconveniences at the operator level, and at the FSO level would help improve a more specific understanding of this barrier.

The fear of retribution (R) construct has historically been one of the biggest barriers not only to safety reporting, but to aviation safety in general. Safety culture largely depends upon the foundation of a just culture in which individuals feel safe to share and learn from their mistakes. Due to its importance, the USCG, along with most highly functioning aviation organizations, has placed great emphasis on establishing and maintaining a just culture. Likely in large part due to these efforts, fear of retribution (R) did not present itself as a predominant issue for USCG safety reporting, as measured by the survey. Paradoxically, in the qualitative section, this them emerged as the most frequent, if not most prominent (it should be noted that of the 18 comments pertaining to (R), not all explicitly stated that they had specifically experienced it as a barrier; some just chose to comment and reiterate the importance of just culture). The qualitative comments concerning fear of retribution (R) may be attributed to a few "bad apples" that an individual has come across in their career more than a broader failure of just culture.

Several respondents specifically stated that they had seen individuals either punished or had information used against them from a safety report. Particularly challenging with this problem is the fact accountability is often still necessary in a military aviation organization. Requiring officers to “dual-hat” as safety officers, flight examiners, department heads, and leaders further compounds this problem. It may be unclear for individuals whether repercussions stemmed from their safety report, or purely from external, parallel accountability processes. Given manpower constraints of such an organization, such challenges may be unavoidable. Interestingly, however, the findings of this research demonstrate that receiving formal safety training does significantly impact how an individual feels about fear of retribution as a barrier to safety reporting participation.

The perceived lack of program value (V) emerged as the most prevalent barrier to safety reporting, as measured by pure averages of the survey constructs, comparison with a respondent’s likelihood of reporting, past underreporting behavior, and as a close second found in qualitative responses. This construct consists of respondents’ feelings towards the level of feedback and responsiveness in adjusting to and repairing issues presented by the safety reporting process. Unfortunately, this is the most complex barrier to tackle. Simply improving training and education, establishing just culture policies, or designing more convenient processes appear to be easy in comparison towards broadly changing perspectives about the value of the program. Large, slow moving, bureaucratic processes to change aircraft equipment, modify policies and respond to change almost never meet the level of timeliness and quality desired by operators. It can be hard to distinguish whether this is a byproduct of a poor safety reporting program or just an inherent limitation of lumbering organizations, but the effect on operators and their perception of the process remains the same. An operator might wonder: why spend my time and energy to submit a report if nothing is going to actually change? In fact, very similar responses were found in the qualitative comments of this research. As Hewitt and Chreim (2015) suggest in their study, some operators perceive that their efforts may be better spent fixing or adjusting to the problem locally and moving on, instead of reporting it and hoping some bigger entity will do something about it. Lack of program value also emerged as the largest influence in reporting for Whittemore's USAF ASAP study as well (2019). Regardless of the challenges associated with improving this barrier, progress can still be made. Educating operators on the value added (assuming there are some merits to the claims) of the organization's safety reporting program and providing greater transparency and communication can certainly help improve this barrier. The single lowest scoring question of this construct was "I am satisfied with the follow-up and feedback after I submit a safety report." (M = 3.6, SD = 1.1). Addressing this could be as simple as improving reverse communication about the process. Frazer (2013) observed that underreporting of safety events could occur because individuals who have reported in the past did not receive enough acknowledgement or feedback as to what was being done with their report. It is easy for safety managers to seize the information and then begin working the problem up the chain of command, while neglecting to keep the initial reporter appraised of the status. In fact, this is probably the standard and most frequent complaint of many organizational processes. Though it presents as an additional burden for the safety manager, incorporating this extra communication and feedback step may be incredibly important to keeping the reporting pipeline open and healthy.

Research Question #3: Does a USCG pilot's total flight time predict their overall attitude towards barriers to reporting?

As shown in the results above, there simply is no statistical indication that an individual's flight time predicts or has a correlation with their attitude towards safety reporting barriers. Considering the normal distribution of flight time experience amongst the respondents, and the near equal distribution between senior and junior pilots amongst the research sample, it is reasonable to conclude that the barriers that exist for safety reporting do not present differently across experience or seniority levels within USCG aviators.

Research Question #4: How do survey respondents feel about incorporating a mandatory safety event form after each flight, to include reporting "No Event" if none occurred? Do the attitudes towards such a program differ significantly between the ranks of pilots?

The idea of integrating a mandatory safety event reporting interface after each flight is complex. It is challenging to separate and balance the potential gains of a new process or policy with the potential drawbacks. As such, this research question was assessed from both aspects by asking respondents about their perception of the value-added of such a reporting process, and their perception of the acceptability of the additional burden it may require. As shown in the results above, USCG aviators responded with a slight skewness favoring the benefits of such a reporting initiative. Regarding the potential level of burden this would induce, the average score of all respondents suggests a near-neutral opinion. However, as explained in the results, the polarity of the responses suggest that the most opinionated respondents lean towards favoring the benefits of the initiative, and accepting of the additional burden it may create.

When comparing demographics, it emerged that junior officers and fixed-wing aviators viewed the initiative more favorably than senior officers and rotary-wing aviators at a statistically significant level. Perhaps senior officers have become apathetic or have been exposed to more organizational initiatives attempting to improve the organization that either became a burden or were not effective in bringing about the desired change. It is also possible that, with their experience, they are simply content to keep the way things are and less open to new processes. It is interesting to consider what would be the overall impact on the inconvenience barrier. A mandatory reporting interface would, of course, be implemented to address and overcome this barrier. It might raise the overall inconvenience of a pilot's post-flight responsibilities, but actually reduce the level of inconvenience of reporting. Having the reporting interface become part of a habit or routine, readily accessible to the participants, would help remove some inconvenience related barriers. Pilots would no longer have to make a mental note to go visit the safety office and provide a report, and coordinate doing so with their other existing obligations. Considering the prevalence of underreporting and experience of barriers amongst fixed-wing aviators, the observation that they felt more favorable (than rotary wing aviators) towards such an initiative suggests that a potential match between a problem and a solution has emerged. A closely monitored trial period of pilot behaviors and engagement with such a process, as well as quantifiable outcomes comparing this method with the current method would be vital in further analysis of this problem.

Further Research

As discussed, several significant safety reporting differences were observed between USCG fixed-wing and rotary-wing pilots. No literature was found to suggest an explanation for these differences. Though some grounded speculation was provided, future research could further investigate cultural and personal differences between these groups. Pre and post testing of personality and safety attitude attributes of subjects at multiple phases of their careers as military aviators could reveal whether certain safety traits and attitudes are inherent characteristics of individuals, learned through professional experiences, or developed as a byproduct of assimilating into distinct subsets of the aviation community.

Additionally, future research could analyze actual reporting rates in military databases (normalized for flight hour differences) to see if any tangible proof of reporting differences could be observed. In order to rule out sampling error, the recorded differences in reporting behavior found in this study could be further validated by assessing actual reporting rates. Another methodology to enhance this study could involve providing safety event vignettes to participants in order to ascertain differences, similar to the research performed by Gilbey et al. (2015).

The idea of incorporating a mandatory post-flight interface with a safety reporting tool, similar to the USN/USMC policy, emerged as one potential tool to overcome or alleviate the inconvenience or lack of knowledge barriers. Future research could be incredibly useful to examine the effectiveness of such programs after they have been implemented. It is valuable to gauge the attitudes and perspectives of prospective participants in such a process, as done by this research, however outcome measures of improvement (or potentially regression) in reporting brought on by such initiatives should be completed prior to expanding or rejecting the process more broadly across aviation organizations.

Among qualitative comments regarding the fear of retribution (R) and program value (V) barrier, a theme emerged of the influential power (or lack of) of safety individuals in the command hierarchy. Some reported that certain individuals at their unit may have wielded their safety privileges to influence personnel management and evaluations. As discussed previously, this dual hatting is a delicate and complex topic, largely specific to USCG aviation. Conversely, some individuals reported that safety personnel did not have enough power or influence relative to other departments or organizational processes. Further research into safety personnel selection, hierarchical balances of safety versus operations and engineering interests, and the role of individual leaders' influence on safety reporting would also advance the understanding of this subject area.

Limitations

A fairly large sample size was received for this study given the limitations of garnering participation, but the 162 responses still represent approximately just 14 percent of USCG aviators. For this reason, the results could be skewed simply by the bias of the individuals that chose to voluntarily participate.

The research design limited the potential factors that contributed to underreporting to 4 items. This limitation was based on literature review, survey design, and subject matter expert review of potential concerns with safety reporting in the USCG. However, additional factors certainly may be present that could confound or act independently of the existing constructs. This limitation was mitigated by allowing respondents to offer qualitative responses, which did not reveal any particularly distinct barriers other than those studied.

Another limitation to this research occurred by the intentional narrowing of the selected population only to designated pilots in the USCG. Surveys can present a large manpower burden on organizations. At or near the same timeline of the distribution of this survey, the USCG aviation workforce was just completing their responses to the broader aviation safety climate survey. All pilots and enlisted aircrew participate in this survey; as an official function of USCG SMS this survey receives deserved special attention. Additionally, the entire workforce was being asked to participate in numerous other DoD, DHS, or USCG specific organizational surveys. These surveys are sponsored and collected on behalf of official governmental departments. Finally, USCG members may also be the recipients of other focus group studies about various aspects of their lives and professional experiences. For these reasons, the survey distributed for this research was subject to great scrutiny and approval process. Limiting the studied sample to exclude enlisted aviators was intentional to alleviate the burden while focusing specifically on the operators who typically are most likely to participate in the reporting process (pilots). However, expanding the research to include enlisted aviators may have produced some novel and very meaningful results regarding barriers to participation in the reporting process.

Conclusion

The broad purpose of this research was to uncover the past behaviors of underreporting amongst USCG aviators, and better understand the prevalence and influence of certain barriers to safety reporting amongst all USCG aviators, especially those who have underreported. Furthermore, differentiating the attitudes and behaviors by various available demographics expanded the depth and understanding of these behaviors and attitudes. The research questions and statistical results successfully achieved this purpose. The results and research process also revealed opportunities for future research of this subject area, and opportunities for the USCG to pursue policy and investments that could increase participation in the safety reporting process. Given the incredible potential value of safety reporting in identifying areas that require implementing hazard control and mitigations, few efforts can compete with the cost-effectiveness of improving the quantity and quality of safety reporting. Furthermore, focusing on tangible improvements to maximize the program's utility by learning and responding to the issues brought by safety reports will serve two purposes.

While further investments into modernizing the safety reporting and tracking software could prove immensely beneficial in improving safety reporting, particularly the inconvenience (C) barrier, such recommendations require significant research and development to execute well.

While such initiatives should be pursued, more immediate and achievable focus areas are also available. Considering the (K) knowledge and (R) fear of retribution variance across different demographics, continued investment at the unit FSO and CSO (Command Safety Officer) levels could significantly improve these components of safety culture and make them a near non-existent barrier. Promoting the value of participation and educating personnel about the process requires little by way of additional funding or manpower. Most importantly, however, is the takeaway for unit FSO, CSO, and USCG headquarters safety personnel to ensure transparency and timely communication about the status of safety investigations and expediently share the lessons learned. Military aviation does not have the structure to offer similar FAA immunity-based incentives for reporting. Instead, it relies on the willingness and desire of participants to contribute, based on the belief that their report actually provides value in fixing the situation and making the aviation community more mission effective and safer (whether it is remediated materially or simply through effective information sharing). In an organization with policy that mandates reporting without a perception of value amongst the participants, operators may default to a mindset of "how can I interpret this occurrence to not meet the threshold of a mandatory report?" However, when participants feel that the system is truly effective, they will develop a mindset of "what can I share from my experience to help my fellow aviators and my organization." Safety reporting is an exceptional tool that is available to enhance communication and organizational improvements. Addressing the barriers uncovered in this research is an important way for aviation organizations (the United States Coast Guard in particular) to maximize the benefits of this valuable tool.

References

Adjekum, D., Keller, J., Walala, M., Young, J., Christensen, C., & DeMik, R. (2015). Cross-sectional assessment of safety culture perceptions and safety behavior in collegiate aviation programs in the united states. *International Journal of Aviation, Aeronautics, and Aerospace*. https://doi.org/10.15394/ijaaa.2015.1074

Boeing Aircraft Company. (2019, September). *Statistical Summary of Commercial Jet Airplane Accidents Worldwide Operations | 1959 ? 2018 50th Edition* [PDF]. www.boeing.com. Retrieved October 29, 2020, from http://www.boeing.com/resources/boeingdotcom/company/about_bca/pdf/statsum.pdf

Chief Air Force Aviation Safety (SEF). (n.d.). *Proactive Aviation Safety*. Air Force Safety Center. Retrieved October 29, 2020, from https://www.safety.af.mil/Divisions/Aviation-Safety-Division/Proactive-Aviation-Safety/

Cooley, J. (2019). *United States Coast Guard aviation safety: Relationship between the safety survey and the extent of hazard reporting*. UND Scholarly Commons. https://commons.und.edu/theses/2449

Darveau, K., & Hannon, D. (2017). Barriers and facilitators to voluntary reporting and their impact on safety culture. *The International Journal of Aerospace Psychology*, *27*(3-4), 92–108. https://doi.org/10.1080/24721840.2018.1442221

Dillman, B. G., Voges, J., & Robertson, M. (2007). Safety occurrences student perceptions regarding failures to report. *Journal of Aviation Management and Education*.

https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.466.7343&rep=rep1&type=pdf

Field, A. (2017). *Discovering Statistics Using IBM SPSS* (5th ed.). Sage Publications Ltd.

Frazer, E. (2013). Safety culture surveys. *Air Medical Journal*, *32*(5), 228. https://doi.org/10.1016/j.amj.2013.06.006

Gilbey, A., Tani, K., & Tsui, W. (2015). Outcome knowledge and under-reporting of safety concerns in aviation. *Applied Cognitive Psychology*, *30*(2), 141–151. https://doi.org/10.1002/acp.3179

Harper, M. L., & Helmreich, R. L. (2005). *Identifying barriers to the success of a reporting system - advances in patient safety: From research to implementation (volume 3: Implementation issues) - ncbi bookshelf*. https://www.ncbi.nlm.nih.gov/books/NBK20544/

Hewitt, T., & Chreim, S. (2015). Fix and forget or fix and report: A qualitative study of tensions at the front line of incident reporting. *BMJ Quality & Safety*, *24*(5), 303–310. https://doi.org/10.1136/bmjqs-2014-003279

International Civil Aviation Organization. (2018). *Safety Management Manual, fourth edition* [PDF]. ICAO Safety. Retrieved October 29, 2020, from https://www.icao.int/safety/safetymanagement/pages/guidancematerial.aspx

Kouzes, J. M., & Posner, B. Z. (2017). *The leadership challenge* (6th ed.). John Wiley & Sons.

Liao, M.-Y. (2015). Safety culture in commercial aviation: Differences in perspective between chinese and western pilots. *Safety Science*, *79*, 193–205. Retrieved October 29, 2020, from https://doi.org/10.1016/j.ssci.2015.05.011

McMurtrie, K. J., & Molesworth, B. C. (2018). Australian flight crews trust in voluntary reporting systems and just culture policies. *Aviation Psychology and Applied Human Factors*, *8*(1), 11–21. https://doi.org/10.1027/2192-0923/a000131

Nevo, B. (1985). Face validity revisited. *Journal of Educational Measurement*, *22*(4), 287–293. https://doi.org/10.1111/j.1745-3984.1985.tb01065.x

Reason, J. (1990). *Human error* (1st ed.). Cambridge University Press.

Reason, J. (1997). *Managing the risks of organizational accidents*. Aldershot, UK: Ashgate.

Steckel, R. J. (2014). *Developing and establishing the validity and reliability of the perceptions toward Aviation Safety Action Program (ASAP) and Line Operations Safety Audit (LOSA) questionnaire* [Doctoral dissertation].

United States Air Force. (2020). *The U.S. Air Force mishap prevention program* (AFI 91-202). https://static.e-publishing.af.mil/production/1/af_se/publication/afi91-202/afi91-202.pdf

United States Coast Guard. (2021). *Safety and Environmental Health Manual* (COMDTINST M5100.47D).

Vrbnjak, D., Denieffe, S., O'Gorman, C., & Pajnkihar, M. (2016). Barriers to reporting medication errors and near misses among nurses: A systematic review. *International Journal of Nursing Studies*, *63*, 162–178. https://doi.org/10.1016/j.ijnurstu.2016.08.019

Whittemore, T. J. (2019). *Aviation Safety Action Program in the United States Air Force: Mobility Aircrews' Intentions to Use Safety Reporting* (427) [Doctoral dissertation, Embry Riddle Aeronautical Universtiy]. PhD Dissertations and Master's Theses. https://commons.erau.edu/edt/474

Wiele, P. (2016). *Healthcare Incident Reporting: The Impacts of Usability of Input Interfaces, Usability of Resulting Data, and Attitudes Towards Reporting* [Thesis]. Rochester Institute of Technology. https://scholarworks.rit.edu/cgi/viewcontent.cgi?article=10174&context=theses

Appendix

Qualtrics Survey Administered February 2022

Kevan Hanson USCG Safety Reporting Survey Graduate Research

Start of Block: Informed Consent

Informed Consent **Study Information Sheet**

Title of Project: Analysis of Safety Event Reporting Behaviors and Attitudes Amongst USCG Aviators

Principal Investigator: LCDR Kevan Hanson (Kevan.hanson@und.edu)

Advisor: Shayne Daku (Shayne.daku@und.edu, 701-777-4914)

Purpose of the Study: The purpose of this research study is to examine barriers to safety event reporting and current reporting participation amongst USCG aviators. Behaviors and attitudes will be compared across different demographics, and the prevalence of identified barriers will be assessed and used to suggest organizational improvements.

Procedures to be followed: You will be asked to answer 37 short questions on this survey, with 10 demographic questions at the end.

Risks: There are no risks in participating in this research beyond those experienced in everyday life.

Benefits: This survey may provide USCG aviators with a better understanding of how certain systemic and personal barriers affect their likelihood to participate in the current USCG safety reporting process. Statistical analysis of the results may aid organizational leaders in overcoming these reporting barriers.

Duration: It will take approximately 5-10 minutes to complete this survey.

Statement of Confidentiality: The survey will only ask demographic questions for aggregate analysis; no specific individual identity questions will be asked. Therefore, you can be assured your responses will be recorded anonymously. The results will be stored by Qualtrics.com and exported to Microsoft Excel and IBM Statistical Package for Social Sciences (SPSS) on the computer of the principal investigator. The data will be stored for three years after the completion of this study. The data will only be accessed by the researcher, his advisory committee, and University of North Dakota Institutional Review Board personnel. However, given that the surveys can be completed from any computer, we are unable to guarantee the security of the computer on which you choose to enter your responses. As a participant in our study, we want you to be aware that certain “key logging” software programs exist that can be used to track or capture data that you enter and/or websites that you visit.

Right to Ask Questions:
The researcher conducting this study is LCDR Kevan Hanson. If you have questions, concerns, or complaints about the research please contact Kevan Hanson at Kevan.hanson@und.edu or Shayne Daku at Shayne.daku@und.edu or 701-777-4914 .
If you have questions regarding your rights as a research subject, you may contact The University of North Dakota Institutional Review Board at (701) 777-4279 or UND.irb@UND.edu. You may contact the UND IRB with problems, complaints, or concerns about the research. Please contact the UND IRB if you cannot reach research staff, or you wish to talk with someone who is an informed individual who is independent of the research team.

General information about being a research subject can be found on the Institutional Review Board website “Information for Research Participants” http://und.edu/research/resources/human-subjects/research-participants.html

Compensation:
You will not receive compensation for your participation.

Voluntary Participation:
You do not have to participate in this research. You can stop your participation at any time. You may refuse to participate or choose to discontinue participation at any time without losing any benefits to which you are otherwise entitled.

You do not have to answer any questions you do not want to answer.

You must be 18 years of age older to participate in this research study.

Completion and return of the survey implies that you have read the information in this form and consent to participate in the research.

Privacy Act Statement
Authority: 5 U.S.C. § 301; 10 U.S.C. § 2358; 14 U.S.C. § 504. Commandant; general powers, 14 U.S.C. § 505 and 44 U.S.C. § 3101

Purpose: To collect information to provide United States Coast Guard (USCG) Aviators with a better understanding of how certain systemic and personal barriers affect their likelihood to participate in the current USCG safety reporting process.

Routine Uses: This information will be used to perform statistical analysis of the results that may aid organizational leaders in overcoming event reporting barriers, and may be disclosed externally as a “routine use” pursuant to DHS/ALL/PIA-069 DHS Surveys, Interviews, and Focus Groups.

Disclosure: Furnishing this information is voluntary.

Consent 1 Do you consent to continue the survey?

- ◯ Yes (1)
- ◯ No (2)

Skip To: End of Survey If Do you consent to continue the survey? = No

End of Block: Informed Consent

Start of Block: Block 6

Start of Block: Definitions and Reporting Behavior

Definition

Definition:
"Safety Event” (ground or in flight, aviation related) is defined here as either a mishap, such as: “any unplanned, unexpected or unintentional event that causes injury, death, material loss or damage”
OR
Any other mistake, hazard, or event that could have resulted in similar negative outcomes if not for luck, circumstance, or some other mitigating factor.

Past Behavior Def.
Please answer the following Yes or No questions about your past safety event reporting behaviors.

Past Behavior 1 1) Have you ever formally reported a safety event?

◯ Yes (1)

◯ No (2)

Past Behavior 2 2) Have you ever reported a safety event that had no tangible negative outcome (i.e. no components damaged, injury, mission abort, etc.)?

◯ Yes (1)

◯ No (2)

Past Behavior 3 3) Have you ever intentionally underreported a safety event (withheld certain details, or did not report at all)?

◯ Yes (1)

◯ No (2)

Number of Reports How many safety events have you formally reported in the last year?

▼ 0 (1) ... More than 10 (13)

End of Block: Definitions and Reporting Behavior

Start of Block: Barriers to Safety Reporting

K1 I know the safety reporting requirements of the Safety and Environmental Health Manual (COMDTINST M5100.47).

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

K2 It is easy to recall which safety events I am required to report.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

K3 I understand what happens to a safety report after I have submitted it.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

K4 I am aware of the role of safety event reporting in Safety Management Systems (SMS).

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

K5 I know how to submit a safety report.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

K6 I am satisfied with the level of training I have received regarding safety reporting.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

K7N Lack of knowledge/education/training is a barrier to my participation in USCG safety reporting.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

C1 It is convenient for me to submit a safety report.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

C2 Submitting a safety report does not take much of my time.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

C3 The software interface for reporting a safety event is convenient.

- ◯ Strongly disagree (1)
- ◯ Somewhat disagree (2)
- ◯ Neutral (3)
- ◯ Somewhat agree (4)
- ◯ Strongly agree (5)

C4 It is easy for me to participate in the safety reporting process.

- ◯ Strongly disagree (1)
- ◯ Somewhat disagree (2)
- ◯ Neutral (3)
- ◯ Somewhat agree (4)
- ◯ Strongly agree (5)

C5 I am satisfied with the level of effort required to submit a safety report.

- ◯ Strongly disagree (1)
- ◯ Somewhat disagree (2)
- ◯ Neutral (3)
- ◯ Somewhat agree (4)
- ◯ Strongly agree (5)

C6N Inconvenience is a barrier to my participation in safety reporting.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

R1N I am concerned that I could lose my designation based solely on a safety report.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

R2 I trust that my supervisors will use my safety report in a non-punitive way.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

R3 I can report safety events without a fear of repercussion.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

R4N I am concerned that a safety report could be used to evaluate my performance.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

R5N Fear of retribution is a barrier to USCG safety reporting for me.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

V1 I believe that my safety reports can help prevent future class A mishaps.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

V2 Information gathered by safety reports is used to change procedures / policies.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

V3 I am satisfied with the follow-up and feedback after I submit a safety report.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

V4 The safety reporting / recording program is effective at improving safety.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

V5 Submitting a safety report is worth my time.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

V6N Lack of program value (including level of feedback, improvements, usefulness, etc.) is a barrier to my participation in USCG safety reporting.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

End of Block: Barriers to Safety Reporting

Start of Block: Likelihood of Reporting and Additional Questions

L1 I would likely submit a safety report for an adverse event even if there was no negative outcome (damage, injury, violation, mission abort, etc.).

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

L2N I am less likely to report a "close call" than an event that resulted in a mission abort.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

L3 Reporting near miss events is just as important to me as events with actual damage/injury.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

L4N I probably would not report a minor safety event if it went unnoticed by anyone else (ATC, Operations, Maintenance, etc.)

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

L5N Having a negative outcome from a safety event influences whether I submit a formal safety report.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

L6N I typically only participate in safety reporting if there was a negative outcome (i.e. damage, injury, violation, etc.)

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

E1 I would prefer the option to report directly (and anonymously if I desired) to a safety database without having to go through my unit FSO.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

E2 Reporting a mistake I made could adversely affect my reputation and how others perceive me as an aviator.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

E3 I feel that including an electronic safety reporting tool as part of the required post flight process (to include “Nothing to report” when applicable) would help improve the quantity and quality of USCG aviation safety reports.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

E4 I feel that including an electronic safety reporting tool as part of the required post flight process (to include “Nothing to report” when applicable) is an unacceptable burden, despite the positive benefits that may exist.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)

End of Block: Likelihood of Reporting and Additional Questions

---

Start of Block: Demographics

Q43 **Demographics** (will only be used for trend analysis and comparison purposes)

Dgender What is your gender?

- Male (1)
- Female (2)
- Other (3)

D1 What is your rank?

▼ O6 (1) ... O1 (6)

D2 What is your current assigned platform?

▼ C-130H (1) ... Other (8)

D3 What is your current designation?

- Aircraft Commander (1)
- First Pilot (2)
- Copilot (3)

D4 Have you ever held an FE or IP qualification?

- Yes (1)
- No (2)

D5 Have you received any formal aviation safety training?

- Yes (1)
- No (2)

D6 Have you served as a unit Flight Safety Officer (FSO)?

- Yes (1)
- No (2)

D7 What is your current or planned career path?

○ Operations (1)

○ Safety / Operations (2)

○ Aviation Engineering (3)

○ Other (4)

○ Unknown (5)

---

*

D8 Flight Time Approximately, what is your total flight time in hours? Please write in: (example: 1,450)

____

End of Block: Demographics

Start of Block: Qualitative Responses

Qual 1 If desired, please provide any feedback you have regarding the USCG safety reporting process (i.e. Anything that inhibits your participation? Enhances your participation? Recommended changes? Experience with other safety reporting programs? etc.)

____

Qual 2 If desired, please provide any other feedback on this topic or suggestions of where further research is needed to improve USCG aviation safety. Thank you!

____

End of Block: Qualitative Responses
