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A Mixed Method Approach to Collegiate Aviation Risk Assessment for Dual Cross-Country Flights at the John D. Odegard School of Aerospace Sciences

Paula Renee Carlson

A MIXED METHOD APPROACH TO COLLEGIATE AVIATION RISK ASSESSMENT FOR DUAL CROSS-COUNTRY FLIGHTS AT THE JOHN D. ODEGARD SCHOOL OF AEROSPACE SCIENCES

by

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ABSTRACT

Risk is unavoidable within aviation. It is not possible to eliminate all risks, but rather to mitigate risks and the potential outcomes that a risk could cause to occur. The University of North Dakota utilizes a risk assessment form that is potentially inadequate in its ability to properly assess the risk of a flight as compared to the risk perceived by the pilots that will conduct the flight. The purpose of this study was to create a more accurate preflight risk assessment form to evaluate the potential risks that could occur on a cross-country training flight and to determine the effectiveness compared to the previous version. Another reason for this particular study was to examine the relationship of perceived risk assessment compared to pilot background characteristics.

Overall, the findings of the study determined that the newer format of the preflight risk assessment is worthwhile in regards to time and an accurate representation of the actual risks perceived during training flights. The study also found that the role of participant, the flight instructor, placed more emphasis on risk assessment before a flight. The flight instructor also applied more mitigation techniques prior and during a flight compared to the student. Another significant finding was the private pilot placed more emphasis on risk assessment after the flight compared to commercial/ATP pilots. The results of this research bring about new areas to explore and examine. Numerous recommendations for further research are presented to help improve the overall safety towards the UND Aerospace program and for general aviation as well.

CHAPTER I

INTRODUCTION

Risk is an omnipresent phenomenon. There is no human state or action that is without risk, although there are clearly some circumstances and actions that carry substantially more risk than others (Hunter, 2002). Over the years, the aviation industry has dramatically increased the safety of air travel by managing and mitigating risks associated with flight (Flight Risk Assessment Tool, 2007). The aviation industry currently provides the safest form of transportation in the United States (Flight Risk Assessment Tool, 2007). However, the industry continues to have accidents that are preventable. Therefore, both the Federal Aviation Administration (FAA) and aviation industry are working to continually improve the safety record.

While flight in commercial aircraft is generally acknowledged to be the safest form of transportation, flying in general aviation aircraft is arguably toward the high end of the risk continuum, even though the pilots are generally oblivious to the magnitude of the risk (O'Hare, 1990). Risk assessment is critical to effective decision-making which ultimately leads to increased aviation safety. According to the National Transportation Board (NTSB) statistics, in the last 20 years, approximately 85 percent of aviation accidents have been caused by pilot error (Risk Management Handbook, 2009). All FAA operations in the United States involve risk and require decisions that include risk assessment and risk management (Aviation Instructor's Handbook, 2008). If risk management is ignored, fatal results could occur (Risk Management Handbook, 2009).

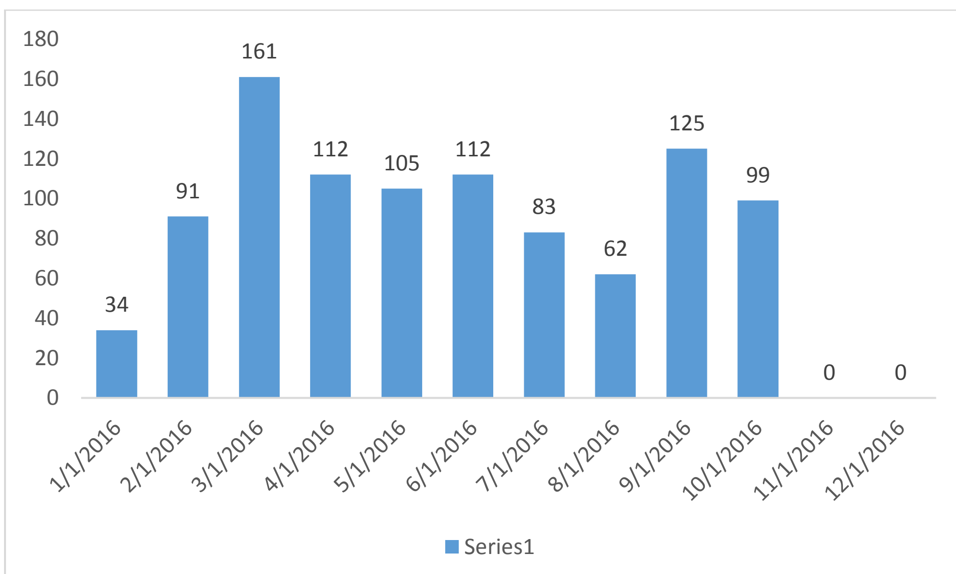
Risk management is a logical process of weighing the potential costs of risks against the possible benefits of allowing those risks to stand uncontrolled (Aviation Instructor's Handbook, 2008). Risk management is a decision-making process designed to identify hazards systematically, assess the degree of risk and determine the best course of action (Aviation Instructor's Handbook, 2008). The certified flight instructor (CFI) who integrates risk management into flight training teaches aspiring pilots how to be more aware of potential risks in flying, how to clearly identify those risks, and how to manage them successfully (Risk Management Handbook, 2009).

The John D. Odegard School of Aerospace Sciences (JDOSAS) within the University of North Dakota (UND) enrolls the largest number of professional pilot students of any public institution of higher education in the United States (University Aviation Association, 2008). The UND Flight Department (UND Aerospace) conducts over 100,000 flight hours and approximately 2,250 solo cross-country flights within a year (UND Aerospace, 2016). Table 1 shows the number of dual cross-country flights dispatch by month in 2016 (UND Aerospace, 2016). Almost 1,000 dual cross-country flights have been conducted at UND Aerospace in 2016 (UND Aerospace, 2016). To ensure the highest level of safety, it is imperative that each flight assess the risk as accurately as possible.

Statement of the Problem

The current procedure that UND has in place, will never prevent the crew from going on a flight with unacceptable risk. Instead, the current risk assessment form only gives a warning that extra care should be taken during the flight. For example, a student may not have slept in the past 24 hours and had nothing to eat for more than 5 hours and they would be allowed to fly. Or even worse, a student may not have had adequate rest in the past week and they would still be dispatched an aircraft to fly. A new preflight risk assessment needs to be developed to stop unacceptable and preventable risks.

Table 1: Number of UND Dual Cross-Country Flights in 2016.



(UND Aerospace, 2016).

Over the next few years, the FAA will mandate operators and certificate holders to develop Safety Management Systems (SMS). These programs will foster a proactive safety conscious environment that will identify hazards in advance and mitigate the associated risks. According to the UND Aerospace SMS Manual, it states, “where individual attitudes are concerned, organizational cultures set by top management establishes the tone that enhances the performance and efficiency of the entire SMS" (UND Aerospace, 2016). The administration's culture at UND consists of the values, beliefs, mission, goals, and sense of responsibility held by the organization's members (UND Aerospace, 2016). The culture fills in the blank spaces in the company's policies, procedures, and processes and provides a sense of purpose to the safety efforts (UND Aerospace, 2016).

UND recognizes the need for a safety culture as an important aspect of the organization. The Dean of JDOSAS, Paul Lindseth states "All endeavors involve an element of risk, aviation notwithstanding; we also have a total commitment to ensure risks have been reduced to the lowest practical level possible" (UND Aerospace, 2016). Dean Lindseth acknowledges, "This is not accomplished by words in a mission statement or safety posters on a wall, but by the daily efforts of the students, staff, administration, and faculty of UND Aerospace (UND Aerospace, 2016). "Each and every one of us has the knowledge, experience, and situational awareness needed to make valuable contributions to safety. Recognizing potential hazards and identifying risks, reporting them and making recommendations for the elimination or reduction, is something we are all capable of doing," said Lindseth (UND Aerospace, 2016). Dean Lindseth states, "As members of UND Aerospace, let us all continue working together to ensure an environment where safety is not only our goal and total commitment, but our passion," (UND Aerospace, 2016).

Prior to each dual cross-country flight training conducted at UND, both the student and the flight instructor must assess certain conditions to obtain an overall risk estimate and determine if the risk is acceptable to continue their flight. A numerical rating from one to five is allocated in each category. The rating column is totaled to achieve an overall total risk score to decide if the lesson will be a low, elevated or high-risk flight. However, the current format of the form is not compliant with the requirements of SMS. There are also no guidelines given to students and flight instructors on how to assess the risk categories on the form. Certain categories, such as type of flight and weather stability could be assessed differently based on individual pilot perception. Another problem with the current cross-country form is that a pilot could score the highest total numerical risk value but still proceed with the flight, which potentially could lead to safety concerns. Figure 1 displays the current preflight risk assessment form utilized at UND Aerospace.

Figure 1. Current Preflight Risk Assessment for Dual Cross-Country Flights.

Preflight Risk Assessment for Dual Cross-Country

Before each flight, assess each of the following conditions and assign a numerical rating of 1 to 5 in the Rating column. Add up the entries in the Rating column to obtain an overall risk estimate, and determine if the risk is acceptable to continue the flight.

	1	2	3	4	5	Instructor Rating	Student Rating
Flight Type	VFR	IFR (VMC)	IFR (IMC)	N/A	N/A		
Dual/Solo	Dual	N/A	N/A	N/A	N/A		
Day/Night	Day	N/A	Night	N/A	N/A		
Visibility	> 10 Miles	6-9 Miles	3-5 Miles	1-3 Miles	< 1 Mile		
Ceiling	> 6,000'	2,000-6,000'	1,000-1,999'	400-999'	< 400'		
Highest Crosswind	Calm	1-5 kts	6-9 kts	10-13 kts	> 13 kts		
Weather Stability	Stable	N/A	Slow Deterioration	N/A	Rapid Deterioration		
Rest in last 24 hours	> 8 hrs	N/A	6-7 hrs	N/A	< 6 hrs		
Last Meal	< 3 hrs	3 hrs	4 hrs	5 hrs	> 5 hrs		
Duration of Flight	< 3 hrs	3 hrs	4 hrs	5 hrs	> 5 hrs		
Duty Day at ETA	< 6 hrs	6-8 hrs	8-10 hrs	10-12 hrs	12-16 hrs		
Hours in aircraft type	> 100 hrs	75-100 hrs	50-74 hrs	30-49 hrs	< 30 hrs		
Hours in the last 90 days	> 20 hrs	15-20 hrs	10-14 hrs	5-9 hrs	< 5 hrs		
Total Hours	> 200 hrs	100-200 hrs	50-99 hrs	30-49 hrs	< 30 hrs		
					Total Risk Score		

LOW RISK: No unusual hazards. Use normal flight planning and established personal minimums and operating procedures.	< 29	< 29
ELEVATED RISK: Somewhat riskier than usual. Conduct flight planning with extra care. Review personal minimums and operating procedures to ensure that all standards are being met. Consider alternatives to reduce risk.	29 to 34 or a 5 in any row.	29 to 34 or a 5 in any row.
HIGH RISK: Conditions present much higher than normal risk. Conduct flight planning with extra care and review all elements to identify those that could be modified to reduce risk. If available, consult with more experienced instructor for guidance before flight. Develop contingency plans before flight to deal with high risk items. Decide beforehand on alternates and on special precautions to be taken during the flight. Consider delaying flight until conditions improve and risk is reduced.	> 34 or a 5 in any two rows.	> 34 or a 5 in any two rows.

I certify the entries on this risk assessment are true. ______________________ *Legible Signature of Pilot* ______________________ *Print Signature of Pilot*

I certify the entries on this risk assessment are true. ______________________ *Legible Signature of Instructor* ______________________ *Print Signature of Instructor*

Dual XC Request White *05/2013*

(UND Aerospace, 2013).

Purpose of the Study

The purpose of this mixed method study is to create an SMS compliant risk assessment form and evaluate the effectiveness of it when used for dual cross-country flights at UND. The study also examined the relationship of perceived risk assessment compared to pilot background characteristics (gender, age, flight hours, role, flight course, pilot certificate and advanced safety courses). The study explored if there is a difference of pilot perceptions from the previous version of the preflight cross-country risk assessment form to the new SMS format. Another reason for the study was to determine if there is a correlation of pilot perception on the new SMS cross-country form based on pilot background characteristics. The results of the research will be used in future modifications of the cross-country form to allow UND students and flight instructors to more accurately predict the level of risk prior to conducting a flight, hopefully, increasing the safety of flight.

Significance of the Study

Poor pilot decision-making has been implicated as a leading factor in fatal general aviation accidents and poor risk assessment can contribute significantly to poor decision-making (Hunter, 2002). Risk assessment and management is only one component of the broader process of pilot decision-making. Advancements continually are updated to improve flight training methods, aircraft equipment and systems, but accidents still occur. Despite all changes in technology to improve flight safety, one factor remains the same: the human element, which leads to errors (Pilots Handbook of Aeronautical Knowledge, 2008). It is estimated that “approximately 80 percent of all aviation accidents are related to human factors” (Pilots Handbook of Aeronautical Knowledge, 2008). Pilots who are involved in accidents generally know what went wrong (Aeronautical Decision Making, 1991). Frequently, the pilot was aware of the potential hazards when the decision made led to the wrong course of action. In the interest of expediency, cost savings, self-gratification, or other often irrelevant factors, the incorrect plan was chosen (Aeronautical Decision Making, 1991). This cycle of decisions began at the flight planning desk with choices made on the route, the alternate route, the amount of fuel and on the weather conditions. While it is true that simple errors of equipment operation are seldom serious, mistakes in judgment can be fatal (Aeronautical Decision Making, 1991). The understanding of how personal attitudes can influence decision-making and how those attitudes can be reformed to enhance safety in the aircraft. It is important to comprehend the factors that cause humans to make decisions and how the decision-making process not only works, but how it can be enhanced.

Research Questions

1. Is there a difference of pilot perception placed on risk assessment during a cross-country flight based on background characteristics?
2. Is there a difference of pilot perception on the old Preflight Risk Assessment for Dual Cross-Country flights versus the new SMS Preflight Risk Assessment form?
3. Is there a difference of pilot perception on the new SMS Risk Assessment form based on background characteristics?

Intended Audience

The study’s findings offered results that may benefit several different groups. For instance, the UND Flight Operation’s management team, faculty members, flight instructors and the flight students attending UND. Other aviation flight schools and the general aviation community may also find the study helpful when conducting a preflight determination of the risks associated for a particular flight. The results may also be beneficial for corporate operators to reference the findings when developing their own risk assessments.

Assumptions

- All participants attend or are employed at UND Aerospace a 14 CFR Part 141 flight training school.
- All participants answered survey questions accurately and honestly.
- Each participant completed the survey independently.
- Each participant took the survey once.

Limitations

- The study only looked at data from one collegiate flight school.
- Participants may have received dissimilar flight training.
- Some participants may become mindful of the study and altered their responses.
- Some participants may have independently studied self-assessment.

Definitions

- 14 CFR Part 141 – Code of the Federal Regulations that the Federal Aviation Administration uses for flight schools. The flight schools are structured by regulations and based on an approved training course outline.

- Acceptable Risk – The part of identified risk that is allowed to persist without further management action. Making this decision is a difficult yet necessary responsibility of the managing activity. This decision is made with full knowledge that it is the user who is exposed to this risk.
- Flight Crew – Consists of the student and flight instructor that conduct training together.
- Hazard – A condition that can lead to injury, illness or death to people; damage to or loss of a system, equipment, or property; or damage to the environment.
- Risk – The possibility of loss of life or injury and it encompasses both the probability of an encounter with a hazard and the severity of a hazard.
- Risk Management – A decision-making process designed to identify hazards systematically, assess the degree of risk, and determine the best course of action.
- Safety Management System (SMS) – Means the formal, top-down, organization-wide approach to managing safety risk and assuring the effectiveness of safety risk controls. It includes systematic procedures, practices, and policies for the management of safety risk.
- Safety Risk Assessment (SRA) – Provides a thorough look at the organization in order to identify situations, processes that may cause harm, particularly to people. After the hazards are identified, the likelihood and severity is evaluated and it is decided what risk mitigation strategies will be used to reduce the risk to an acceptable level.
- Unacceptable Risk – Risk which cannot be tolerated by the managing activity. It is subset of identified risk that must be eliminated or controlled.

Review of Literature

Risk is unavoidable within aviation. It is not possible to eliminate all risks, but rather to mitigate threats and the potential outcomes that a hazard could occur. This review provides background information on risk management, assessment, and perception. While inadequate risk assessment in everyday life does not constantly lead to tragedy, the margin for error in aviation is thin (Risk Management Handbook, 2008).

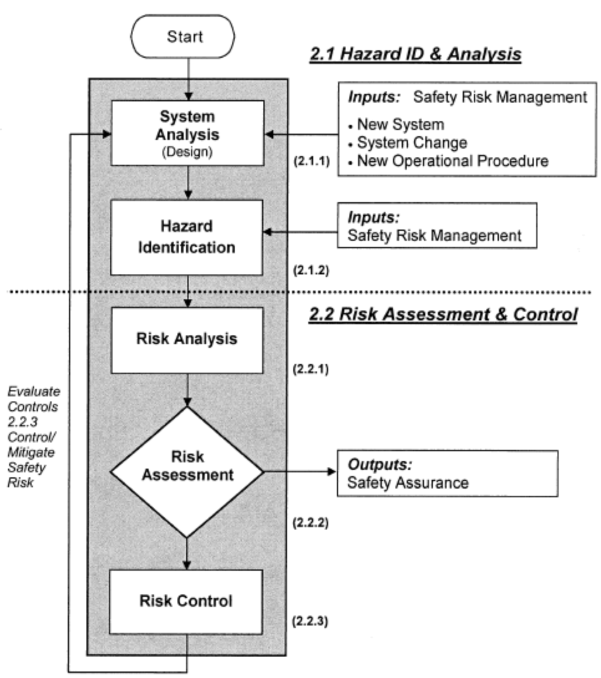
Safety Management System

The National Transportation Safety Board (NTSB) accident investigations have revealed, in numerous cases, that an SMS program could have prevented the loss of lives or injuries (Hunter, 2002). SMS continually monitor operations and collect data to identify emerging and developing safety problems before an accident would occur. Having identified these risks, the program would devise interventions and evaluate how well it performs at successfully mitigating risks.

Currently, the FAA encourages each aviation service provider to develop and implement an SMS. An SMS program is recommended for pilot schools, but not mandatory at this time. The framework stresses what the organization must do rather than how it will be accomplished (Safety Management System Assurance Guide, 2010). The FAA SMS framework is organized around four building blocks: safety policy and objectives, safety risk management, safety assurance and safety promotion (Safety Management System Assurance Guide, 2010). These four pillars are essential for a safety-oriented management system.

The first component of SMS is policy. All management systems must define policies, procedures and organizational structures to accomplish their goals (Safety Management System Assurance Guide, 2010). The second component of SMS is safety risk management. This is a formal system of hazard identification, which is essential in controlling risk to acceptable levels (Safety Management System Assurance Guide, 2010). The third pillar is safety assurance. Once safety risk management controls are identified and operational, the operator must ensure the process continues to be effective in a changing environment (Safety Management System Assurance Guide, 2010). Safety promotion and culture make up the last pillar. Finally, the operator must promote safety as a core value with practices that support a strong safety culture (Safety Management System Assurance Guide, 2010). Figure 2 shows the SMS process flow.

Figure 2. Safety Risk Management Process Flow.



(UND Aerospace, 2016).

Aeronautical Decision-Making

Aeronautical decision-making (ADM) is "a systematic approach to the mental process used by pilots to consistently determine the best course of action in response to a given set of circumstances" (Pilots Handbook of Aeronautical Knowledge, 2008). For over 25 years, the importance of good pilot judgment, or ADM, has been recognized as a crucial part of the safe aircraft operation and accident avoidance (Pilots Handbook of Aeronautical Knowledge, 2008). According to the NTSB statistics, in the last 20 years, approximately 85 percent of aviation accidents have been caused by pilot error (Risk Management Handbook, 2009). Many of these accidents are the result of the tendency to focus flight training on the physical aspects of flying to teach the student enough to pass the practical test and ignoring risk management (Risk Management Handbook, 2009). Research has shown that "pilots who have received ADM training made fewer inflight errors than those who had not received the specific training. The differences were statistically significant and ranged from about 10 to 50 percent fewer judgment errors" (Pilots Handbook of Aeronautical Knowledge, 2008).

Contrary to popular belief, good judgment can be taught. Tradition held that good judgment was a natural by-product of experience, but as pilots continued to log accident-free flight hours, a corresponding increase of good judgment was assumed (Pilots Handbook of Aeronautical Knowledge, 2008). Building upon the foundation of decision-making, ADM enhances the process to decrease the probability of human error and increases the probability of a safe flight (Pilots Handbook of Aeronautical Knowledge, 2008). ADM is a systematic approach to the mental process used by pilots to consistently determine the best course of action in response to a given set of circumstances (Risk

Management Handbook, 2009). Aeronautical decision making is the cornerstone in managing risk.

Risk management is the responsibility of everyone involved in aviation. The following question must always be kept in mind when making a decision: "Is the success of the task worth the risk?" (Aeronautical Decision Making, 1991). One essential decision point before a flight is the checklist of basic principles that cannot be compromised. This personal checklist should include the fundamental tenets applicable to every flight. Consider the following factors that contribute significantly to an unsafe flight:

> Flight while under the influence of alcohol or drugs or conducting a flight with a known medical deficiency. Flying outside the certified flight envelope is never safe. Flight with less than the required minimum fuel is certainly not reasonable. Flight into the clouds when not on an instrument flight plan or descent below the applicable minimum enroute altitude is under no circumstances justified. Casual neglect of any applicable checklist is never warranted (Aeronautical Decision Making, 1991).

A pilot does not have to be a genius to be a safe aviator. However, a pilot should be an emotionally steady individual who can accept the fact that they are not in possession of all the facts or skills for every situation and be willing to take the recommendations of those who specialize in evaluating, assessing and administering aviation procedures (Aeronautical Decision Making, 1991). An experienced, mature pilot will accept and follow the rules and regulations which will benefit the aviation community (Risk Management Handbook, 2009).

Many years of research has been dedicated to the FAA publishing manuals oriented to decision-making needs of variously rated pilots (Hunter, 2002). These multifaceted materials are designed to help reduce the number of decision related accidents, which account for 52 percent of fatal general aviation pilot error accidents (Aeronautical Decision Making, 1991). ADM provides a structured, systematic approach to analyzing changes that occur during a flight and how these changes might affect a flight's safe outcome (Aeronautical Decision Making, 1991). The ADM process starts with the recognition of change, following with an assessment of alternatives, a decision to act or not act is made and the results are monitored (Risk Management Handbook, 2009).

Existing rules would go a long way to remedy the accident rate; however, personality traits that cause irrational behavior also make pilots prone to disregard the procedures that would assure safe operations (Aeronautical Decision Making, 1991). The development of good decision-making skills is far more difficult than developing decent flying abilities, but it can be accomplished (Risk Management Handbook, 2009). One of the most important decisions a pilot will make is to acquire and adhere to the published rules, which can take the hazards out of flying (Aeronautical Decision Making, 1991).

Hazards and Risks

Risk management, a formalized way of dealing with hazards, is the logical process of weighing the potential costs of risks against the possible benefits of allowing those risks to stand uncontrolled (Risk Management Handbook, 2009). Two defining components of ADM and risk management are hazard and risk. Hazard is a real or perceived condition, event or circumstance that a pilot encounters (Pilot's Handbook of

Aeronautical Knowledge, 2008). Recognizing hazards is critical to beginning the risk management process (Risk Management Handbook, 2009). When confronted with a hazard, the pilot makes an assessment of that hazard based upon numerous factors. The pilot assigns a value to the potential impact of the hazard, which qualifies the pilot's assessment of the hazard – risk (Pilot's Handbook of Aeronautical Knowledge, 2008). Therefore, risk is an assessment of the distinct or cumulative hazard confronting the pilot; however, a group of pilots will perceive hazards differently (Pilot's Handbook of Aeronautical Knowledge, 2008). No two pilots see hazards in exactly the same way, making prediction and standardization of hazards a challenge (Risk Management Handbook, 2009). The ability to recognize a hazard is predicated upon personality, education and experience (Risk Management Handbook, 2009). Hence, elements or influences affecting individuals are diverse and profoundly impact decision-making. During every flight, the pilot makes numerous decisions under hazardous situations. To fly safely, the pilot needs to assess the degree of risk and determine the best options to mitigate risk.

For instance, a pilot deliberately flew a Beechcraft King Air into moderate to severe icing conditions (Pilot's Handbook of Aeronautical Knowledge, 2008). A sensible pilot would assess the risk as high and beyond the capabilities of the aircraft. Yet, the pilot made the opposite decision because of past experiences. The pilot had successfully flown into these settings repeatedly although the icing conditions were previously forecasted 2,000 feet above the surface and this time the conditions were from the surface (Pilot's Handbook of Aeronautical Knowledge, 2008). Since the pilot was in a rush and failed to factor in the differences, he assigned a low risk to the hazard and took a chance.

Unfortunately, the pilot and passengers all died from a poor risk assessment of the situation (Pilot's Handbook of Aeronautical Knowledge, 2008).

Assessing risk is not as simple as it sounds. For example, a fatigued pilot who has flown 16 hours is asked if they are too tired to continue flying, the answer may be no (Pilot's Handbook of Aeronautical Knowledge, 2008). Humans are very poor monitors of their own mental condition and level of fatigue (Risk Management Handbook, 2009). Most pilots are goal oriented when inquired to accept a flight, there is a tendency to deny personal limitations while adding weight to issues not germane to the mission (Pilot's Handbook of Aeronautical Knowledge, 2008).

NTSB reports and other accident research can help a pilot learn to access risk more effectively. For example, the accident rate during night visual flight rules decreases by nearly 50 percent once a pilot obtains 100 hours and continues to decrease until the 1,000 hour level (Hunter, 2002). The data suggest that for the first 500 hours, pilots flying visual flight rules at night might want to establish higher personal limitations than are required by the regulations (Pilot's Handbook of Aeronautical Knowledge, 2008).

Several risk assessment models are available to assist in the method of assessing risk. These models all take altered approaches to seek a collective goal. The most basic tool is the risk matrix which helps the pilot differentiate between low risk and high risk flights (Risk Management Handbook, 2009). It assesses two items: the likelihood of an event occurring and the consequence of that event (Pilot's Handbook of Aeronautical Knowledge, 2008). This risk matrix can be used for almost any operation by first assigning a likelihood and then matching the severity to get a consequence. For example, the pilot assigned a likelihood of occasional and the severity as catastrophic and the results fall into the high risk area (Pilots Handbook of Aeronautical Knowledge, 2008). Likelihood is nothing more than taking a situation and determining the probability of it occurring. The following guidelines as displayed in table 2 are the assignments to the likelihood of an event occurring.

Table 2. Likelihood of an Event Occurring.

Likelihood of an Event Occurring	
Probable	An event will occur several times
Occasional	An event will probably occur sometime
Remote	An event is unlikely to occur, but is possible
Improbable	An event is highly unlikely to occur

(Pilot's Handbook of Aeronautical Knowledge, 2008).

The next element is the severity or magnitude of a pilot's actions. It can relate to injury or damage. The following are guidelines displayed in table 3, represent the severity of an event.

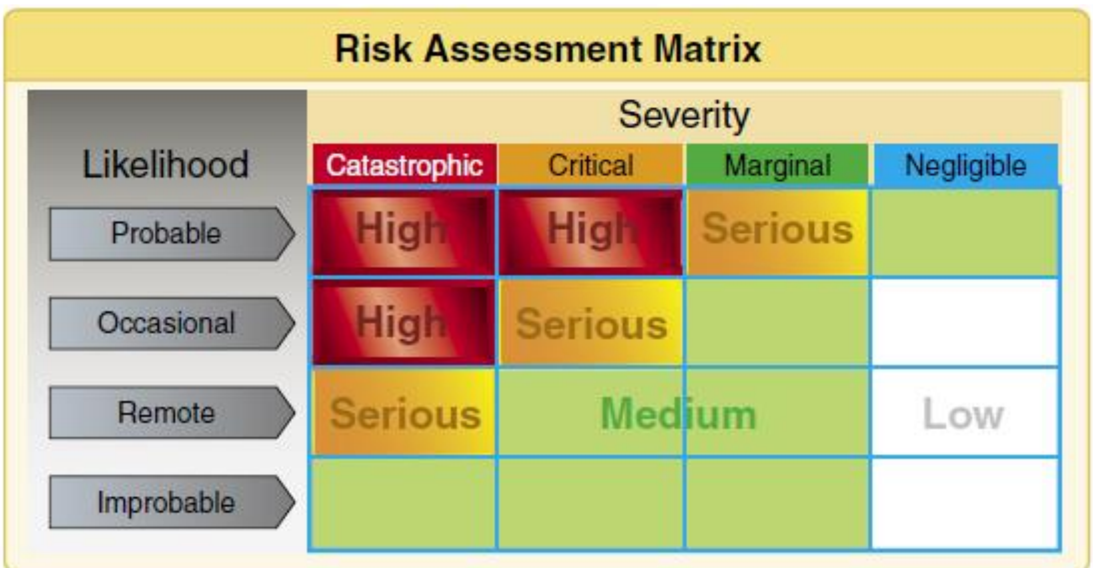
Table 3. Severity of an Event.

Severity of an Event	
Catastrophic	Results in fatalities, total loss
Critical	Severe injury, major damage
Marginal	Minor injury, minor damage
Negligible	Less than minor injury, less than minor system damage

(Pilot's Handbook of Aeronautical Knowledge, 2008).

For instance, a pilot is going to conduct a cross-country flight in marginal visual flight rules (MVFR) conditions without an instrument rating. The first question the pilot needs to ask, is what is the likelihood of encountering potential instrument meteorological (IFR) conditions? The experience of the pilot coupled with the forecast, might cause the pilot to assign the likelihood of occasional as to the probability of encountering IMC. The next step is to assign the event a severity. Since the pilot is not instrument rated, the consequences are catastrophic. By simply connecting the two factors in the Risk Assessment Matrix, as seen in Figure 3, indicates the risk is high. The pilot should either chose to cancel the flight or find ways to mitigate the risk.

Figure 3. Risk Assessment Matrix



(Pilot's Handbook of Aeronautical Knowledge, 2008).

Flight Risk Assessment Tool

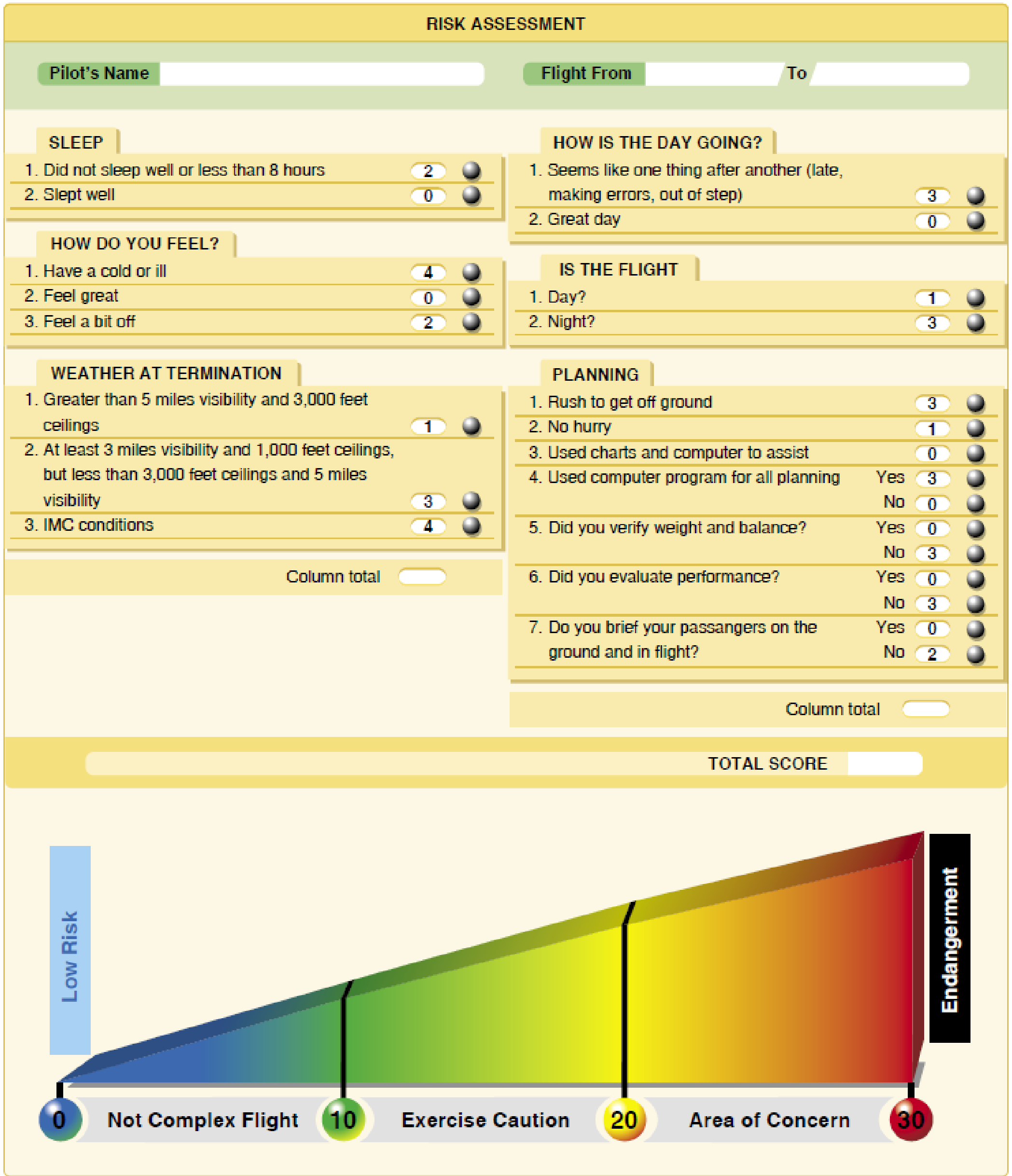
The purpose of a flight risk assessment tool (FRAT) is to take a proactive identification of possible hazards and help mitigate risks as aspects of SMS (Flight Risk Assessment Tool, 2007). In creating this tool, the Turbine Aircraft Operations Subgroup reviewed accident data, identified hazards and used normal risk assessment development methodology (Flight Risk Assessment Tool, 2007). The particular tool provides ways for operators to determine which flights have more risk and allow administration to intervene and reduce the threats when possible (Flight Risk Assessment Tool, 2007). FRAT delivers a simple way to implement preemptive risk management. An operator can use the risk assessment tool as a standalone instrument, but incorporating it into an SMS is preferable (Flight Risk Assessment Tool, 2007). The FRAT cannot guarantee a safe flight; safety is ultimately the responsibility of the pilot (Antunes, Cooke, & Jackson, 2012). However, it does supply an additional tool to assist the pilot in making a safe decision.

Every flight has hazards and some level of risk associated with it. It is critical that operators and pilots are able to differentiate, in advance, between a low risk flight and a high risk flight (Flight Risk Assessment Tool, 2007). A review process needs to be established to develop risk mitigation strategies for that particular flight (Flight Risk Assessment Tool, 2007). Once the FRAT is tailored to the specific flight department and an operator has established the parameter of the tool, operational thresholds need to establish a "risk number" before each flight (Antunes, et al., 2012). Each operator should determine an acceptable level of risk for its flights based on the type of operation, environment, aircraft used, crew training and overall operating experience (Flight Risk

Assessment Tool, 2007). When the risk for a flight exceeds the acceptable level, the hazards associated with that risk should be further evaluated and the risk reduced (Flight Risk Assessment Tool, 2007). A higher risk flight should not be operated if the hazards cannot be mitigated to an acceptable level (Flight Risk Assessment Tool, 2007). Each operator may want to add or change items that are unique to its operation (Flight Risk Assessment Tool, 2007).

The first section of the FRAT form is based on operational planning and task analysis performed by a dispatcher. Such items include: the duty day and rest of the crew, total flight time and segments and airport hazard designation (Antunes, et al., 2012). The second part is details on the operating environment filled out by the flight crew (Antunes, et al., 2012). These areas contain: airport data, terrain, weather and miscellaneous factors (Antunes, et al., 2012). The final components are information relating to the equipment, which is filled out by the maintenance department (Antunes, et al., 2012). Each section must have an established parameter and threshold with a point value assigned to every flight segment. Then a matrix is used to determine the overall risk assessment as shown in Figure 4.

Figure 4. Comprehensive Risk Assessment Form.


RISK ASSESSMENT

Pilot's Name ____ Flight From ____ To ____

SLEEP

1. Did not sleep well or less than 8 hours		2
2. Slept well		0

HOW DO YOU FEEL?

1. Have a cold or ill		4
2. Feel great		0
3. Feel a bit off		2

WEATHER AT TERMINATION

1. Greater than 5 miles visibility and 3,000 feet ceilings		1
2. At least 3 miles visibility and 1,000 feet ceilings, but less than 3,000 feet ceilings and 5 miles visibility		3
3. IMC conditions		4

Column total ____

HOW IS THE DAY GOING?

1. Seems like one thing after another (late, making errors, out of step)		3
2. Great day		0

IS THE FLIGHT

1. Day?		1
2. Night?		3

PLANNING

1. Rush to get off ground		3
2. No hurry		1
3. Used charts and computer to assist		0
4. Used computer program for all planning	Yes	3
	No	0
5. Did you verify weight and balance?	Yes	0
	No	3
6. Did you evaluate performance?	Yes	0
	No	3
7. Do you brief your passangers on the ground and in flight?	Yes	0
	No	2

Column total ____

TOTAL SCORE ____

Low Risk
Endangerment
0 Not Complex Flight 10 Exercise Caution 20 Area of Concern 30

(Pilot's Handbook of Aeronautical Knowledge, 2008).

Risk Perception

There are three main theories which attempt to explain behavior in the presence of risk. Risk homeostasis, as proposed by Wilde (1994) maintains that people in any given activity have a target level of acceptable risk. People do not attempt to minimize risk, rather they seek to maintain an equilibrium by adjusting their behavior to maintain their target level (Wilde, 1994). People compare the amount of risk they perceive with their target level of risk and will adjust their behavior in an attempt to eliminate any discrepancies between the two (Wilde, 1998).

According to the zero risk theory, the perceived risk in a situation is the product of the perceived likelihood of a hazardous event and importance attached by the individual to the consequences of the event (Ranney, 1994). Meaning, as self-confidence increases (largely as a function of increasing experience in the situation), perceived risk diminishes to the point of zero perceived risk (Ranney, 1994). An example of this theory, "to prevent drivers to be motivated towards higher speeds and thus to adapt to greater risk in the traffic system so speed limits are therefore a necessary condition of effective traffic safety work" (Summala, 1988).

The third main theory is called the threat avoidance model. This concept suggests that drivers learn to anticipate hazardous events and avoid them, so that negative consequences do not occur (Fuller, 1988). Thus, the driver rarely experiences any perceived risk of a crash since those situations are evaded (Fuller, 1988).

In 1990, O'Hare developed an Aeronautical Risk Judgment Questionnaire to assess pilots' perceptions of the risks and hazards of general aviation. Hazard awareness was assessed by having pilots estimate the percentage of accidents attributable to six broad categories (Hunter, 2002). Then ranking the phases of flight by hazard level and also ranking the causes of fatal accidents (Hunter, 2002). O'Hare found that pilots significantly underestimated the risk of general aviation flying relative to other activities and similarly undervalued their likelihood of being involved in an accident (Hunter, 2002). Lester and Bombaci (1984) found that invulnerability was the preponderant response in a study of hazardous attitudes among pilots. Out of five alternative explanations for why they might engage in a risky aviation scenario, 43% of the pilots chose the response associated with arrogance of invulnerability, possibly indicating that they felt no risk from the situation (Lester & Bombaci, 1984).

Risk perception and risk tolerance are associated and often confounded constructs. DeJoy (1992) notes that the various risk perception formulations based on driver research advocate that "risk taking behavior is mediated by the level of perceived risk in the outcome, suggesting that low levels of perceived risk would be associated with riskier driving" (p. 237). From his research of gender differences in risk perception by drivers, he concludes, "The problem is not that young males do not consider driving to be a dangerous activity…The problem is that this danger is not perceived as applying to them personally" (p. 246). He recommends that interventions should be established that personalize the risk to the driver, as opposed to making the risk an abstract statistical notion.

In the Accident Analysis and Prevention Journal, a study examined risk taking behavior among young drivers, Jonah (1986) alleged that "risk-taking does not necessarily imply volition. Risks can be taken while driving with or without awareness of what one is doing" (p. 258). He concludes that, "The weight of the empirical evidence tends to support the view that young may take risks more often because they are less likely to recognize risky situations when they develop" (p. 265).

Risk perception is the recognition of the risk inherent in a situation (Hunter, 2002). Risk perception may be mediated mutually by the characteristics of the situation and the characteristics of the viewer. Situations which present a high level of risk for one person may present only low risk for another (Hunter, 2002). For example, the existence of clouds and low visibility may present a very high risk for a pilot only qualified to fly under visual meteorological conditions, but the identical conditions would present a slight risk for an experienced pilot qualified to fly in instrument meteorological conditions.

Risk tolerance may be defined as the amount of risk that an individual is prepared to accept in the pursuit of some goal (Hunter, 2002). Risk tolerance may be mediated both by the general tendency to risk aversion of the person and the personal value attached to the objective of a particular situation (Hunter, 2002). In one survey, pilots indicated that they would take more risks in order to return home for the Holiday's than they would for flying medicine to a remote village (Driskill, Weissmuller, Quebe, Hand, & Hunter, 1998).

In the 2002 study of Risk Perception and Risk Tolerance in Aircraft Pilots by Hunter, original measures were established to gauge pilot risk perception and risk tolerance. The data concluded for weather, pilot perception of risk was negatively related to tolerance for risk (Hunter, 2002). These discoveries were important because it means that pilots who do not perceive the risks associated with adverse weather are expected to engage in higher risk activities when encountering weather (Hunter, 2002). The measures of risk tolerance were only somewhat related to the measures of risk perception. This suggests that these are reasonably distinct concepts. None of the measures of risk tolerance were related to hazardous activities (Hunter, 2002). However, risk perception measures remained linked to hazardous actions (Hunter, 2002). Pilots with a low perception of risk tended to be involved in more hazardous events and further tolerant of risks (Hunter, 2002).

Examining the NTSB reports and other accident related research can help a pilot learn to assess risk more effectively. Historically, the term “pilot error” has been used to describe an accident in which an action or decision made by the pilot was the cause or a contributing factor that led to the accident (Pilots Handbook of Aeronautical Knowledge, 2008). This definition also includes the pilot’s failure to make the correct decision or take the proper action (Pilots Handbook of Aeronautical Knowledge, 2008). A single decision or event does not lead to an accident, but a series of events and subsequent decisions together form a chain of events leading to an outcome (Pilots Handbook of Aeronautical Knowledge, 2008). For example, an NTSB investigation found the probable cause of fatal landing accident on a medical evacuation flight as a lack of adherence to effective risk management procedures and the pilot’s inadequate assessment of the weather (National Transportation Safety Board, 2009).

CHAPTER II

METHODOLOGY

Introduction

With the ongoing pressures for aviation schools to develop an SMS program, the lack of an SMS-type risk assessment at UND for each cross-country flight leaves a gap in the safety net that would otherwise be created by this type of preflight assessment. Because the existing risk assessment used by UND was not in an SMS format, a new form had to be developed. Also, the old dual cross-country form was never evaluated on the effectiveness of predetermining the upcoming risk of the flight. The research study comprised of a sample of collegiate aviation flight students and flight instructors at UND Aerospace. In order to answer the research questions, an anonymous survey was used to collect the data. The survey incorporated a mixed methods approach to gather information. Participants responded to questions on the survey instrument using a five point Lickert scale of strongly disagree, disagree, neither disagree nor agree, agree, strongly agree (Creswell, 2009). There was also an allotted space for respondents to include any additional comments or feedback. The results compared pilot perception of the old Preflight Risk Assessment for Dual Cross-Country flights against a revised SMS format. Pilot demographic, experience, and perception of risk were variables within this study.

Setting

This research study was conducted at the University of North Dakota within the Department of Aviation. The four-year Bachelor of Science in Aeronautics program offers a major in Commercial Aviation, along with other majors related to aviation. The John D. Odegard School of Aerospace Sciences is a certified 14 CFR Part 141 flight school located in Grand Forks, North Dakota.

Participants

The study analyzed the survey data of approximately 50 students and 70 flight instructors. The participants of this study were students enrolled in a flight course offered at the John D. Odegard School of Aerospace Sciences. The student sample included several ground school courses ranging from student pilots to commercial pilots, as seen in the table 4. The study targeted these flight courses because they have multiple cross-country flights within each course. The students were all actively conducting flight training in the respective courses. All of the certified flight instructors that participated in the study are employees of UND Aerospace.

Table 4. Flight Courses Used in the Study.

Course Number	Course Title
102	Private Pilot
221	Basic Attitude Instrument Flying
222	IFR Regulations and Procedures
323	Commercial Single-engine
325	Commercial Multi-engine
480	Advanced Airline Operations
710	King Air

Study Design

A mixed method design was utilized in this study. A quantitative methodology was utilized to interpret the statistics from the survey. Qualitative data was gathered by the participants providing additional comments and feedback at the end of the survey. Subjects were recruited for this study through an email message. In compliance with the Institutional Review Board of the University of North Dakota, study advertisements were made via mass email distributed to students of the UND's aviation department and flight instructors employed by UND. The email (Appendix A) contained a general description of the study and a hyperlink directing them to a website where the survey could be accessed. A reminder email containing the same content as the original email was sent to the same individuals. The survey was administered through an online survey tool called Qualtrics. An online survey tool was utilized because it would allow flexibility for the participants to take the survey anonymously at a time and place at their convenience. It also helps to ensure privacy, confidentiality, accuracy and expedited analysis. The survey was available for two weeks to allow ample time for the participants' to respond. The data was collected and stored on a secure server of the University. A full listing of the survey questions are available in Appendix B.

Data Collection

The goal of this study was to use a mixed method research approach. Both quantitative and qualitative data obtained from a survey to assess pilot perception of risk assessment on dual cross-country flights conducted in a collegiate aviation program.

Before any data collection could begin, the new SMS compliant Pre-flight Risk Assessment Tool for Dual Cross-country flights had to be developed. To create the new assessment, a series of meetings were held with subject matter experts employed by UND met to discuss the criteria and format. The assessment form was altered so that it would more accurately assess the risk that might occur on a given cross-country flight. Multiple revisions were produced during the review process. The updated form was approved by the UND Safety Council for implementation for the spring 2014 semester.

The changes were made to the form so that it would follow the Risk Acceptance guidelines provided by the UND SMS Manual (UND Aerospace, 2013). The form is designed to provide an accurate assessment of the risk that will be encountered on the pending flight. While the risk assessment does not consider every potential category of risk, the important categories, as determined by the subject matter experts, are included on the form. The UND Safety Policies and Procedures (UND Aerospace, 2013) were utilized to set the specific limitations to each category.

The new form includes specific categories that were agreed upon to be paramount in assessing the risk before conducting a cross-country training flight. Rather than compiling an overall risk score, the new form focuses on individual categories of risk. If any single category exceeds a specified threshold of unacceptable risk, the flight must be postponed until the level of risk is reduced. If a category includes an elevated level of risk, then the flight crew must consider mitigation techniques before conducting the flight. Guidance on mitigation techniques, including suggested methods, are included in the UND SMS Manual (2013). Flight crews are reminded that "risk management is a continual process and does not stop after completing this form" stated by text located on the form itself (UND Aerospace, 2013). Before completing the form, the flight crew must circle the assessed level of risk as Acceptable, Acceptable with Mitigation, or Unacceptable. Lastly, the student and flight instructor will initial the form to certify that all the entries are true and correct.

More detailed instructions on how to properly complete the assessment were added for students and flight instructors. An additional yes or no question was added for both the student and flight instructor to answer if there is any reason why they should not fly today. This question was added to get them to start thinking of the overall safety of the flight and to evaluate their personal situations. Figure 5 shows the completed SMS form.

Figure 5. SMS Preflight Risk Assessment for Dual Cross-Country Flights.

Preflight Risk Assessment for Dual Cross-Country

Before each flight, assess each of the following conditions and write down the corresponding value. Both current and forecast conditions should be considered for each category. Compare your values to the values in the provided risk table to determine the acceptability of risk.

Is there any reason why you should not fly today? Student: YES / NO Flight Instructor: YES / NO

	Value	ACCEPTABLE RISK	ACCEPTABLE RISK WITH MITIGATION	UNACCEPTABLE RISK
Total duration of today's flight	_____ hours	< 4 hours	4 - 8 hours	> 8 hours
Lowest braking action report	_____	Good	Fair or poor	Nil
Student: Sleep in the last 24 hours	_____ hours	> 6 hours	5 - 6 hours	< 5 hours
Student: Time since last meal	_____ hours	< 6 hours	6 - 12 hours	> 12 hours
Student: Duty day at the end of today's flight	_____ hours	< 8 hours	8 - 16 hours	> 16 hours
Student: Total time in aircraft type last 90 days	_____ hours	> 15 hours	< 15 hours	
CFI: Sleep in the last 24 hours	_____ hours	> 6 hours	5 - 6 hours	< 5 hours
CFI: Time since last meal	_____ hours	< 6 hours	6 - 12 hours	> 12 hours
CFI: Duty day at the end of today's flight	_____ hours	< 8 hours	8 - 16 hours	> 16 hours
CFI: Total time in aircraft type last 90 days	_____ hours	> 15 hours	< 15 hours	
<u>VFR Flights Only:</u>				
Lowest forecast visibility (day)	_____ sm	> 6 sm	1 - 6 sm	< 1 sm
Lowest forecast visibility (night)	_____ sm	> 8 sm	5 - 8 sm	< 5 sm
Lowest forecast ceiling (day)	_____ feet	> 3,000 feet	500 - 3,000 feet	< 500 feet
Lowest forecast ceiling (night)	_____ feet	> 5,000 feet	1,500 - 5,000 feet	< 1,500 feet
<u>IFR Flights Only:</u>				
Lowest forecast visibility (day)	_____ sm	> 4 sm	1/2 - 4 sm	< 1/2 sm
Lowest forecast visibility (night)	_____ sm	> 4 sm	1 - 4 sm	< 1 sm
Lowest forecast ceiling (day)	_____ feet	> 600 feet	200 - 600 feet	< 200 feet
Lowest forecast ceiling (night)	_____ feet	> 600 feet	400 - 600 feet	< 400 feet
<u>Cessna 172 (C172) Flights Only:</u>				
Highest forecast crosswind	_____ knots	< 13 knots	13 - 20 knots	> 20 knots
Highest forecast total wind	_____ knots	< 17 knots	17 - 25 knots	> 25 knots
<u>Seminole (SEMI) and Arrow (ARRO) flights only:</u>				
Highest forecast crosswind	_____ knots	< 16 knots	16 - 25 knots	> 25 knots
Highest forecast total wind	_____ knots	< 21 knots	21 - 30 knots	> 30 knots

The entries on this risk assessment are true and correct. This flight can be safely accomplished as risks have been properly identified and effectively mitigated to the lowest practical level. Risk management is a continual process and does not stop after completing this form. Reference the UND SMS Manual for additional guidance.

This flight's risk is assessed as: (circle one) **ACCEPTABLE** **ACCEPTABLE WITH MITIGATION** **UNACCEPTABLE**

Flight Instructor initials: ______________ Student Initials: ______________

SMS Dual XC Request White 11/13

(UND SMS, 2013)

The survey consisted of four sections. In compliance with IRB procedures, the first section was the informed consent form. Each participant consented to the study by submitting the survey to the author of the study. The second section of the survey consisted of demographic information. The demographic questions entailed questions of age, gender, current flight course, pilot and/or flight instructor certificates held, total flight hours, total cross-country flight hours and elective safety classes that students or flight instructors may have taken at UND. The third section involved pilot perceptions of risk assessment prior, during or after the cross-country flight was conducted. The fourth section of the survey comprised of quantitative questions based on the current dual cross-country form versus the new SMS format. The last question of the survey allowed the applicants to provide their own feedback or comments. Participant responses were saved at the completion of the survey to the Qualtrics server. Upon conclusion of the surveying period, the results were downloaded onto a secure computer. Some of the submitted responses from the survey were excluded from the total responses during analysis by the Statistical Package for the Social Sciences (SPSS) software due to missing data. These comprised of the responses from participants who failed to answer any question beyond the consent page or did not answer any of the survey questions for that section.

Instrument Reliability and Validity

Subject matter experts reviewed and revised the survey and the new SMS Preflight Risk Assessment for Dual Cross-Country form used throughout this study to ensure precision and a lack of both bias and uncertainty. The validity of the study was accurate and the results could be duplicated.

Data Analysis

The study used IBM SPSS Statistics Version 24 software for computations and for identifying significance to the .05 alpha-level. Relationships among multiple variables allowed for thorough, in-depth analysis. These are the questions that the data and analysis will seek to answer:

1. Is there a difference of pilot perception placed on risk assessment during a cross-country flight based on pilot background characteristics?
2. Is there a difference of pilot perception on the old Preflight Risk Assessment for Dual Cross-Country flight versus the new SMS format?
3. Is there a difference of pilot perception on the new SMS Preflight Risk Assessment form based on background characteristics?

Protection of Human Subjects

Participants agreed via consent form to complete the voluntary survey and received no compensation or consequences based on their responses. All data was collected anonymously. The author notified and received permission from UND Flight Operations and faculty to conduct the study. The Institutional Review Board at UND also reviewed and approved the research project.

CHAPTER III

RESULTS AND DATA ANALYSIS

Data Analysis

The study utilized data from an online survey. The survey was comprised with quantitative and qualitative data. The quantitative data was imported into the SPSS software and analyzed. All the additional comments and responses were coded manually by the researcher for themes. Significant values were set at the 0.05 alpha levels (2-tailed). A Five (5) point Likert Scale gave respondents the choice to select their response as either strongly disagree (1), disagree (2), neither agree nor disagree (3), agree (4) and strongly agree (5). Values (1, 2, 3, 4 and 5) were assigned to answers. The scale reflected, that higher measurement values, represented higher emphasis being placed on risk assessment.

Demographics of the Participants

The survey compared the pilot perception on the emphasis placed on risk assessment of the older edition of the Preflight Risk Assessment for Dual Cross-Country flight request form to the newer SMS format of the form. At the end of the response period, (N= 133) responses were obtained from the survey and included (N= 116) completed survey responses representing an 87.2% return rate. There was some missing data in the responses that could not be used for analysis due to the fact that the respondents decided not to answer those questions so that information was excluded. The SPSS software was used to sort out the data with the omitted components.

Gender

Survey results indicated out of the (n= 116) valid responses, 109 respondents (94%) were male, 6 respondents (5.2%) were female and 1 individual (0.9%) preferred not to respond. With such a small percentage of the contributors being female, the data for gender was not utilized. Table 5 shows the responses.

Table 5. Gender Distribution of Respondents.

Gender	N	%
Male	109	94.0
Female	6	5.2
Missing	1	0.9
Total	116	100

Age

The survey requested for the participants to respond to what year they were born. The year born was then changed into an age. The mean age of the (n= 113) participants was 24.5 years old. The standard deviation of age was 3.48. The minimum age of a participant was 21 and the oldest participant was 38 years old. Table 6 below shows the results.

Table 6. Age of Respondents.

	N	Mean	SD
Age	113	24.58	3.49

Flight Hours

The survey asked the participants to write out their approximate total flight hours and their total cross-country flight hours. The mean total flight time of the (n= 116) participants was 752.44 hours with a standard deviation of 964.05 hours. The minimum amount of total flight times was 60 hours and the maximum was 4,900 total time. The mean of the (n= 115) participants was 237.14 total cross-country flight hours with a standard deviation of 479.41 hours. The minimum amount of total cross-country flight time was 7 hours and the maximum was 3,500 hours. Table 7 below indicates the findings.

Table 7. Flight Hours of Respondents.

	N	Mean	SD
Total Flight Hours	116	752.44	964.05
Total Cross-Country Flight Hours	115	237.14	479.41

Role

The survey requested the participants to answer which of the following best describes your role during flight training and they could either chose a student or a flight instructor. A total of (n= 116) responded to what role they held when conducting the cross-country flight, of which, 48 were flight students (41.4%) and 68 were flight instructors (58.6%). Table 8 shows the responses.

Table 8. Role of Respondent.

Role	N	%
Student	48	41.4
Flight Instructor	68	58.6
Total	116	100

The survey queried three questions on the role of either being a flight student or flight instructor and if a different emphasis is placed on risk assessment when conducting a cross-country flight. The flight instructor (n= 68) placed more importance on risk assessment prior to the flight with a 4.54 mean and a standard deviation of 0.58 than the flight students (n= 48) with a mean of 4.02 and a standard deviation of 1.45. The flight instructor (n= 68) also indicated a higher emphasis on risk assessment with a 4.13 mean and a standard deviation of 0.77 compared to the student (n= 46) with a 4.00 mean and a standard deviation of 1.39 during the flight. However, the student (n= 46) displayed more emphasis on risk assessment after the flight with a 3.30 mean and a standard deviation of 1.19 and the flight instructor had a 3.17 mean and a standard deviation of 0.93. Table 9 depicts the results.

Table 9. Group Statistics Based on Role of Risk Assessment.

	N	Mean	SD
Before the Flight			
Student	48	4.02	1.45
CFI	68	4.54	0.58
During the Flight			
Student	46	4.00	1.39
CFI	68	4.13	0.77
After the Flight			
Student	46	3.30	1.19
CFI	68	3.17	0.93

The survey asked how an applicant would apply risk mitigation strategies when conducting a cross-country flight based on their role. The flight instructor (n= 68) applied more risk mitigation strategies with a mean of 4.43 and a standard deviation of 0.65 before conducting a cross-country flight than the student (n= 47) with a mean of 4.00 and standard deviation of 1.41. The flight instructor (n= 68) also used more risk mitigation strategies during a cross-country flight with a 4.24 mean and a standard deviation of 0.83 than the student (n= 44) at a 3.82 mean and a standard deviation of 1.35. Table 10 shows the findings.

Table 10. Group Statistics Based on Role of Risk Mitigation Strategies.

	N	Mean	SD
Before the Flight			
Student	47	4.00	1.41
CFI	68	4.43	0.65
During the Flight			
Student	44	3.82	1.35
CFI	68	4.24	0.83

Flight Course

One of the survey questions requested the applicant to select the flight course at UND that they were enrolled in. Of the 48 flight students, they were enrolled in a variety of flight courses. The 68 missing data entries on the flight courses were from the flight instructors. One student (0.9%) was enrolled in Private Pilot flight course 102. Of the participants, 21 students (18.1%) were registered in the 221 flight course called the Basic Attitude Instrument flight course. Only 2 flight students (4.2%) were enrolled in the 222 Instrument course. A total of 3 students (2.6%), were sign up in the Commercial Single-engine flight course. The Commercial Multi-engine 325 flight course had 15 participants (12.9%). One student (0.9%) was enrolled in the Advanced Aircraft Operations 480 course. The 710 King Air flight course had 5 students (4.3%). Table 11 shows what flight courses the students were enrolled in when they took the survey.

Table 11. Flight Course of Respondent.

Flight Course	N	%
102	1	0.9
221	21	18.1
222	2	4.2
323	3	2.6
325	15	12.9
480	1	0.9
710	5	4.3
Missing	68	58.6
Total	116	100

Pilot Certificate

The survey request the participants to select all of the pilot and flight instructor certificates that they held. The results were then group into either student pilot, private pilot and a combination of commercial and ATP. The flight instructor certificates were not analyzed during this study. Of the (n= 116) of the respondents, 1 held a student pilot certificate (0.9%), 38 held a private pilot certificate (32.8%) and 77 held either a commercial or airline transport pilot (ATP) certificate (66.4%). Table 12 shows the results.

Table 12. Pilot Certificate of Respondent.

Pilot Certificate	N	%
Student	1	0.9
Private	38	32.8
Commercial/ATP	77	66.4
Total	116	100

The survey asked the applicant to answer how strongly they agree or disagree with the statement, "I place an emphasis on risk assessment when conducting a cross-country flight." A five point Likert scale was used with one being strongly disagree to five being strongly agree. The respondents then selected the value for an emphasis placed on risk assessment before, during and after the flight. The participants with a private pilot certificate (n= 38) had a similar emphasis being placed on risk assessment before the cross-country flight with a mean of 4.34 and a standard deviation of 1.12 as a commercial and airline transport pilot (n= 77) with a mean of 4.32 and a standard deviation of 1.04. The private pilots (n= 37) had a slightly higher emphasis on risk assessment during the flight with a mean of 4.35 and a standard deviation of 1.09 on risk assessment compared to the commercial and ATP pilots (n= 76) at a mean of 3.95 and a standard deviation of 1.04. The private pilots (n= 37) also placed a higher importance 3.59 mean with a standard deviation of 1.01 on the risk assessment after the flight compared to the commercial and ATP (n= 76) at a 3.05 mean and a standard deviation of 1.02. Table 13 indicates the outcomes.

Table 13. Group Statistics Based on Pilot Certificate of Risk Assessment.

	N	Mean	SD
Before the Flight			
Private	38	4.34	1.12
Commercial/ATP	77	4.32	1.04
During the Flight			
Private	37	4.35	1.09
Commercial/ATP	76	3.95	1.04
After the Flight			
Private	37	3.59	1.01
Commercial/ATP	76	3.05	1.02

The survey used the same five point Likert scale to see how the applicants would rate to the question, "I apply risk mitigation strategies when conducting a cross-country flight." The participants answered this statement with a value for before and after the cross-country flight. The risk mitigation strategies when conducting a cross-country flight for both before the flight and during the flight had a very similar means based on pilot certificate. The mitigation strategies utilized by private pilots (n= 37) had a 4.27 mean with a standard deviation of 1.12 and the commercial and ATP pilots (n= 77) had a 4.25 mean and a 1.03 standard deviation. The mitigation plans used during the flight by private pilots (n= 35) had a mean of 4.17 and a standard deviation of 1.04 and the commercial and ATP pilots (n= 76) had a mean of 4.03 and a standard deviation of 1.11. Table 14 indicates the results.

Table 14. Group Statistics Based on Pilot Certificate of Risk Mitigation.

	N	Mean	SD
Before the Flight			
Private	37	4.27	1.12
Commercial/ATP	77	4.25	1.03
During the Flight			
Private	35	4.17	1.04
Commercial/ATP	76	4.03	1.11

Advanced Safety Class

The survey had a list of all the elective safety classed offered at UND and asked if the participants had taken any one of them. Out of the (n= 116) respondents, 25 participants (21.6%) had taken an advanced safety class and 80 participants (69%) had not taken a safety elective. 11 respondents (9.5%) elected not to respond to the question. Table 15 indicates the results.

Table 15. Attendance of Advanced Safety Classes.

Taken Advanced Safety Class	N	%
Yes	25	21.6
No	80	69.0
Missing	11	9.5
Total	116	100

The survey asked a series of questions about the attendance of an advanced safety course compared to the risk assessment on the Preflight Risk Assessment for Dual Cross-Country flights. The statement used a 5 point Likert scale asking the participant to rate how strongly they agreed or disagreed with the emphasis they placed on risk assessment before, during and after a cross-country flight. The participants who have taken an elective safety class (n= 25) had a mean of 4.48 of placing an emphasis on risk assessment prior to the flight with a standard deviation of 0.51. The participants who have not taken an advance safety class (n= 80) had an average of 4.39 score of placing an emphasis on risk assessment before the flight with a standard deviation of 0.97. The respondents who had taken an advanced safety class (n= 25) placed a slightly higher emphasis on risk assessment during the flight with a 4.28 mean compared to the respondents who did not take the class (n= 80) with a mean of 4.10. The participants who took the elective safety course (n= 25) had a 3.52 mean for placing emphasis on risk assessment after the flight and the participants who have not taken the extra safety class (n= 80) had a 3.15 mean with the highest standard deviation of 1.01. Table 16 indicates the results.

Table 16. Group Statistics Based on Advanced Safety Class of Risk Assessment.

	N	Mean	SD
Before the Flight			
Yes	25	4.48	.51
No	80	4.39	.97
During the Flight			
Yes	25	4.28	.74
No	80	4.10	.99
After the Flight			
Yes	25	3.52	.82
No	80	3.15	1.01

The responses given for applying risk mitigation strategies before and during a cross-country flight were slightly higher if the participant had attended an advanced safety class. If the participant had taken an additional safety course (n= 25), the mean for applying risk mitigation prior to the flight was 4.48 and during the flight the mean was 4.20. If the participant had not taken the elective safety class (n= 79), the mean for applying risk mitigation was 4.27 before the flight and 4.13 mean during the flight. Table 17 shows the results.

Table 17. Group Statistics Based on Advanced Safety Class of Risk Mitigation.

	N	Mean	SD
Before the Flight			
Yes	25	4.48	.51
No	79	4.27	.99
During the Flight			
Yes	25	4.20	.87
No	79	4.13	.98

Used Old Format of Preflight Risk Assessment for Dual Cross-Country

The survey displayed a picture of the older version of the Dual Cross-Country Preflight Risk Assessment form and asked the participants if they have ever fill it out. Out of the (n= 116) respondents, 115 participants (99.1%) had used the old version of the Preflight Risk Assessment for Dual Cross-Country flights at UND Aerospace. Only one respondent (0.9%) had not used the old style of the form so the entire survey was completed at that time for them. Table 18 indicates the results.

Table 18. Used Old Format of Preflight Risk Assessment for Dual Cross-Country Form.

Used Old Form	N	%
Yes	115	99.1
No	1	0.9
Total	116	100

Out of the 115 participants that had utilized the old format of the Preflight Risk Assessment for Dual Cross-Country flights at UND, only (n=111) had answered the 3 related questions based on their experiences with it. The participants were asked on a Likert Scale of 1 (strongly disagree) to 5 (strongly agree) if they felt that the old cross-country risk assessment form accurately determines the level of risk prior to their flight. The participants (n= 111) responded with a 3.63 mean and a standard deviation of 1.04. The next question asked if the level of risk assessed by the old cross-country form is an accurate representation of the actual risks perceived during each flight. The respondents (n= 111) answered with a 3.36 mean and a standard deviation of 1.05. The last question asked if the time required to complete the old cross-country form is valuable to assess the risk of the flight. The participants (n= 111) responded with a 3.48 mean and a standard deviation of 1.09. Table 19 indicates the results.

Table 19. Analysis of the Old Format of the Preflight Risk Assessment Form.

	N	Mean	SD
Accurately Determines Level of Risk	111	3.63	1.04
Accurate Representation of Perceived Risks	111	3.36	1.05
Time is Worthwhile	111	3.48	1.09

Used New SMS Format of Preflight Risk Assessment for Dual Cross-Country

A picture of the new SMS Preflight Risk Assessment for Dual Cross-Country flights was displayed for the applicants to view. The participants were then asked if they have ever used this risk assessment form while conducting a cross-country flight lesson at UND. The (n= 116) participants, 106 contributors (91.4%) had used the new SMS format of the Preflight Risk Assessment for Dual Cross-Country flights. Six of the participants (5.2%) had not used the new SMS format and 4 participants (3.4%) did not answer the question and resulted in the survey ending for them. Table 20 shows the results.

Table 20. Used New SMS Format of Preflight Risk Assessment for Dual Cross-Country.

Used New SMS Form	N	%
Yes	106	91.4
No	6	5.2
Missing	4	3.4
Total	116	100

Out of the 106 participants that had utilized the new SMS format of the Preflight Risk Assessment for Dual Cross-Country flights at UND, only (n=105) had answered the 3 related questions based on their experiences with it. The participants were asked on a Likert Scale of 1 (strongly disagree) to 5 (strongly agree) if they felt that the new SMS cross-country risk assessment form accurately determines the level of risk prior to their flight. The participants (n= 105) responded with a 3.74 mean and a standard deviation of 1.08. The next question inquired if the level of risk assessed by the new SMS cross-country form is an accurate representation of the actual risks perceived during each flight. The respondents (n= 105) answered with a 3.58 mean and a standard deviation of 1.07. The last question requested if the time required to complete the new SMS cross-country form is valuable to assess the risk of the flight. The participants (n= 105) responded with a 3.70 mean and a standard deviation of 1.07. Table 21 indicates the results.

Table 21. Analysis of the New SMS Format of the Preflight Risk Assessment Form.

	N	Mean	SD
Accurately Determines Level of Risk	105	3.74	1.08
Accurate Representation of Perceived Risks	105	3.58	1.07
Time is Worthwhile	105	3.70	1.07

Very similar means were given on the following questions from the student and the flight instructors. Both the student (n= 43) and the flight instructor (n= 62) had a mean of 3.74 when they responded that the new SMS cross-country risk assessment form accurately determines the level of risk prior to their flight. The student (n= 43) and the flight instructor (n= 62) also had the same mean of 3.58 that the level of risk assessed by the new SMS form is an accurate representation of the actual risks perceived during each flight. The flight instructors (n= 62) had a slightly higher mean of 3.74 than the students (n= 42) mean of 3.63 on responding that the time required to complete the updated SMS cross-country form is valuable to assessing the hazards on the flight. Table 22 represents the results.

Table 22. Analysis of New SMS Preflight Risk Assessment Form Based on Role.

	N	Mean	SD
Accurately Determines Level of Risk			
Student	43	3.74	1.31
CFI	62	3.74	.904
Accurate Representation of Perceived Risks			
Student	43	3.58	1.35
CFI	62	3.58	.841
Time is Worthwhile			
Student	43	3.63	1.27
CFI	62	3.74	.922

The survey asked a series of questions between the new SMS Preflight Risk Assessment form and the pilot certificate of the participant. The private pilot (n= 34) had a mean of 4.03 and the commercial/ATP (n= 70) had a mean of 3.60 when they responded that the new SMS cross-country risk assessment form accurately determines the level of risk prior to their flight. The private pilot (n= 34) had a higher mean of 3.85 and the commercial/ATP (n= 70) had a mean of 3.46 that the level of risk assessed by the new SMS form is an accurate representation of the actual risks perceived during each flight. The private pilots (n= 34) had a slightly higher mean of 3.85 than the commercial and ATP (n= 70) mean of 3.61 on responding that the time required to complete the updated SMS cross-country form is valuable to assessing the hazards on the flight. Table 23 represents the results.

Table 23. Group Statistics of New SMS Form Based on Pilot Certificate.

	N	Mean	SD
Accurately Determines Level of Risk			
Private	34	4.03	.999
Commercial/ATP	70	3.60	1.11
Accurate Representation of Perceived Risks			
Private	34	3.85	1.10
Commercial/ATP	70	3.46	1.05
Time is Worthwhile			
Private	34	3.85	.958
Commercial/ATP	70	3.61	1.13

Research Results

Question One

Is there a difference of pilot perception placed on cross-country risk assessment based on pilot background characteristics? Since this research question assesses the relationship between numerous independent variables to a single dependent variable, the t-test was utilized as the primary statistical test. An independent-samples t-test was conducted to compare risk assessment to pilot demographics. The following were the independent variables: age, flight hours, role, pilot certificate and advanced safety class.

A Pearson correlation was computed to assess the relationship between the risk assessed on the cross-country forms to age and flight hours.

Age

A Pearson correlation coefficient was calculated to compare the relationship placed on the emphasis of risk assessment prior, during and after a cross-country flight to age. There was not a correlation between the risk assessment prior to the flight and age, $r = 0.068$, $n = 113$, $p = 0.472$. There was also not a correlation between the risk assessment placed during the flight and age, $r = -0.014$, $n = 111$, $p = 0.882$. There was no correlation between the emphasis placed on risk assessment and age, $r = 0.036$, $n = 111$, $p = 0.705$. The outcomes suggest there is no correlation between the emphases placed on risk assessment based on age. Table 24 indicates the results.

Table 24. Analysis of Risk Assessment Based on Age.

Age	N	r	Sig.
Before the Flight	113	0.068	0.472
During the Flight	111	-0.014	0.882
After the Flight	111	0.036	0.705

A Pearson correlation coefficient was computed to assess the relationship between the application of risk mitigation strategies and age. There was no correlation found when comparing risk mitigation strategies before a flight and age, $r = 0.019$, $n = 113$, $p = 0.838$. No correlations were found when comparing applying risk mitigation strategies to age during the cross-country, $r = 0.020$, $n = 110$, $p = 0.837$. Overall, there were no correlations between the application of risk mitigation strategies before or during the flight compared to age. Table 25 shows the results.

Table 25. Analysis of Risk Mitigation Based on Age.

Age	N	r	Sig.
Before the Flight	113	0.019	0.838
During the Flight	110	0.020	0.837

Flight Hours

A Pearson correlation coefficient was computed to assess the relationship between the emphasis placed on risk assessment and total flight hours. There were no correlations found when comparing risk assessment before a flight to total flight hours, r = 0.154, n = 116, p = 0.099. No correlations were determined between the emphasis placed on risk assessment during the flight to total flight hours, r = -0.005, n = 114, p = 0.957. Again, there were no correlation between the emphasis placed on risk assessment after the cross-country flight to the total amount of flight time, r = -0.030, n = 114, p = 0.748. Overall, there were no significant correlations between the emphases placed on risk assessment to the total amount of flight hours. Table 26 displays the results.

Table 26. Analysis of Risk Assessment Based on Total Flight Hours.

Total Flight Hours	N	r	Sig.
Before the Flight	116	0.154	0.099
During the Flight	114	-0.005	0.957
After the Flight	114	-0.030	0.748

A Pearson correlation coefficient was performed to measure the relationship between the application of risk mitigation strategies used prior and during a cross-country flight to the total amount of flight hours. No correlations were found when comparing risk mitigation strategies before a flight to a participants' total flight hours, r = 0.132, n = 115, p = 0.160. There were no correlations were determined between the application of risk mitigation techniques during the flight to the total flight time, r = 0.144, n = 112, p = 0.129. Inclusive, no correlations were determined between the application of risk mitigation strategies before or during a cross-country flight to the participants' total flight time. Table 27 displays the results.

Table 27. Analysis of Risk Mitigation Based on Total Flight Hours.

Total Flight Hours	N	r	Sig.
Before the Flight	115	0.132	0.16
During the Flight	112	0.144	0.129

A Pearson correlation coefficient was computed to assess the relationship between the emphasis placed before, during and after a flight compared to the participants' total amount of cross-country flight hours. There was no correlation between the emphasis placed on risk assessment before a flight and total cross-country flight time, r = 0.128, n = 115, p = 0.173. Also, no correlation was found between the risk assessment placed during a flight to the participant's total cross-country flight hours, r = .011, n = 113, p = 0.907. There were not any correlations between the risk assessment placed after a flight and total cross-country flight time of the applicant, r = -0.012, n = 113, p = 0.898. There were no correlations found between the emphasis placed on risk assessment before, during or after the flight compared to total cross-country flight hours. Table 28 shows the results.

Table 28. Analysis of Risk Assessment Based on Total Cross-Country Flight Hours.

Total Cross-Country Flight Hours	N	r	Sig.
Before the Flight	115	0.128	0.173
During the Flight	113	0.011	0.907
After the Flight	113	-0.012	0.898

A Pearson correlation coefficient was calculated to evaluate the relationship between the application of risk mitigation strategies used before and during a flight to the participants' total amount of cross-country flight hours. There was no correlation between the application of risk mitigation techniques prior to a flight and the applicants' total amount of cross-country flight time, r = 0.116, n = 114, p = 0.219. There were also no correlations between the application of risk mitigation during the flight compared to the respondents total cross-country hours, r = 0.113, n = 111, p = 0.236. No significant relationships were found when comparing risk mitigation techniques to total cross-country flight hours for either before or during the flight. Table 29 indicates the results.

Table 29. Analysis of Risk Mitigation Based on Total Cross-Country Flight Hours.

Total Cross-Country Flight Hours	N	r	Sig.
Before the Flight	114	0.116	0.219
During the Flight	111	0.113	0.236

Role

In order to compare scores between the student and flight instructor of how much emphasis was placed on risk assessment when conducting a cross-country prior, during and after the flight, an independent-samples t-test was conducted. The variances in the samples were assumed equal and the scores were independent. There was a significant difference indicated that the flight instructor (M= 4.54, SD= 0.58) placed more emphasis on risk assessment before the cross-country flight than the students (M= 4.02, SD= 1.45), conditions; $t(114) = -2.69$, $p = 0.008$. These results suggest that the flight instructor places a higher emphasis on risk assessment prior to the cross-country flight than the student. There was not a significant difference during the flight in the flight instructor (M= 4.13, SD= 0.77) and the student (M= 4.00, SD= 1.40), conditions; $t(112) = -.65$, $p = 0.518$. There was not a significant difference after the flight in the flight instructor (M= 3.18, SD= 0.93) and the student (M= 3.30, SD= 1.19), conditions; $t(112) = 0.64$, $p = 0.522$. These results were found to be statistically non-significant between the role during or after the flight. Table 30 indicates the results.

Table 30. Analysis of Risk Assessment Based on Role.

	t	df	Sig.
Before the Flight	-2.685	114	0.008
During the Flight	-0.649	112	0.518
After the Flight	0.643	112	0.522

The next self-assessment question asked each participant if they apply risk mitigation strategies before a cross-country flight or during the flight. An independent-samples t-test was conducted to compare the risk mitigation strategies before and after the flight to the role of the participant. The variances in the samples were assumed equal and the scores were independent. There was a significant difference in the mitigation strategies before the flight on the role of the flight instructor (M= 4.43, SD= 0.65) and the student (M= 4.00, SD= 1.41), conditions; $t(113) = -2.18$, $p = 0.032$. The test was found to be statistically significant in the mitigation strategies during the flight between the flight instructor (M= 4.24, SD= 0.83) and the student (M= 3.81, SD= 1.35), conditions; $t(110) = -2.02$, $p = 0.045$. These results suggest that the flight instructor places a higher emphasis on mitigation techniques both prior and during a cross-country flight than the student. Table 31 indicates the findings.

Table 31. Analysis of Risk Mitigation Based on Role.

	t	df	Sig.
Before the Flight	-2.176	113	0.032
During the Flight	-2.024	110	0.045

Pilot Certificate

In order to test the effect of the emphasis placed on risk assessment prior, during and after a cross-country flight compared to the pilot certificate held, an independent-samples t-test was accomplished. The variances in the samples were assumed equal and the scores were independent. The test was found to be statistically non-significant in the risk assessment scores before the flight for private (M= 4.34, SD= 1.12) and commercial and ATP pilots (M= 4.32, SD= 1.04) conditions; $t(113) = 0.08$, p = 0.935. The test did not reach statistical significance in the risk assessment scores during the flight for private (M= 4.35, SD= 1.09) and commercial and ATP pilots (M= 3.95, SD= 1.04) conditions; $t(111) = 1.91$, p = 0.059. There was a significant difference in the risk assessment after the flight between the private pilots (M= 3.59, SD= 1.01) and the commercial and ATP pilots (M= 3.05, SD= 1.02) conditions; $t(111) = 2.66$, p = 0.009. The results suggest the private pilots place more emphasis on risk assessment after the flight than the commercial and ATP pilots. Table 32 shows the results.

Table 32. Analysis of Risk Assessment Based on Pilot Certificate.

	t	df	Sig.
Before the Flight	.082	113	.935
During the Flight	1.905	111	0.59
After the Flight	2.660	111	0.009

In order to compare scores between the private pilots and the commercial/ATP pilots on the risk mitigation strategies used prior and during a cross-country flight, an independent-samples t-test was performed. The variances in the samples were assumed equal and the scores were independent. The test was found to be statistically non-significant with the mitigation used before the flight in the scores between the private pilot (M= 4.27, SD= 1.12) and the commercial/ATP pilots (M= 4.25, SD= 1.03) conditions; $t(112) = 0.11$, p = 0.912. The test also did not reach a statistical significance with the mitigation used during the flight in the scores between the private pilots (M= 4.17, SD= 1.04) and the commercial/ATP pilots (M= 4.03, SD= 1.11) conditions; $t(109) = 0.65$, p = 0.515. According to the test, the risk mitigation strategies used prior and during a cross-country flight did suggest no significance based on the pilot certificate. Table 33 shows the conclusions.

Table 33. Analysis of Risk Mitigation Based on Pilot Certificate.

	t	df	Sig.
Before the Flight	.111	112	.912
During the Flight	.653	109	.515

Advanced Safety Class

An independent-samples t-test was conducted to determine the relationship between the participants placing a different emphasis on risk assessment based on if they had attended an additional safety class. The test was found to be statistically non-significant with the risk assessment prior to a cross-country flight in the scores between the participants who have taken an elective safety course (M= 4.48, SD= 0.51) versus a non-participant (M= 4.39, SD= 0.97) conditions; $t(103) = 0.46$, p = 0.650. The test was also indicated a statistically non-significant difference during flight between the attendance of the participants who had attended the extra safety class (M= 4.28, SD= 0.73) and the participants who had not attended (M= 4.10, SD= 0.99) conditions; $t(103) = 0.84$, p = 0.403. The test did not reach statistical significance with the emphasis of risk assessment after the flight between the participants who attended the advanced safety class (M= 3.52, SD= 0.82) and the non-participants (M= 3.15, SD= 1.01) conditions; $t(103) = 1.67$, p = 0.098. These results indicate that individuals who have attended advanced elective safety classes show a higher mean of risk assessment more prior, during or after a cross-country flight. Table 34 displays the findings.

Table 34. Analysis of Risk Assessment Based on Advanced Safety Class.

	t	df	Sig.
Before the Flight	.455	103	.650
During the Flight	.839	103	.403
After the Flight	1.67	103	.098

An independent-samples t-test was conducted to compare the application of risk mitigation before and during a cross-country flight by the applicants who have and have not taken an advanced safety class. The variances in the samples were assumed equal and the scores were independent. The test was found to be statistically non-significant for the application of risk mitigation strategies before the flight between the attendance of participants who have attended an additional safety course (M= 4.48, SD= 0.51) and the non-participants (M= 4.27, SD= 1.00) conditions; $t(102) = 1.03$, $p = 0.305$. The test did not reach statistical significance for risk mitigation during the cross-country flight between the participants who have taken an elective safety course (M= 4.20, SD= 0.87) and non-participants (M= 4.13, SD= 0.98) conditions; $t(102) = 0.34$, $p = 0.738$. The results suggest, there was no significant findings in the application of risk mitigation strategies if a participant had or had not taken an advanced safety class. Table 35 displays the data.

Table 35. Analysis of Risk Mitigation Based on Advanced Safety Class.

	t	df	Sig.
Before the Flight	1.03	102	.305
During the Flight	.336	102	.738

Question Two

Is there a difference of pilot perceptions on the old Preflight Risk Assessment for Dual Cross-Country flight versus the new SMS format? Since this research question assesses the relationship between numerous independent variables to a single dependent variable, an independent-samples t-test was utilized as the primary statistical test. The following three statements were the independent variables: the cross-country risk assessment form accurately determines the level of risk prior to a flight, the level of risk assessed by the cross-country form is an accurate representation of the actual risks perceived on each flight and the time required to complete the cross-country form is valuable to assess the risk of the flight.

Comparison of Old and New SMS Format

In order to test the perceived pilot perception of the old preflight cross-country risk assessment form to the new SMS form an independent-samples t-test was conducted. The variances in the samples were assumed equal and the scores were independent. The test was found to be statistically non-significant for the perception that the old form (M= 3.63, SD= 1.04) accurately determines the level of risk prior to a flight compared to the new form (M= 3.74, SD= 1.08) conditions; $t(103) = -1.18$, p = 0.241. The test was found to be statistically significant for the perception that the new SMS form (M= 3.58, SD=

1.07) is an accurate representation of the actual risks that perceived compared to the old form (M= 3.36, SD= 1.05) conditions; *t*(103) = -2.73, p = 0.007. The results suggest the level of risk assessed by the new SMS cross-country is an accurate representation of the actual risks perceived during a flight. There was also a significant difference in the scores for the new SMS form (M= 3.70, SD= 1.08) compared to the old form (M= 3.48, SD= 1.09) conditions; *t*(103) = -2.63, p = 0.010 for the time required to complete the risk assessment form is a valuable to the determination of the risk on the flight. This tests illustrates that the participants feel the new SMS format of the Preflight Risk Assessment for Dual Cross-Country flights is a more precise depiction of the real risks experienced during the actual cross-country flight and that the time required to assess the risk is valuable. Table 36 indicates the findings.

Table 36. Analysis of Old vs. New SMS Risk Assessment Form.

	t	df	Sig.
Accurately Determines Level of Risk	-1.179	103	.241
Accurate Representation of Perceived Risks	-2.731	103	.007
Time is Worthwhile	-2.627	103	.010

Question Three

Is there a difference of pilot perceptions on the new SMS Preflight Risk Assessment for Dual Cross-Country flights based on background characteristics? Since this research question assesses the relationship between numerous independent variables to a single dependent variable, an independent-samples t-test was utilized as the primary statistical test. The following were the independent variables: role, pilot certificate, attendance of advanced safety class, age and flight hours.

An independent-samples t-test was conducted to compare the perceived risk assessed by the new SMS cross-country form and the role of the participant. The variances in the samples were assumed equal and the scores were independent. The test was found to be statistically non-significant on the form accurately determining the level of risk prior to a cross-country flight between the student (M= 3.74, SD= 1.31) and the flight instructor (M= 3.74, SD= 0.90) conditions; $t(103) = 0.01$, $p = 0.992$. The test also suggest there was not a significant difference in the scores of the student (M= 3.58, SD= 1.35) and the flight instructor (M= 3.58, SD= 0.84) conditions; $t(103) = 0.00$, $p = 0.997$ related to the cross-country form is an accurate representation of the actual risks perceived during a cross-country flight. The test also indicate the findings to be statistically non-significant on the time required to complete the cross-country is worthwhile to assessing the risks of the flight by the student (M= 3.63, SD= 1.27) and the flight instructor (M= 3.74, SD= 0.92) conditions; $t(103) = -0.53$, $p = 0.596$. These results suggest that the role of the participant does not have an effect on the perceived risk assessed by the new SMS cross-country form. Table 37 indicates the results.

Table 37. Analysis of the New SMS Form Based on Role.

	t	df	Sig.
Accurately Determines Level of Risk	.010	103	.992
Accurate Representation of Perceived Risks	.004	103	.997
Time is Worthwhile	-.533	103	.596

The t-test showed no significant differences determined between the risk assessed by the new SMS cross-country form and the pilot certificate of the participant. The cross-country risk assessment form accurately determines the level of risk prior to a flight was found to be statistically non-significant between a private pilot (M= 4.03, SD= 1.00) and a commercial/ATP (M= 3.60, SD= 1.11) conditions; $t(102) = 1.91$, $p = 0.059$. The statement of the level of risk assessed by the new SMS form is an accurate depiction of the actual risks perceived by the private pilot (M= 3.85, SD= 1.10) and the commercial/ATP (M= 3.46, SD= 1.05) did not reach statistical significance, $t(102) = 1.78$, $p = 0.078$. The question about the time required to complete the new SMS cross-country form is valuable to assess the risk of the cross-country flight perceived between the private pilot (M= 3.85, SD= 0.96) and the commercial/ATP (M= 3.61, SD= 1.13) was found to be statistically non-significant, $t(102) = 1.06$, $p = 0.293$. These results suggest that the pilot certificate held does not have an effect on the perceived risk assessed on the new SMS cross-country form. Table 38 indicates the results.

Table 38. Analysis of the New SMS Form Based on Pilot Certificate.

	t	df	Sig.
Accurately Determines Level of Risk	1.912	102	.059
Accurate Representation of Perceived Risks	1.778	102	.078
Time is Worthwhile	1.058	102	.293

A t-test was completed to determine if there was any significance between the new SMS Preflight Risk Assessment form and if the participant had taken an advanced safety class. The respondents who had partook in an elective safety course (n= 23) had a mean of 3.96 and the respondents who had not completed an additional safety classes (n= 76) had a mean of 3.76 when they responded that the new SMS cross-country risk assessment form accurately determines the level of risk prior to their flight. The participants of the advanced safety elective (n= 23) had a higher mean of 3.83 then the participants who didn't attend an extra safety course (n= 76) had a mean of 3.61 that the level of risk assessed by the new SMS form is an accurate representation of the actual risks perceived during each flight. The respondents who attended the advanced safety class (n= 23) had a slightly higher mean of 3.96 than the ones who were not present (n= 76) mean of 3.72 on responding that the time required to complete the updated SMS cross-country form is valuable to assessing the hazards on the flight. Table 39 represents the results.

Table 39. Group Statistics of the New SMS Form Based on Advanced Safety Class.

	N	Mean	SD
Accurately Determines Level of Risk			
Yes	23	3.96	1.11
No	76	3.76	.991
Accurate Representation of Perceived Risks			
Yes	23	3.83	.984
No	76	3.61	1.01
Time is Worthwhile			
Yes	23	3.96	.767
No	76	3.72	1.08

In order to test the effect of perceived risk assessed by the new SMS form to the attendance of the participant taking an advanced safety class, an independent-samples t-test was performed. The variances in the samples were assumed roughly equal and scores were independent. The test was found to be statistically non-significant between the mean risk assessed by the new SMS cross-country form accurately determines the level of risk prior to a cross-country flight and if the participant had taken an advanced safety course (M= 3.96, SD= 1.11) and a non-participant (M= 3.76, SD= 0.99) conditions; $t(97) = 0.80$, p = 0.427. The test also did not reach a statistical significance with the level of risk assessed by cross-country form is an accurate representation of the actual risks perceived by a respondent who attended an additional safety course (M= 3.83, SD= 0.98) to a non-respondent (M= 3.61, SD= 1.01) conditions; $t(97) = 0.93$, p =

0.357. There was not a significant difference in the time required to complete the cross-country form is valuable to assess the risk of the flight by a participant who has taken an elective safety class (M= 3.96, SD= 0.77) compared to a non-participant (M= 3.72, SD= 1.08) conditions; *t*(97) = 0.96, p = 0.338. These results suggest that the attendance of an advanced safety course does not have an effect on the perceived risk assessed by the new SMS cross-country form. Table 40 indicates the findings.

Table 40. Analysis of the New SMS Form Based on Advanced Safety Class.

	t	df	Sig.
Accurately Determines Level of Risk	.797	97	.427
Accurate Representation of Perceived Risks	.926	97	.357
Time is Worthwhile	.963	97	.338

A Pearson correlation coefficient was computed to measure the relationship between the emphases of risk assessed by the new SMS cross-country form to the participants' age. No significant correlations were determined between the cross-country risk assessment form accurately determining the level of risk prior to a flight compared to the participants' age, r = -0.113, n = 103, p = 0.256. There were no correlations between the level of risk assessed by the new SMS cross-country form that is an accurate representation of the actual risks perceived compared to the applicants' age, r = -0.030, n = 103, p = 0.760. Again, no relationship was determined by the time required to complete the new form is worthwhile compared to the respondents' age, r = -0.065, n =

103, p = 0.512. Overall, there were no correlations of the relationships between how accurately the new SMS cross-country form determines risk related to the participants age. Table 41 indicates the results.

Table 41. Analysis of the New SMS Form Based on Age.

	N	r	Sig.
Accurately Determines Level of Risk			
Age	103	-0.113	0.256
Accurate Representation of Perceived Risks			
Age	103	-0.030	0.760
Time is Worthwhile			
Age	103	-0.065	0.512

A Pearson correlation coefficient was calculated to assess the relationship between the accuracy of risk perceived on the SMS cross-country risk assessment form to the participants' flight hours. There were no correlations found between how the participant answered if the new cross-country form correctly determines the level of risk prior to their flight and their total amount of flight hours, r = -0.005, n = 105, p = 0.956. There were also no correlations between the above statement compared to the applicants total cross-country flight time, r = 0.055, n = 104, p = 0.577. No correlations were determined between the level of risk assessed that the new form is an accurate representation of the actual risks perceived on the flight compared to total flight hours, r = 0.018, n = 105, p = 0.854. The above statement did not have a correlation to the respondents total cross-country flight time, r = 0.076, n = 104, p = 0.441. The test found no correlation between the time required to complete the SMS form was a valuable tool to assess the risk of the flight and total flight time of the participant, r = -0.061, n = 105, p = 0.537. There also was no correlation between the time required and total cross-country flight hours, r = -0.034, n = 104, p = 0.733. All of the test performed, indicated no correlation between the accuracy of perceived risks on the SMS preflight form compared to the participants' flight hours. Table 42 displays the findings.

Table 42. Analysis of the New SMS Form Based on Flight Hours.

	N	r	Sig.
Accurately Determines Level of Risk			
Total Flight Hours	105	-0.005	0.956
Total XC Hours	104	479.41	0.577
Accurate Representation of Perceived Risks			
Total Flight Hours	105	0.018	0.854
Total XC Hours	104	0.076	0.441
Time is Worthwhile			
Total Flight Hours	105	-0.061	0.537
Total XC Hours	104	-0.034	0.733

Qualitative Results

The participants of the survey were given an opportunity to provide any comments or additional feedback about their personal experiences using either the old or the newer Preflight Risk Assessment form for Dual Cross-Country flights. The results were grouped into themes and listed below.

Theme 1: New SMS Risk Assessment Form Preferred

The majority of the comments indicated they preferred using the new SMS form over the older version. The participants stated that the new format is more specific and applicable in the criteria for each category. Respondents said the new SMS form identifies actual hazards and gives makes it easier to recognize the risks. Participant 1 stated, “The new SMS form is an improvement since it requires a little more thought to actually record the numerical values for items such as ceilings and visibilities rather than just circling an approximate value.” Applicant 2 remarked, “The new form makes following the UND Safety Policies and Procedures easier.” The new form can help a student draw their attention to a category that may exceed a policy limit which can help them make the determination not to fly instead of the flight instructor making the final decision. Overall, the majority of the comments favored the new risk assessment form.

Theme 2: Older Risk Assessment Form Preferred

Out of all the feedback, only one individual preferred the older format of the risk assessment form. They preferred the older version of the cross-country form because it showed elevated risk without disqualifying a person from flying. The flight crew would have to make the go/no-go decision instead of the form stopping the flight. Participant 3 stated, “I should be able to make that decision on my own.” The older numeric style form only displayed if the flight would be considered low, elevated or high risk but would never stop a flight from occurring.

Theme 3: Improvements for the New SMS Form

The following comments were provided to improve the new SMS form. Multiple respondents indicated they give an estimate for the total time in the aircraft type in the last 90 days. Participant 4 said, "I generally don't know how many hours I've flown in the past week, much less in the last 90 days. I'd put money on 95% of those numbers being complete guesses." The category is not being properly evaluated if the flight crews are just taking a guess at their total time in the last 90 days in the specific aircraft type.

Additional categories were suggested to be added to the risk assessment form to improve the thoroughness. Enroute weather should be evaluated to determine the potential of turbulence, precipitation or icing. Applicant 5 suggested, "I understand that the form is not meant to be a catch all, but I feel that for many flights there are factors that pose a much greater risk such as icing conditions and thunderstorms." The form may want to include known or unknown airport surface braking action reports. Another category could be inflight delays to include traffic pattern saturation or even poor student performance. Migration of waterfowl should also be a risk considerations. One participant suggested to add the day of departure checklist from the solo cross-country form to the dual request form. The overall quality of sleep could also be evaluated. These suggestions should be considered to be to help improve the risk assessment form.

Theme 4: Compounding Areas Marked as Acceptable Risk with Mitigation

The new risk assessment form does not address if compounding categories are marked as acceptable risk with mitigation. One participant stated, "The form is good in identifying individual elevated risks, but it does not consider the combination or compounding of various risks." Another applicant suggested, "If a culmination of areas fell into the risk with mitigation, then maybe the flight should be considered unacceptable and discontinued." For example, if a flight crew measured their risk assessment with 6 hours of sleep, 7 hours from last meal and a 9 hour duty day, the flight only requires some type of mitigation. A combination of categories assessed as acceptable with mitigation should be further evaluated to determine a better solution.

Theme 5: Additional Education on Risk Assessment and Mitigation Techniques

The following feedback was provided to offer more guidance on how to properly use the risk assessment form. More education needs to be offered to the students on how to properly fill out the form and assess risk. Additional clarification needs to be provided that actual numbers needed to written on the blank spaces. For example, a student should write 9 hours of sleep across from the statement of student sleep in the last 24 hours and then circle the acceptable risk of greater than 6 hours.

Theme 6: Effectiveness of the Risk Assessment Form

A few participants gave feedback in regards to the effectiveness of the risk assessment form. Participant 6 commented, "I'm undecided as to whether this new form actually improves the safety of the flight or if a prudent flight crew would come to the same decision without using the form." Respondent 7 indicated, "It's very hard to make a perfect form, if not impossible." Applicant 8 stated, "Risk assessment is necessary in every hazardous occupation and it's essential to the safety at UND Aerospace." Most comments reflected that the effectiveness of risk assessment was not based on the form, but instead from the individual.

Theme 7: Self-Assessment

A few comments generalized that it's the pilot's responsibility to accurately assess themselves and the weather conditions prior to conducting a cross-country flight. Contributor 9 said, "Self-assessment always comes with limitations. If assessed honestly and accurately, these risk assessment tools are extremely valuable." However, a pilot may not be exercising good judgement if not properly evaluating the all the risk elements fairly before going on a flight.

This chapter presented the results of using an independent-samples t-test and a Pearson correlation coefficient to measure the relationship between the participants' emphasis placed on risk assessment to their age, flight hours, role, pilot certificate and if they attended an advanced safety class. The qualitative results were also presented. The findings of this section are further analyzed and explained in Chapter V.

Chapter IV

CONCLUSIONS AND RECOMMENDATIONS

This study explores pilot perceptions of risk assessment when conducting a dual cross-country flight at UND Aerospace. This chapter presents a discussion of the research questions' results and concludes with recommendations for future research.

Summary

The results of this study indicate that there is a relationship of the perceived risk assessment for a cross-country flight at UND and the pilot background characteristics. These findings indicate that the flight instructor places more emphasis on risk assessment and application of risk mitigation strategies prior and during a cross-country flight. A relationship was also determined that a private pilot applies more risk mitigation techniques after the completion of a flight. There was also a significant difference in the participants' perceptions that the new SMS Preflight Risk Assessment for Dual Cross-Country flights is a better form to assess risks.

Conclusions and Discussion

Research Question 1: Is there a difference of pilot perception placed on cross-country risk assessment based on pilot background characteristics?

There was a relationship with two significant variables to perceive risk assessment. The pilot background characteristics that had a significant difference were based on the role and the pilot certificate held by the participant. It was determined that the flight instructor placed more emphasis on risk assessment before a flight than the student. The flight instructor also applied additional risk mitigation strategies before and during a cross-country flight than the student.

Aviation instructors are on the front line of efforts to improve the safety record of the aviation industry (Aviation Instructor's Handbook, 2008). These findings would suggest that the flight instructor who is acting as the pilot in command has more responsibility with the overall safety of the flight and is therefore placing more emphasis on the preflight risk assessment. With the flight instructor having more experience, they are applying more mitigation techniques before and during a cross-country flight to reduce risks. Safety, one of the most fundamental considerations in aviation training, is paramount (Aviation Instructor's Handbook, 2008).

The ability to recognize a hazard is predicated upon personality, education and experience (Risk Management Handbook, 2009). Pilots' experience and exposure to training may always slightly vary (Dekker, Mavin, Roth, and Weber, 2016). These statements indicate that the pilot background characteristics have many variables which makes it harder to find a relationship with perception of risks and needs more research. Risks are more easily assessed and managed in the planning stages of an operation (Aviation Instructor's Handbook, 2008). Anyone can make a risk decision. However, the appropriate decision-maker is the person who can develop and implement risk controls (Aviation Instructor's Handbook, 2008).

There were no significant results between the role of the participant and the emphasis placed on risk assessment during and after a cross-country flight. The student actually placed a greater emphasis on risk assessment after the completion of the cross-country flight. These results indicate that a student may have more invested after the end of the flight training cross-country than the flight instructor because the student is continually learning and reflecting on the decisions made throughout the flight. To reinforce the risk management lessons of the flight, the flight instructor repeats, restates and reemphasizes important points during a post flight critique to help the student learn (Aviation Instructor's Handbook, 2008). Further research could be conducted to determine if a relationship between the low experience of student changes the perception of risk assessment on a cross-country flight compared to higher experienced student. Additional research could also investigate if a new flight instructor with low experience conducting cross-country flights perceive risk differently than an experienced flight instructor.

Another significant finding indicated that a private pilot placed more emphasis on risk assessment after the flight than the commercial and ATP pilots. According to the zero risk theory, as self-confidence increases (largely as a function of increasing experience in the situation), perceived risk diminishes to the point of zero perceived risk (Hunter, 2002). This indicates that experienced pilots feel there is no real risk at all. Further research could be conducted to determine if a relationship would exist on how risk assessment is perceived between a student pilot and a private pilot and the difference between a commercial pilot and ATP viewpoints.

Age was measured in relation to the emphasis placed on risk assessment prior, during and after the flight. Age was also calculated in relation to the application of risk mitigation strategies used before and during a cross-country flight. There were no significant findings in regards to the participants' age at any point in the flight compared to the amount of emphasis they put on risk assessment or the practice of risk mitigation techniques. A Pearson correlation coefficient was computed and indicated that a persons' age does not have a direct relationship on the emphasis of risk assessment or mitigation techniques utilized for a cross-country flight. Additional research could examine different age groups to compare the pairings amongst each other.

Flight hours were computed to assess the correlation between the emphases placed on risk assessment and mitigation strategies prior, during and after a cross-country flight. No correlations were determined between the emphasis placed on risk assessment based on total flight hours or total cross-country flight hours. This indicates no direct correlation of either risk assessment or risk mitigation techniques are effected by the participants' flight time. Other studies have found that experience often produces better diagnostic decision-making skills; however, it may also reduce pilot perception of risk (Ji, 2013).

The advanced safety course attendance of the respondent was compared to the risk assessment and the risk mitigation strategies applied throughout a cross-country flight to determine if a relationship was present. There were no significant findings determined. This indicates that additional education in safety does not affect the outcome of the risk assessed or mitigated for a dual cross-country training flight. Even though the findings were not significant, the participants who had attended additional safety courses had a higher mean score of emphasis placed on risk assessment. In aviation, experience, training and education help a pilot learn how to spot hazards quickly and accurately (Risk Management Handbook, 2009).

The lack of statistically significant variables of background characteristics compared to the perception placed on risk assessment may be an area of further research. According to the Pilot's Handbook of Aeronautical Knowledge (2008), "A group of pilots will perceive hazards differently." Further research could include the perceptions of international students compared to the traditional undergraduate student to determine if culture plays a role in risk assessment.

Since this sample size consisted mainly of participants who held commercial pilot certificates or higher, another study should try to gather a larger sample size of student pilots. Also, a bigger sample size would allow for the comparisons of gender and flight course. Another variable could be to compare the highest level of flight instructor certificate held to see if there is a relationship between the risks perceived.

Research Question 2: Is there a difference of pilot perceptions on the old Preflight Risk Assessment for Dual Cross-Country flight versus the new SMS format?

A significant relationship was determined that the new SMS Preflight Risk Assessment for Dual Cross-Country form is a more accurate representation of the actual risks perceived on each flight compared to the old version of the form. It was also determined that the time required to complete the new SMS cross-country form is more valuable than the old format to assess the risk of the flight. These finding suggest that the new cross-country risk assessment form is a precise illustration that the time spent completing the form is worthwhile of predicting the risks on the flight.

Aviation organizations realize that threats to safety always exist (Robertson, 2016). For the past several years, the implementation of SMS is designed to identify threats and mitigate risk before accidents occur (Gill, 2004). The significant results of the updated SMS preflight risk assessment form are attributed to the successful operation of SMS at UND Aerospace.

There were no significant findings that one particular form more accurately determines the level of risk prior to a flight. This indicates that the participants perceive that one preflight risk assessment form does not perform better than the other in estimating the level of risk before a cross-country flight. Every flight has hazards and some level of risk associated with it. It's critical that pilots and especially students are able to differentiate in advance between a low-risk and a high risk flight and then establish a review process and develop risk mitigation strategies (Aviation Instructor's Handbook, 2008). Supplementary research could be conducted to see if students and flight instructors can determine the difference between a low and high risk flight before a flight.

Further research needs to be conducted with a follow-up online survey to gather more information on the actual effectiveness of the updated SMS risk assessment form. Survey questions could include questions relating to the actual values of the risk assessed for a training cross-country flight. More questions could focus on the actual categories marked with acceptable risk with mitigation to determine the frequency and to determine if risk mitigation strategies were actually necessary. Or if mitigation techniques needed to be used during the flight that were not previously assessed prior to the flight. Additional research needs to be calculated to determine if any statistically significant relationships exist between the background characteristics, categories evaluated as acceptable with mitigation and necessary risk mitigation strategies.

Other research could include more qualitative data by conducted interviews of the flight crews after they have completed a dual cross-country flight. It would be interesting to see if the student and flight instructor would share the same perceived experience of the flight. The interviews could provide more insight on the preflight evaluation process and in-depth explanation of the mitigation techniques actually considered versus the ones used.

Research Question 3: Is there a difference of pilot perceptions of the new SMS Preflight Risk Assessment for Dual Cross-Country flights based on background characteristics?

There were no significant relationships between pilot perceptions of the new SMS form and pilot background characteristics. This indicates that all the variables did not show an effect on pilot perception of the new preflight risk assessment form. Thus, more perceived risk research needs to be conducted to incorporate major influencing factors. Additional research on pilot background characteristics such as gender and cultural differences could be studied to determine if any relationships may exist.

The role of the participant was measured in relation to the perceptions of accuracy with the new preflight risk assessment form. There were no significant findings in regards to the student perceiving the accuracy of the new preflight risk assessment compared to the flight instructor. The flight instructor's attitude and approach to flying may often influence students more than any specific lesson. By always setting a good example and by giving students support, a flight instructor helps students develop good judgement and sound flying practices (Aeronautical Decision Making, 1991). Additional research could be conducted to determine personal capabilities on the perception of risk.

For example, Hunter found (2006), some situations present greater risk for some individuals (e.g. with less experience) than they do for other individuals (e.g. with more training).

The type of pilot certificate held was compared in relation to the perceptions of how accurate the SMS risk assessment form determines the level of risk. There were no significant findings in regards to the private pilots compared to the commercial/ATP pilots with perceiving the level of risk. Overall, the findings were similar to other studies with slight differences in risk perception as a result of pilot certificate held. Pilots who had more experience as determined by license type reported lower levels of perceived risk than their less experienced counterparts (Hunter, 2006). Awareness of possible threats seems to be especially critical during the preflight planning as many general aviation accidents result from short-sightedness during that phase of flight such as failure to consider weather trends and their implications (AOPA, 2003). If pilots recognized these threats early, they would be in a better position to control them. A few mitigation strategies could be to delay the flight or change the route of flight. By training private pilots to look ahead and to plan for future threats, it could improve their decision making skills which should translate to a lower accident rate.

The attendance of an advanced safety class was measured in relation to the perceptions of the accuracy on the preflight risk assessment. No significant results were determined between the respondent's attendance of the additional safety training. The results indicate that participants who exhibited greater safety orientation tended to rate the risks assessed by the new form higher. Other studies have provided evidence that an educational program which incorporates instruction in risk identification and management is associated with improvements in pilot judgement (Hunter, 2005). The safety course offered at UND could incorporate more scenario based training to evaluate risk management techniques.

The age and flight time was compared in relation to the perceptions of the accuracy of the preflight cross-country risk assessment. There were no significant findings in regards to age or total flight hours compared to the perceived level of risk in regards to the new SMS preflight risk assessment. These results suggest that age and flight experience were not a reliable indicator in how accurate the SMS preflight form is to assess risks. Further research could explore the possibilities of a relationship that may exist between different age groups and gender.

Qualitative Results

The participants of the survey were given an opportunity to provide any comments or additional feedback about their personal experiences using either the old or the newer version of the Preflight Risk Assessment form for Dual Cross-Country flights at UND Aerospace. The results were grouped into themes with suggestive actions on how to implement the recommendations.

Theme 1: New SMS Risk Assessment Form Preferred

The majority of the comments indicated they preferred using the new SMS form over the older version. The participants stated that the new format is more specific and applicable in the criteria for each category. Respondents said the new SMS form identifies actual hazards and gives makes it easier to recognize the risks. Participant 1 stated, "The new SMS form is an improvement since it requires a little more thought to actually record the numerical values for items such as ceilings and visibilities rather than just circling an approximate value." Applicant 2 remarked, "The new form makes following the UND Safety Policies and Procedures easier." Further research could look into rewriting the policies to make it simpler to follow. UND's Safety Policies and Procedures consist of 12 sections and can be overwhelming for a new student so the SMS preflight form is simpler to determine if the flight can be conducted inside of all the policies. The new form can help a student draw their attention to a category that may exceed a policy limit which can help them make the determination not to fly instead of the flight instructor making the final decision. Overall, the majority of the comments favored the new risk assessment form.

Theme 2: Older Risk Assessment Form Preferred

Out of all the feedback, only one individual preferred the older format of the risk assessment form. They preferred the older version of the cross-country form because it showed elevated risk without disqualifying a person from flying. The flight crew would have to make the go/no-go decision instead of the form stopping the flight. Participant 3 stated, "I should be able to make that decision on my own." Allowing the flight crew to make a go/no-go decision is complicated. The older numeric style form only displayed if the flight would be considered low, elevated or high risk but would never stop a flight from occurring. The overall learning process for the student is better, however, the risk associated to UND Aerospace as an organization, are too great.

Theme 3: Improvements for the New SMS Form

The following comments were provided to improve the new SMS form. Multiple respondents indicated they give an estimate for the total time in the aircraft type in the last 90 days. Participant 4 said, “I generally don’t know how many hours I’ve flown in the past week, much less in the last 90 days. I’d put money on 95% of those numbers being complete guesses.” The category is not being properly evaluated if the flight crews are just taking a guess at their total time in the last 90 days in the specific aircraft type. In the Aviation Information Management System (AIMS) program, it gives the flight instructor their contact time in the past 24 hours and 7 days for airplane time but the program could be designed to have a column with the amount of time in each make and model of aircraft in the past 90 days so the participants would not be guessing. This tool should also be available for the students to utilize as well. Another fix to this problem could be to just have the participants to respond with either greater than or less than 15 hours in a specific type, instead of an exact number.

Additional categories were suggested to be added to the risk assessment form to improve the thoroughness. Enroute weather should be evaluated to determine the potential of turbulence, precipitation or icing. Applicant 5 suggested, “I understand that the form is not meant to be a catch all, but I feel that for many flights there are factors that pose a much greater risk such as icing conditions and thunderstorms.” A recommendation to improve this area would be to have the pilots draw out the weather along the intended route of flight. Either a plan view or cross-section view including terrain and airspace could help the pilot better visualize the weather that could be printed on the backside of the navigation log. The picture on the map could include cloud bases and tops, icing levels, winds aloft, fronts, areas of IMC, and thunderstorm movement. The map could help improve the situational awareness of the conditions.

The form may want to include known or unknown airport surface braking action reports. The first edition of the new SMS form had the lowest braking action report as a risk category. If the braking action was reported as good then it was considered acceptable risk, fair and poor reports were acceptable risk with mitigation and nil reports were considered unacceptable risk. This item was later removed in an update of the form because it was very uncommon to see the fair, poor and nil. The flight restrictions would always be set according to the present conditions so it doesn't need to be evaluated again.

Theme 4: Compounding Areas Marked as Acceptable Risk with Mitigation

The new risk assessment form does not address if compounding categories are marked as acceptable risk with mitigation. One participant stated, "The form is good in identifying individual elevated risks, but it does not consider the combination or compounding of various risks." Another applicant suggested, "If a culmination of areas fell into the risk with mitigation, then maybe the flight should be considered unacceptable and discontinued." For example, if a flight crew measured their risk assessment with 6 hours of sleep, 7 hours from last meal, a 9 hour duty day, and a crosswind component of 18 knots; the flight only requires some type of mitigation and the flight could be allowed. A combination of categories assessed as acceptable with mitigation should be further researched. A possible recommendation could be, if a total of 4 categories or more are assessed as acceptable risk with mitigation, then the flight would not be permissible.

Theme 5: Additional Education on Risk Assessment and Mitigation Techniques

The following feedback was provided to offer more guidance on how to properly use the risk assessment form. More education needs to be offered to the students on how to properly fill out the form and assess risk. Additional clarification needs to be provided that actual numbers needed to written on the blank spaces. For example, a student should write 9 hours of sleep across from the statement of student sleep in the last 24 hours and then circle the acceptable risk of greater than 6 hours. In order to improve this area, the flight instructor first needs to know how to properly use the form. This training is needs to be updated and offered during the initial flight instructor hiring meetings. Any changes to the forms also need to be explained as to why and how to utilize the new versions. Then this information must be passed to the flight students to ensure the form is being utilized properly. The General Aviation Joint Steering Committee feels that improved risk assessment before the flight can significantly improve pilots' chances avoiding accidents and incidents (FITS, 2003).

Theme 6: Effectiveness of the Risk Assessment Form

A few participants gave feedback in regards to the effectiveness of the risk assessment form. Participant 6 commented, "I'm undecided as to whether this new form actually improves the safety of the flight or if a prudent flight crew would come to the same decision without using the form." Respondent 7 indicated, "It's very hard to make a perfect form, if not impossible." Applicant 8 stated, "Risk assessment is necessary in every hazardous occupation and it's essential to the safety at UND Aerospace." Most comments reflected that the effectiveness of risk assessment was not based on the form, but instead from the individual. No Flight Risk Assessment Tool (FRAT) can anticipate all the hazards that may impact a particular flight but there are some common hazards that General Aviation Pilots encounter regularly (FITS, 2003). Hopefully, the UND form will help the flight crew in assisting what areas may have potential risks and devising effective ways to try to minimize those effects.

Theme 7: Self-Assessment

A few comments generalized that it's the pilot's responsibility to accurately assess themselves and the weather conditions prior to conducting a cross-country flight. Contributor 9 said, "Self-assessment always comes with limitations. If assessed honestly and accurately, these risk assessment tools are extremely valuable." However, a pilot may not be exercising good judgement if not properly evaluating the all the risk elements fairly before going on a flight. At a minimum, additional education could be undertaken to improve the self-awareness of the risk elements associated on a cross-country flight. More research could be conducted to determine if the students and flight instructors honestly assess all the categories on the preflight risk assessment. This would ensure that UND is holding to its' safety culture.

New SMS Preflight Risk Assessment for Dual Cross-Country Form Updates

The SMS Preflight Risk Assessment for Dual Cross-Country flights was updated in May 2014. More guidance was provided on how to use the form in the introduction section. It now states to assess each of the following conditions then write down the corresponding value and circle the appropriate value in the provided table. Additional reminders were further added to make sure that both the current and forecasted weather conditions should be considered for each category. It was decided by a group of experts to remove the assessment of the lowest braking action report. According to the Safety Policies and Procedures (2016), if this was an unacceptable risk, then the flight restrictions would be set appropriately to not allow the flight to go. Supplementary guidance sheets were created to provide more risk mitigation techniques and distributed to the students and hung on the preflight planning rooms at UND.

After the new format was applied to the Dual Cross-Country form, then changes were also made to the Solo, Stage Check and King Air Cross-Country request forms to match. The overall format is standardized but each risk category has applied the appropriate numbers according to the type of operation occurring from Safety Policies and Procedures (2016). With UND Aerospace being SMS compliant now, the forms will be continuously evaluated and updated as necessary.

Future Development of Online FRAT

With advancing technology, further research should be explored to create a digital version of the preflight risk assessment form. An app could be developed for a student to select the course and lesson that their planning on conducting which could be linked directly to the specific Training Course Outline (TCO). The specific lesson will display if the flight is a local or cross-country training lesson then the appropriate risk categories would be available to type in the data. The student could put the specific route for that flight which could automatically pre-select the risk categories for weather and NOTAMS. The student could also select the current runways in use so the crosswind component could be calculated. This could also provide all performance calculations for the take-off and landing for the make and model of aircraft to be flown.

The app could be tailored to each pilot to allow them to have their personal minimums set as saved values. The personal pilot assessment could focus on their certification, training and experience level (FITS, 2003). These areas should be reviewed and revised at least annually (FITS, 2003). A pilot should assess their highest certificate level and ratings held. The area of training should look at their last flight review or if currently attending a ground school class. Then the area of experience should include the total flight hours, years flying, flight hours in the last month, hours in make and model, landings in the last month, night hours and instrument currency which could all be tracked by AIMS. The personal minimums for weather could include the total wind, total crosswind component, minimum visibility and minimum ceilings.

The UND management software program, AIMS could auto-fill all of the experience items so it could be an accurate number. The student and flight instructor would only need to fill in the appropriate categories to evaluate themselves for areas such as rest, last meal and external pressures. The FAA's IMSAFE checklist would also be considered.

When all the data has been entered, the program could determine the potential risks associated with that flight. The differences of risk could be color-coded between acceptable risk as green, acceptable risk with mitigation as yellow and unacceptable risk as red. If acceptable risk with mitigation or unacceptable risk had any areas marked, then the program could allow for the pilot to select pre-programmed mitigation techniques or they could enter in their own options for reducing the risks. Then the program could also request a backup plan if the flight is still considered acceptable risk with mitigation. The last step in every flight planning progress should be to evaluate the planning and make a final decision about conducting the flight.

The flight instructor could enter their personal minimums before their first flight of the day and save it so when the student types in their CFI identifier, their information can be added together to make the final decision if the flight should be conducted. If the crew agrees to go and all of the risk elements were classified as acceptable risk, the stored preflight risk assessment could be sent to the dispatchers directly to get an aircraft and the paper copy of the form could be eliminated. If the flight was determined to have acceptable risk with mitigation, then the flight crew would still need to go through the SOF to discuss the mitigation strategies utilized to conduct the flight safely. The innovation of technology could have endless opportunities to improve the preflight risk assessment prior to training flights.

Summary

The purpose of this study was to create a more accurate preflight risk assessment form to evaluate the potential risks that could occur on a cross-country training flight and to determine the effectiveness compared to the older form. Another reason for this particular study was to examine the relationship of perceived risk assessment compared to pilot background characteristics. Overall, the findings of the study determined that the newer format of the preflight risk assessment is worthwhile in regards to time and an accurate representation of the actual risks perceived during training flights. The study also found that the role of participant, the flight instructor, placed more emphasis on risk assessment before a flight. The flight instructor also applied more mitigation techniques prior and during a flight compared to the student. Another significant finding was the private pilot placed more emphasis on risk assessment after the flight compared to commercial/ATP pilots.

The results of this research bring about new areas to explore and examine. Numerous recommendations for further research have been presented to help improve the overall safety towards the UND Aerospace program and for general aviation as well. The findings in this study can be cross-validated to build a usable database and provide a baseline for the development and continuous improvement of flight risk assessment tools in collegiate aviation programs.

APPENDICES

Appendix A

E-mail Advertisement:

Dear UND Flight Students and Flight Instructors,

I am requesting your help in the completion of my Graduate Thesis. The purpose of this research project is to collect feedback about the preflight risk assessment that is on the Dual Cross-Country Request form.

This research project will utilize survey-based research to gather responses from as many participants as possible. Survey completion should take no longer than 5 minutes. The survey will ask for some background information, and then ask about your experiences with the risk assessment included on the Dual Cross-Country Request forms used by UND Aerospace. This survey has been approved by University of North Dakota's Institutional Review Board.

Survey Link: https://und.qualtrics.com/SE/?SID=SV_0VBxeCBB3apbw1L

This survey will remain for approximately two weeks.

Thank you for taking the time to participate. If you have any questions or if you would like a copy of the final study, please contact me at pcarlson@aero.und.edu.

Thanks,

Paula Carlson
Assistant Chief Instructor/Course Manager
UND Aerospace

Appendix B

Q17 Dear UND Flight Students and Flight Instructors,

I am requesting your help in the completion of my Graduate Thesis. The purpose of this research project is to collect feedback about the preflight risk assessment that is on the Dual Cross-Country Request forms.

This research project will utilize survey-based research to gather responses from as many participants as possible. Survey completion should take no longer than 10 minutes. There are no risks to participation. While there are no benefits to participation, information compiled from this research may be used for future development of Cross-Country Request forms. No identifying information will be collected during the course of this survey, and all survey responses will be kept confidential. You do not have to participate in this research project. If you agree to participate, you can withdraw your participation at any time.

If you have any questions about this research project or if you would like a copy of the final study, please contact me at pcarlson@aero.und.edu.

Thanks,

Paula Carlson

Q1 Please select your gender.

- ❍ Male (1)
- ❍ Female (2)
- ❍ Prefer not to respond (3)

Q2 What year were you born?

Q8 Which of the following best describes your role during flight training?

- ❍ Student (1)
- ❍ Flight Instructor (2)

If Flight Instructor Is Selected, Then Skip To Select all the pilot/instructor certi...

Q11 What flight course are you currently enrolled in?

- ❍ 102 (1)
- ❍ 221 (2)
- ❍ 222 (3)
- ❍ 323 (4)
- ❍ 325 (5)
- ❍ 414 (6)
- ❍ 415 (7)
- ❍ 416 (8)
- ❍ 710 (9)
- ❍ Other Flight Course (Please List Course Number) (10) ____________________

Q3 Select all of the pilot/instructor certificates that you hold.

- ❑ Student (1)
- ❑ Private (2)
- ❑ Commercial (3)
- ❑ ATP (4)
- ❑ CFI (5)
- ❑ CFII (6)
- ❑ MEI (7)

Q4 Approximately how many total flight hours do you have?

Q5 Approximately how many total cross-country flight hours do you have?

Q23 Please rate how strongly you agree or disagree with each of the following statements:

Q6 I place an emphasis on risk assessment when conducting a cross-country flight.

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
Before the flight (1)	❍	❍	❍	❍	❍
During the flight (2)	❍	❍	❍	❍	❍
After the flight (3)	❍	❍	❍	❍	❍

Q7 I apply risk mitigation strategies when conducting a cross-country flight.

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
Before the flight (1)	❍	❍	❍	❍	❍
During the flight (2)	❍	❍	❍	❍	❍

Q18 Have you used this risk assessment form while conducting a flight lesson at the University of North Dakota? If so, the next 3 questions will be based on your experiences using this form.

Preflight Risk Assessment for Dual Cross-Country

Before each flight, assess each of the following conditions and assign a numerical rating of 1 to 5 in the Rating column. Add up the entries in the Rating column to obtain an overall risk estimate, and determine if the risk is acceptable to continue the flight.

	1	2	3	4	5	Instructor Rating	Student Rating
Flight Type	VFR	IFR (VMC)	IFR (IMC)	N/A	N/A		
Dual/Solo	Dual	N/A	N/A	N/A	N/A		
Day/Night	Day	N/A	Night	N/A	N/A		
Visibility	> 10 Miles	6-9 Miles	3-5 Miles	1-3 Miles	< 1 Mile		
Ceiling	> 6,000'	2,000-6,000'	1,000-1,999'	400-999'	< 400'		
Highest Crosswind	Calm	1-5 kts	6-9 kts	10-13 kts	> 13 kts		
Weather Stability	Stable	N/A	Slow Deterioration	N/A	Rapid Deterioration		
Rest in last 24 hours	> 8 hrs	N/A	6-7 hrs	N/A	< 6 hrs		
Last Meal	< 3 hrs	3 hrs	4 hrs	5 hrs	> 5 hrs		
Duration of Flight	< 3 hrs	3 hrs	4 hrs	5 hrs	> 5 hrs		
Duty Day at ETA	< 6 hrs	6-8 hrs	8-10 hrs	10-12 hrs	12-16 hrs		
Hours in aircraft type	> 100 hrs	75-100 hrs	50-74 hrs	30-49 hrs	< 30 hrs		
Hours in the last 90 days	> 20 hrs	15-20 hrs	10-14 hrs	5-9 hrs	< 5 hrs		
Total Hours	> 200 hrs	100-200 hrs	50-99 hrs	30-49 hrs	< 30 hrs		
					Total Risk Score		

	Instructor	Student
LOW RISK: No unusual hazards. Use normal flight planning and established personal minimums and operating procedures.	< 29	< 29
ELEVATED RISK: Somewhat riskier than usual. Conduct flight planning with extra care. Review personal minimums and operating procedures to ensure that all standards are being met. Consider alternatives to reduce risk.	29 to 34 or a 5 in any row.	29 to 34 or a 5 in any row.
HIGH RISK: Conditions present much higher than normal risk. Conduct flight planning with extra care and review all elements to identify those that could be modified to reduce risk. If available, consult with more experienced instructor for guidance before flight. Develop contingency plans before flight to deal with high risk items. Decide beforehand on alternates and on special precautions to be taken during the flight. Consider delaying flight until conditions improve and risk is reduced.	> 34 or a 5 in any two rows.	> 34 or a 5 in any two rows.

I certify the entries on this risk assessment are true. ____________ *Legible Signature of Pilot* ____________ *Print Signature of Pilot*

I certify the entries on this risk assessment are true. ____________ *Legible Signature of Instructor* ____________ *Print Signature of Instructor*

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❍ Yes (1)
❍ No (2)

If No Is Selected, Then Skip To Have you used this risk assessment fo...

Q10 The cross-country risk assessment form accurately determines the level of risk prior to my flight.

- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Neither Agree nor Disagree (3)
- ❍ Agree (4)
- ❍ Strongly Agree (5)

Q15 The level of risk assessed by the cross-country form is an accurate representation of the actual risks that I perceive during each flight.

- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Neither Agree nor Disagree (3)
- ❍ Agree (4)
- ❍ Strongly Agree (5)

Q14 The time required to complete the cross-country form is valuable to assess the risk of my flight.

- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Neither Agree nor Disagree (3)
- ❍ Agree (4)
- ❍ Strongly Agree (5)

Q32 Have you used this risk assessment form while conducting a flight lesson at the University of North Dakota? If so, the next 3 questions will be based on your experiences using this form.

Preflight Risk Assessment for Dual Cross-Country

Before each flight, assess each of the following conditions and write down the corresponding value. Both current and forecast conditions should be considered for each category. Compare your values to the values in the provided risk table to determine the acceptability of risk.

Is there any reason why you should not fly today? Student: YES / NO Flight Instructor: YES / NO

		ACCEPTABLE RISK	ACCEPTABLE RISK WITH MITIGATION	UNACCEPTABLE RISK
Total duration of today's flight	_____ hours	< 4 hours	4 – 8 hours	> 8 hours
Student: Sleep in the last 24 hours	_____ hours	> 6 hours	5 – 6 hours	< 5 hours
Student: Time since last meal	_____ hours	< 6 hours	6 – 12 hours	> 12 hours
Student: Duty day at the end of today's flight	_____ hours	< 8 hours	8 – 16 hours	> 16 hours
Student: Total time in aircraft type last 90 days	_____ hours	> 15 hours	< 15 hours	
CFI: Sleep in the last 24 hours	_____ hours	> 6 hours	5 – 6 hours	< 5 hours
CFI: Time since last meal	_____ hours	< 6 hours	6 – 12 hours	> 12 hours
CFI: Duty day at the end of today's flight	_____ hours	< 8 hours	8 – 16 hours	> 16 hours
CFI: Total time in aircraft type last 90 days	_____ hours	> 15 hours	< 15 hours	
<u>VFR Flights Only:</u>				
Lowest forecast visibility (day)	_____ sm	> 6 sm	1 – 6 sm	< 1 sm
Lowest forecast visibility (night)	_____ sm	> 8 sm	5 – 8 sm	< 5 sm
Lowest forecast ceiling (day)	_____ feet	> 3,000 feet	500 – 3,000 feet	< 500 feet
Lowest forecast ceiling (night)	_____ feet	> 5,000 feet	1,500 – 5,000 feet	< 1,500 feet
<u>IFR Flights Only:</u>				
Lowest forecast visibility (day)	_____ sm	> 4 sm	½ - 4 sm	< ½ sm
Lowest forecast visibility (night)	_____ sm	> 4 sm	1 – 4 sm	< 1 sm
Lowest forecast visibility (day)	_____ feet	> 600 feet	200 – 600 feet	< 200 feet
Lowest forecast visibility (night)	_____ feet	> 600 feet	400 – 600 feet	< 400 feet
<u>Cessna 172 (C172) Flights Only:</u>				
Highest forecast crosswind	_____ knots	< 13 knots	13 – 20 knots	> 20 knots
Highest forecast total wind	_____ knots	< 17 knots	17 – 25 knots	> 25 knots
<u>Seminole (SEMI) and Arrow (ARRO) Flights Only:</u>				
Highest forecast crosswind	_____ knots	< 16 knots	16 – 25 knots	> 25 knots
Highest forecast total wind	_____ knots	< 21 knots	21 – 30 knots	> 30 knots

The entries on this risk assessment are true and correct. This flight can be safely accomplished as risks have been properly identified and effectively mitigated to the lowest practical level. Risk management is a continual process and does not stop after completing this form. Reference the UND SMS Manual for additional guidance.

This flight's risk is assessed as: (circle one) **ACCEPTABLE** **ACCEPTABLE WITH MITIGATION** **UNACCEPTABLE**

Flight Instructor Initials: ___________ Student Initials: ___________

- ❍ Yes (1)
- ❍ No (2)

If No Is Selected, Then Skip To Which of the following elective safet...

Q26 Please rate how strongly you agree or disagree with each of the following statements:

Q29 The cross-country risk assessment form accurately determines the level of risk prior to my flight.

- Strongly Disagree (1)
- Disagree (2)
- Neither Agree nor Disagree (3)
- Agree (4)
- Strongly Agree (5)

Q30 The level of risk assessed by the cross-country form is an accurate representation of the actual risks that I perceive during each flight.

- Strongly Disagree (1)
- Disagree (2)
- Neither Agree nor Disagree (3)
- Agree (4)
- Strongly Agree (5)

Q31 The time required to complete the cross-country form is valuable to assess the risk of my flight.

- Strongly Disagree (1)
- Disagree (2)
- Neither Agree nor Disagree (3)
- Agree (4)
- Strongly Agree (5)

Q20 Which of the following elective safety classes have you taken (or are currently taking) at UND?

- ❑ AVIT 310 - Public Safety Aviation (1)
- ❑ AVIT 311 - Safety Management System (2)
- ❑ AVIT 312 - Aircraft Accident Investigation (3)
- ❑ AVIT 412 - Aviation Safety Assurance (4)
- ❑ None of the Above (5)

Q21 If you have any additional comments or feedback regarding the Dual Cross-Country Risk Assessment or this survey, please provide them below:

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