REVISING THE HAZARD REPORT PROGRAM WITH SAFETY MANAGEMENT SYSTEM PERSPECTIVE: ASSESSING BRAZILIAN AIR FORCE SAFETY SPECIALISTS’ PERCEPTION

by

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An Abstract
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April, 2011
ABSTRACT

by

Fernando L. Volkmer

The Brazilian Air Force Hazard Report Program has not been significantly changed since its creation, but the rise of Safety Management System has introduced several new concepts to aviation, resulting in important improvements to safety. The purpose of this study was to verify the need for a revision of the Hazard Report Program and the applicability of Safety Management System concepts in this review. A quantitative-descriptive research was proposed, and a survey instrument was designed to assess the perceptions of the Brazilian Air Force safety specialists. The results determined the applicability of Safety Management System concepts to revise the Hazard Report Program. The overall acceptance of these concepts indicated their usefulness to improve reporting systems and the aviation safety.
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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIST OF TABLES</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td></td>
<td>xi</td>
</tr>
<tr>
<td><strong>CHAPTER 1: NATURE AND SCOPE OF THE STUDY</strong></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Background of the Study</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Statement of the Problem</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Need and Significance of the Study</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Definition of Terms</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Scope and Delimitations of the Study</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Assumptions</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Summary</td>
<td>9</td>
</tr>
<tr>
<td><strong>CHAPTER 2: REVIEW OF RELATED LITERATURE</strong></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Overview</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Summary of Search Strategies and Terms</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Safety Management System Background</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Evolution of Safety</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Reason Model</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>SMS Importance</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Reporting Systems</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Significance and Uses of Reporting Systems</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>The Brazilian Air Force’s Hazard Report Program</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>SMS Perspective to Hazard Reporting System</td>
<td>21</td>
</tr>
</tbody>
</table>
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The Classification Model of Human Factors and Classification System</td>
<td>27</td>
</tr>
<tr>
<td>2. Safety Risk Probability</td>
<td>29</td>
</tr>
<tr>
<td>3. Safety Risk Severity</td>
<td>30</td>
</tr>
<tr>
<td>4. Example of Matrix Severity x Probability</td>
<td>31</td>
</tr>
<tr>
<td>5. Example of Safety Risk Tolerability Matrix</td>
<td>32</td>
</tr>
<tr>
<td>6. Distribution of Questions of the Survey Instrument</td>
<td>48</td>
</tr>
<tr>
<td>Figure</td>
<td>Page</td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
</tr>
<tr>
<td>1. Evolution of Safety Thinking</td>
<td>12</td>
</tr>
<tr>
<td>2. The Breaches of the Safety Defenses in the Reason Model</td>
<td>14</td>
</tr>
<tr>
<td>3. Flaws in the Systems Barriers Classified by Four Levels</td>
<td>26</td>
</tr>
<tr>
<td>4. The Process of Safety Risk Management</td>
<td>34</td>
</tr>
<tr>
<td>5. Respondents’ Safety Experience</td>
<td>57</td>
</tr>
<tr>
<td>6. Participation in SMS Course</td>
<td>57</td>
</tr>
<tr>
<td>7. HAZREP Importance as Safety Tool</td>
<td>59</td>
</tr>
<tr>
<td>8. Effective Safety Environment</td>
<td>59</td>
</tr>
<tr>
<td>9. Importance of Just Culture to Promote Safety</td>
<td>60</td>
</tr>
<tr>
<td>10. Confidence in the Organization</td>
<td>61</td>
</tr>
<tr>
<td>11. Formal Commitment of the Commander</td>
<td>61</td>
</tr>
<tr>
<td>12. Responsibility of Commanders and Managers</td>
<td>62</td>
</tr>
<tr>
<td>13. Fear of Punishment</td>
<td>63</td>
</tr>
<tr>
<td>14. Importance of Written Statement to Safeguard Safety Data</td>
<td>64</td>
</tr>
<tr>
<td>15. Non-Punitive Environment for Unintentional Errors</td>
<td>64</td>
</tr>
<tr>
<td>16. The Use of Guidelines to Differentiate Between Acceptable and Unacceptable Performance</td>
<td>65</td>
</tr>
<tr>
<td>17. The Use of SMS Concepts to Improve the HAZREP Effectiveness</td>
<td>66</td>
</tr>
<tr>
<td>18. Operational Personnel Training</td>
<td>67</td>
</tr>
<tr>
<td>19. Investigation of the Validity of Reports</td>
<td>67</td>
</tr>
<tr>
<td>20. Identification of the Causal Factors of Hazard Reports</td>
<td>68</td>
</tr>
<tr>
<td>21. The Use of Investigative Techniques</td>
<td>69</td>
</tr>
</tbody>
</table>
22. Classification of Hazards Reported .................................................................69
23. The Use of a Common Taxonomy to Disseminate Information .......................70
24. The Use of a Common Taxonomy to Develop Trend Analysis .......................71
25. The Use of a Common Taxonomy to Hazard Classification and Accident
    Investigation .............................................................................................................71
26. The Taxonomy Related to Human Error and Modern Safety Theories .............72
27. The Adaptation Capacity of the Taxonomy ........................................................73
28. The Use of Taxonomy in Existent Databases ......................................................74
29. The Importance of Evaluating the Probability ...................................................74
30. The Importance of Evaluating the Severity .......................................................75
31. The Use of a Matrix Probability x Severity .......................................................76
32. The Importance of Tolerability Evaluation .......................................................76
33. The Tolerability Evaluation Importance for the Decision-Making Process .......77
34. The Second Tolerability Evaluation ..................................................................78
35. The Evaluation of Controls Effectiveness ..........................................................78
36. Prioritizing Controls According to its Effectiveness ...........................................79
37. Evaluating the Costs of Controls ....................................................................80
38. Training to Perform Risk Assessment and to Establish Controls ....................81
CHAPTER 1
NATURE AND SCOPE OF THE STUDY

Background of the Study

The early days of aviation were characterized by a high frequency of accidents. Since then, technological improvements resulting from accident investigations, together with the development of an adequate infrastructure and increasing regulations led to a gradual but steady decline in the rate of accidents (ICAO, 2009).

According to the Brazilian Aeronautical Accidents Investigation and Prevention Center (CENIPA), the constant technological improvement imposes a challenge to everyone linked to aviation, which is the update of knowledge to maintain safety in air operations (CENIPA, 2009a). This call to action shows the importance of keeping a state of the art awareness of safety theories and studies to ensure the effectiveness of the best practices in aviation. In order to enhance safety, a closer look at new theories and approaches must be a persevering effort.

The rise of Safety Management System (SMS) and its focus on risk management has introduced several new concepts to aviation. Many principles and tools used in quality management have been incorporated into SMS and are being applied in the aviation environment, resulting in important improvements to safety (Stolzer, Halford, & Goglia, 2008). SMS also incorporated some important theories such as the industry-wide accepted concept of the organizational accident developed by Professor James Reason (ICAO, 2009).

CENIPA (2009a) considers that some of the concepts of SMS have great potential for use in modernizing the Brazilian Air Force Safety Program. In consequence, a review
of these concepts and tools is important and could bring valuable contributions to improve many of the tools and safety initiatives currently in use by the Air Force.

One of the most important tools in SMS is an effective safety reporting system. According to ICAO (2009), effective safety reporting is the gateway for safety data acquisition and the cornerstone of the management of safety. The identification of hazards is a fundamental activity within SMS and the first step to manage proactively the safety.

**Statement of the Problem**

The Hazard Report (HAZREP) Program is essential to the Brazilian Air Force’s effort to identify hazards to flight operations and develop safety actions to mitigate the risks (Lima, 2007). It is a reporting system widely used in all flight squadrons and proved to be a valorous tool to enhance safety. Since its creation, there has been no significant change in form or the way it is managed.

A study conducted by Lima (2007) was the first attempt to evaluate the HAZREP Program within the Brazilian Air Force squadrons. The purpose of the study was to investigate the knowledge, attitudes, and beliefs of the operational personnel toward the HAZREP and discover users’ opinions of the Brazilian Air Force Hazard Report Program as an aviation safety tool.

Mendonça (2008) conducted another study to verify the applicability of SMS concepts into a bird hazard report. The bird hazard report is a widely used report by civilian and military pilots in Brazil and an important source of data to provide orientation to address mitigation actions. The study proposed a model to deal with bird hazard based on the SMS perspective.
Safety Management System concepts can constitute an important contribution to revise the Brazilian Air Force’s HAZREP Program. However, there is no current study to verify the applicability of incorporating SMS concepts into the Hazard Report Program. For the Brazilian Air Force most of the aviation safety specialists are concentrated in CENIPA and in the Aeronautical Accidents Investigation and Prevention Regional Services (SERIPA), but there is no study to specifically assess the perceptions of these safety specialists on the need to review the hazard report.

Therefore, the purpose of this study is to verify the need for a revision of the Hazard Report Program using the SMS perspective and to highlight the most important aspects that should be considered in this review.

Specifically, the purpose of this study is to seek answers for the following questions:

1. What are the perceptions of the CENIPA/SERIPA safety specialists about the need to revise the HAZREP Program using the SMS perspective for reporting systems?
2. Which aspects of the SMS related to reporting systems should be used to review the HAZREP Program?

**Need and Significance of the Study**

Aircraft accidents are a big concern to all managers in aviation industry. In civilian organizations, accidents result in major revenue losses not only because of aircraft damage, compensation to the victims, and increasing insurance premiums, but also because of the loss of credibility and the company’s stock market value (Wood, 2003). On the other hand, military organizations’ main concerns regarding aircraft accidents are related to the decrease in operational capability (Lupoli, 2006). Of course,
the greatest losses in aircraft accidents are always the human lives because they are impossible to restore.

However, according to ICAO (2009), “failures and operational errors will occur in aviation, in spite of the best and most accomplished efforts to prevent them. No human activity or human-made system can be guaranteed to be absolutely free from hazards and operational errors” (p. 2-2). This means that hazards are integral parts of the aviation environment.

These hazards have to be identified and eliminated or controlled to prevent accidents from occurring (Perrow, 1999). According to Bhagwati (2007), discovering the hazards present in a system and mitigating them can be a powerful tool for prevention. This concept is considered so important that ICAO (2009) included into the definition of safety the need for a “continuing process of hazard identification and safety risk management” (p. 2-2).

In the Brazilian Air Force context, the HAZREP Program is the backbone of the current effort to identify hazards to flight operations and develop safety actions to mitigate the risks (Lima, 2007). In this study, new concepts included in SMS were identified and analyzed to verify whether they could be used to revise the HAZREP Program. According to CENIPA (2008c), professionals from the Aeronautical Accidents Investigation and Prevention System (SIPAER) are responsible for advising the top-level administration in subjects related to safety in aviation. This study specifically targeted these safety specialists’ perceptions about SMS concepts because of their high level of knowledge in accident prevention.
Definitions of Terms

The following terms and definitions are used in this study:

**Accident.** CENIPA (2008a) defines aeronautical accident as:

An occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all persons have disembarked, in which: A person is fatally injured; the aircraft sustains major structural failures or damage; the aircraft is missing or completely inaccessible (p. 16).

**CENIPA.** Portuguese for *Centro de Investigação e Prevenção de Acidentes Aeronáuticos* [Aeronautical Accidents Investigation and Prevention Center], it is the Brazilian Air Force Safety Center and it is in charge of all aspects related to aeronautical safety in Brazil (CENIPA, 2008c).

**Hazard.** “A condition or an object with the potential to cause injuries to personnel, damage to equipment or structures, loss of material, or reduction of ability to perform a prescribed function” (ICAO, 2009, p. 4-1).

**Hazard report form (HAZREP form).** “Formal document for the voluntary report of a potential risk situation to the flight safety” (CENIPA, 2008a, p. 32).

**Hazard report process (HAZREP process).** This term is operationally defined as a three step process, including the voluntarily report by operational personnel of a potential hazardous situation to aviation, the analysis of the hazard, and the establishment of mitigation actions to address the hazard (CENIPA, 2008b).

**Hazard report program (HAZREP program).** “Program that manages the voluntary reporting of a potential risk situation to the flight safety” (CENIPA, 2008b,
It includes the directives from CENIPA to the safety managers and its purpose is to allow the establishment of mitigation actions to correct the hazard situation (CENIPA, 2008b).

**Incident.** “An occurrence, other than an accident, associated with the operation of an aircraft which affects or could affect the safety of the operation” (CENIPA, 2008a, p. 25)

**Perceptions.** “Personal feelings, impression, belief or comprehension of an object, event, or quality that may or may not be factual” (Swanson & Holton III, 1999, p. 134).

**Risk management.** “Risk management is the process of measuring risk and developing strategies to manage it” (Stolzer et al, 2008, p. 20).

**Safety.** “The state in which the possibility of harm to persons or of property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and safety risk management” (ICAO, 2009, p. 2-2).

**Safety culture.** “A group of individuals guided in their behavior by their joint belief in the importance of safety, and their shared understanding that every member willingly upholds the group’s safety norms and will support other members to that common end” (Helmreich & Merritt, 1998, p. 134).

**Safety Management System (SMS).** “A dynamic risk management system based on quality management system (QMS) principles in a structure scaled appropriately to the operational risk, applied in a safety culture environment” (Stolzer et al, 2008, p. 18).

**Safety risk.** “The assessment, expressed in terms of predicted probability and
severity, of the consequences of a hazard, taking as reference the worst foreseeable situation” (ICAO, 2009, p. 5-2).

**SERIPA.** Portuguese for *Serviço Regional de Investigação e Prevenção de Acidentes Aeronáuticos* [Aeronautical Accidents Investigation and Prevention Regional Service], they are the regional organizations subordinated to CENIPA and responsible for all aspects related to aeronautical safety in their respective regions. There are seven SERIPA, each responsible for one region (CENIPA, 2008c).

**SIPAER.** Portuguese for *Sistema de Investigação e Prevenção de Acidentes Aeronáuticos* [Aeronautical Accident Investigation and Prevention System], it is a system that manages flight safety in Brazil, headed by a center, the CENIPA. Under its structure are all the aviation organizations such as airlines, aeronautical industry, airport infrastructure, and the Brazilian Armed Forces. These organizations are connected as a system and are subordinated to the CENIPA for subjects related to aviation safety (CENIPA, 2008c).

**Scope and Delimitations of the Study**

The following delimitations are presented for this study.

1. The survey instrument was sent to safety specialists in CENIPA and its seven regional offices (SERIPA) with an explanation of the purpose of this project, which could be subjected to different interpretation by recipients.

2. Only personnel who had previously attended a recognized safety course in CENIPA and hold a safety credential were considered.

3. Only safety specialists who are currently working for CENIPA/SERIPA were requested to participate.
4. This study does not intend to determine the safety level within or between participant organizations.

5. Results may be impacted by participants’ time in their positions, safety background, and prior experience.

6. No sensitive information about the operational capacity of the Brazilian Air Force was disclosed in any part of this study.

Assumptions

The following assumptions are presented in the study.

1. According to CENIPA, all safety specialists who hold a safety credential are trained to carry on the duties of a safety section, including knowledge of safety theories and safety programs, and practice training with HAZREP and other tools.

2. Based on recognized training programs provided from CENIPA, all safety specialists were considered capable of identifying hazards and making use of the Hazard Report form.

3. The Hazard Report Program is implemented in all flight squadrons throughout the Brazilian Air Force (CENIPA, 2008b).

4. CENIPA and SERIPA are responsible for managing Hazard Report Programs within their organizations, including not only the process of collecting the hazard reports, determining the safety risks, and developing mitigation actions, but also for the training to the operational personnel (CENIPA, 2008b).

5. The Safety Management System is a current approach of ICAO to enhance safety worldwide in aviation.

6. It is feasible to adapt and apply ICAO SMS concepts to any kind of
organization, including the Brazilian Air Force.

**Summary**

This chapter introduced the main aspects focused on this study. First, the constant improvement of aviation was presented, leading to the need to enhance safety accordingly. The potential of SMS to review the Hazard Report Program was shown in the statement of the problem, but there is no current study to verify the applicability of SMS concepts. Finally, the purpose of the study was presented: To verify the need for a revision of the Hazard Report Program using the SMS perspective and to highlight the most important aspects that should be considered in this review.

In order to focus the study, two research questions were presented and the terms used in this report were defined. The scope, delimitations, and assumptions were provided to permit a clear understanding of the research. This first chapter serves as an initial guide for the rest of the study and shows the essential aspects that will be investigated in order to build a comprehensive set of knowledge.
CHAPTER 2
REVIEW OF RELATED LITERATURE

Overview

This study is intended to assess the perceptions of the CENIPA/SERIPA’s safety specialists to revise the Brazilian Air Force Hazard Report Program with concepts from Safety Management Systems (SMS). In order to accomplish this task, the review of related literature will focus first on SMS history, importance, and theory showing the role it plays in aviation safety. Then a brief view of the hazard reporting systems will be presented with some concepts and characteristics, as well as a review of the Brazilian Air Force Hazard Report Program (HAZREP Program). Finally, the SMS perspective to hazard reporting systems will be explored and the characteristics of effective reporting systems will be highlighted and compared to the Brazilian Air Force HAZREP program.

Summary of Search Strategies and Terms

An internet search for the terms Safety Management System, Reporting System, and Hazard Report was conducted to find valid sources. The databases of James C. Kirkpatrick Library were used, especially those listed under Applied Science. This procedure identified thesis and peer-reviewed journals directly related to the subject, and some important concepts were found in books about SMS. Another source used was the Brazilian Air Force database with documents related to the Hazard Report Program. Government documents from the Federal Aviation Administration (FAA), Transport Canada (TC), and International Civil Aviation Organization (ICAO) were also used in this study.
Safety Management System Background

Evolution of safety. According to ICAO (2009), before the Second World War and until the 1950s the aviation industry suffered from poor regulation, a lack of infrastructure, and underdeveloped technology. Other problems were related to the lack of oversight and the need to achieve a better understanding of the hazards associated to aviation. As a result, this period was characterized by a high frequency of accidents.

The priority for safety was the prevention of accident based on the investigation of the occurrence (ICAO, 2009). The airplanes were flown until an accident occurred and then an investigation was developed to determine the causes to prevent it from happening again. This approach was known as fly-crash-fix-fly (Stolzer et al., 2008) and frequently the causes would be related to human error, usually the pilot.

The typical result of this approach was to generate safety recommendations aimed at the specific, immediate safety concern identified as causing the safety breakdown (ICAO, 2009). Little emphasis was placed on correcting the hazardous conditions that held damaging potential for aviation operations, but were not identified as causal in the occurrence under investigation.

According to ICAO (2009), the aviation safety thinking has experienced a significant evolution since the 1950s (see Figure 1). The period immediately following the Second World War until the 1970s, can be characterized as the technical era. The safety concerns were mostly related to technical factors because technology was not fully developed, and technological failures were frequent. The safety focus was placed on the investigation and improvement of technical factors.
Figure 1. Evolution of safety thinking. Source: Safety Management Manual (Document 9859, by ICAO, 2009, Montreal, Canada: Author. 

The major technological advances in the early 1970s and consequently improvement of safety shifted the focus to human performance (ICAO, 2009). It was the beginning of the human era. Some of the initiatives of this period were the development of line-oriented flight training (LOFT), cockpit resource management (CRM), human-centered automation and other human performance interventions.

In spite of the investment of resources in error mitigation, by the mid-1990s human performance continued to be a recurring factor in accidents (ICAO, 2009). The problem of the human performance approach was the tendency to focus on the individual, rather than the operational context in which individuals are surrounded to accomplished their missions.

In the early 1990s, scientific literature became available addressing the question of how features of an operational context can influence human performance and shape
outcomes. It was the beginning of the *organizational era* (ICAO, 2009), when the approach to safety changed to a systemic perspective, to encompass organizational, human and technical factors, and to focus safety efforts on the organizational process.

**Reason model.** Many theorists have proposed different models and perspectives to explain the accident causation and the role of human error in highly technological environments. However, none has achieved the almost universal acceptance that James Reason has received for his model (Wiegmann & Shappell, 2003).

Reason (1997) developed an organizational causation model, known as the *Swiss cheese* model that has been widely used in the aviation industry. Reason considered that any model is inadequate if it simply attributes accidents to individual operator performance. Reason’s approach is based on the assumption that any organization has fundamental elements that must work harmoniously in order to achieve a safe operation (Wiegmann & Shappell, 2003).

Complex systems such as aviation are extremely well-defended by layers of defenses (ICAO, 2009). Reason’s model states that accidents require the coming together of a number of enabling factors to breach these defenses. According to ICAO (2009), the “breaches in safety defenses are a delayed consequence of decisions made at the highest levels of the system, which remain dormant until their effects or damaging potential are activated by specific sets of operational circumstances” (p. 2-5).

Human failures at the operational level act as triggers of latent conditions, facilitating a breach of the system’s inherent safety defenses (see Figure 2). All accidents include a combination of both human failures and latent conditions. These failures can be viewed as holes within different layers of the system, giving the appearance of *Swiss*
cheese (Wiegmann & Shappell, 2003).

In accident investigation, the Reason model is important because it forces the investigators to address the latent failures (Wiegmann & Shappell, 2003). The human failures at the operational level are normally easy to identify, but latent failures may lie dormant and undetected for a long period. In this model, the focus on latent failures helps prevent investigators from overlooking them.

The organizational approach, focused on a systemic view to safety, provides a more productive perspective to prevention. In this approach, the hazards to aviation must be systematically identified ranging from the human actions to the organizational processes, allowing the proper management of the risk. This makes it possible to design out of the system all the causes to accidents, enhancing safety (Stolzer et al., 2008).

ICAO incorporated the Reason model into the SMS, allowing a comprehensive
approach to safety. In the Safety Management Manual (Doc 9859), the organizational accident causational model is used as a central background theory for the development of principles and tools to prevent accidents within the aviation industry (ICAO, 2009). This modern approach to safety allows SMS to be a more effective and useful perspective to identify hazards and manage risks to aviation.

**SMS importance.** The FAA recognizes the growth in aviation demand and the need to move to a more proactive and efficient way to assure safety in these operations. In the objectives of the FAA to 2009 – 2013, it is clear the role of SMS in aviation as the new standard to safety in air operations worldwide (FAA, 2009). For the FAA, this will enhance safety and provide more efficient oversight because of the SMS emphasis in a participative approach between government and aircraft operators.

According to Stolzer et al. (2008), “regulatory authorities, safety experts and industry leaders have proclaimed that SMS represents the future of safety management in the aviation industry” (p. 13). SMS has been applied in many countries and is gaining impulse in the United States. It provides a powerful framework of safety theory, tools, and methodologies to build proactive safety systems in any organization.

SMS is also very attractive because of its resulting economic advantages in reducing the accidents of particular operators (Transport Canada, 2008). Some of the direct costs of accidents are normally covered by insurance companies. However, the indirect costs are difficult to quantify and normally are not covered by the insurance. Some of these costs are related to the loss of reputation, legal fees, loss of income (lost use of equipment), increased insurance premiums, and the cost of replacement workers (Wood, 2003). Therefore, one of the most important reasons to implement an SMS
program into any aircraft operator is simply the reduction of costs associated with the decrease in accident frequency.

Despite that the reduction of costs is not the first priority to the Brazilian Air Force, SMS is very important to keep the combat capacity of the air squadrons. Incidents and accidents that could be avoided represent an inadmissible reduction in air combat potential. It is important to notice that SMS could help to reduce the irreparable loss of human lives (Mendonça, 2008).

Concerned about this, CENIPA is revising its documentation and rules to incorporate SMS concepts established in the ICAO Safety Management Manual. According to CENIPA (2009a), SMS can be applied to military aviation and its concepts have a great potential to the Brazilian Air Force. A closer look to SMS is now being considered, and one particular area that is especially relevant to safety and could receive benefits from SMS perspective is the Brazilian Air Force Hazard Report Program.

**Reporting Systems**

**Significance and uses of reporting systems.** The central idea of an accident prevention program is to identify all hazards associated with an operation, and develop actions or defenses to mitigate the safety risk (Strauch, 2002). The early identification of hazards is essential to safety prevention efforts (Lu, Wetmore & Przetak, 2006).

According to Wood (2003), it is impossible to operate safety program based only in data gathered from accidents. There is simply not enough data available because of the low frequency of accidents in modern aviation and waiting for an accident to correct deficiencies is not the best approach for safety. Thus, some kind of tool is necessary to collect safety related information.
O’Connor and O’Dea (2007) studied the U.S. Navy’s Aviation Safety program. They identified that the purpose of the hazard report is not only an early detection of hazards to take positive actions, but also to share the information with other organizations and to allow the building of a database for future studies.

A good example of the need to share hazard information was the accident of TWA Flight 514 near Washington, in December 1, 1974. The Boeing 727 crashed into Mount Weather, about 25 miles from Dulles Airport, killing 92 people onboard. The National Transportation Safety Board (NTSB) investigation revealed various problems, but the most significant was that just six weeks before another flight from a different carrier experienced the same misinterpretation of the approach clearance with a near catastrophic consequences. The information that could avoid the accident was shared within the company, but not to others carriers (Stolzer et al., 2008).

As a result of this accident, in 1976, the Aviation Safety Reporting System (ASRS) was created to disseminate safety information within the aviation industry. Similar initiatives like this were developed all around the world to address local needs and ensure timely correction of identified hazards and adequate flow of safety information (Wells & Rodrigues, 2003).

According to the ICAO (2009), an effective reporting system is the cornerstone to safety management and the gateway to acquire safety information. After the report the information must be transformed into valid safety data through data classification according to a system (Stolzer et al, 2008).

Hobbs and Kanki (2008) studied patterns of errors in maintenance confidential reports and demonstrated the value of this approach. Confidential reporting systems
provide a large database, and the volume of data is important to make it easier to identify patterns of maintenance errors and others insights. Different types of hazard reports have been used in order to establish a comprehensive database for hazard analysis (Lee & Weitzel, 2005). Another advantage of this kind of database is the use of operational personnel language, making it very simple to the workers to report the hazards.

Reporting systems are fundamental not only for hazard identification and management of safety, but for developing the safety culture among the employees. According to the ICAO (2009), the way that an organization designs the procedures and practices for its reporting system is one of the most influential issues in the organizational safety culture.

Finally, the reporting systems take advantage of the fact that the best people to report hazards are the operational personnel who have direct contact with the problems (Wood, 2003; ICAO, 2009). Mendonça (2008) showed that pilots believe that communication is essential to safety. They have a clear understanding that flight safety does not depend only on the safety department and that their participation is very important for the organization. According to Stolzer et al. (2008), to access the experience of the employees that face hazards on the shop floor is an effective principle to enhance safety.

**The Brazilian Air Force’s Hazard Report Program.** The Hazard Report Program is a reporting system used in the Brazilian Air Force. Its purpose is to allow a voluntarily submitted report of a hazard to aviation and the subsequent process of the analysis and development of the mitigation actions (CENIPA, 2008b). Any person, operational or non-operational, who identifies a potential hazard to aviation, may
complete a hazard report form. It is important to recognize that the Hazard Report is the current backbone of the Air Force’s effort to identify and neutralize hazards (Lima, 2007).

All the air squadrons in the Brazilian Air Force and the Air Traffic System (ATS) have implemented a Hazard Report Program. The basic guidelines on how to manage the HAZREP, the procedures, and the restrictions are included in the Systemic Regulation from Aeronautical Command 3-3: Management of Operational Safety (CENIPA, 2008b). This document is elaborated by CENIPA and contains the directives to all the safety programs in use in the Brazilian Air Force. According to this document, any person may report a hazard using the internet, fax, phone or the printed formulary. The reporter may choose to identify himself or not, but if identified he will receive feedback about the actions adopted to correct the problem.

The document also explains how to manage the process of hazard reports. The HAZREP must be managed only by a safety manager working in Aeronautical Accident Investigation and Prevention System (SIPAER) (CENIPA, 2008b). This means that the manager received the proper training and the organizations are connected as a system, subordinated to the CENIPA for subjects related to aviation safety.

The safety manager should make the analysis of the hazard reported and the assessment of the risk with a matrix of probability versus severity (CENIPA, 2008b). If necessary, the report will be forwarded to the sector responsible to correct the problem. In this case the sector is responsible to inform the necessary mitigation actions to the safety manager, who will assess the efficacy of the measures to improve safety.

The safety manager is responsible to inform the reporter about the situation and
disseminate the lessons learned to other organizations and operators when applicable. According to CENIPA (2008b), if the situation of risk could occur in different organizations the hazard report must be released to them, allowing the adoption of the proper mitigation actions.

The HAZREP form should be completed only to report a hazard that affects the safety of air operations, including the maintenance of aircraft. However, any report will be received by the safety manager. If the situation reported is not a safety issue, then the report will not be considered valid; the process is completed and the reporter will be informed by the safety manager (CENIPA, 2008b).

The safety manager must always preserve the identity of the reporter, assuring the confidentiality of the process (CENIPA, 2008b). However, if the reporter agrees, the identity may be revealed due to instructive or motivational purposes. If the report includes inappropriate terms, they will be removed to preserve the reporter without prejudice to the content.

Finally, all occurrences will be kept on file to later perform trend analysis, dissemination of information, and definition of goals to safety (CENIPA, 2008b). In the same document there is a model of formulary (see Appendix A) to be used in HAZREP. Each organization may develop a different formulary, but CENIPA recommends that the descriptive part filled by the reporter is kept as simple as possible.

The formulary explains that following Brazilian regulations the purpose of the report is to enhance safety and should only be used to prevent aeronautical accidents. It also states that “this report does not need to be identified. Should the reporter, however, choose to identify him/herself, he/she will be informed on the measures adopted” (see
Appendix A).

There is a space in the formulary to report the hazard and to identify the reporter with the respective means to contact him. The next part is for the safety manager to forward the HAZREP to the sector responsible to analyze the situation and establish the mitigation actions, with the number of the process. After the analysis and mitigation actions, the sector responsible will forward back the HAZREP to the safety manager. Then the safety manager will establish the recommended actions and will assess the safety risk to verify if it is acceptable.

There is another reporting instrument titled Confidential Report for Aviation Safety (RCSV), available for the whole Brazilian aeronautical industry (CENIPA, 2009b). The RCSV is the Brazilian counterpart to the American ASRS, and the program is managed by CENIPA, the Brazilian governmental authority for aviation safety.

After this brief review of the reporting systems and specifically the Brazilian HAZREP, it is important to look closer at the concepts and philosophy being proposed by ICAO in the Safety Management Manual (Doc 9859). Some concepts and tools currently in use in SMS may be applied to the Hazard Report Program in the Brazilian Air Force with potential to enhance safety and reduce accidents. The differences and similarities between both systems will be discussed to help in the development of the survey.

**SMS Perspective to Hazard Reporting Systems**

**Safety risk management process.** In order to understand the SMS perspective to the reporting systems, it is important to present the process of managing safety according to ICAO. Without the understanding of this process is not possible to establish a comparison with the process used in the Brazilian HAZREP Program.
SMS is organized around four basic blocks of safety management (FAA, 2006; Wood, 2003). These blocks, also called *pillars*, are policy, safety risk management, safety assurance, and safety promotion. This study focuses on safety risk management because it is the core of the SMS and is directly related to the reporting systems. The safety risk management is essential to keep the risks under acceptable levels.

According to Stolzer et al. (2008), FAA and ICAO have the same basic three-step process for the safety risk management: identify the hazards, assess the risks, and control the risks. This process is the essence of the safety risk management and need to be well understood. ICAO (2009) considers this the dogmatic component that underlies the concept of system safety.

**First step – identification of hazards.** As already explained reporting systems were created to help with this problem by allowing any worker to report a hazard. The process of hazard identification, however, is broader than HAZREP and comprehends many other activities, tools, and methods. According to Stolzer et al. (2008), it is possible to classify the hazard identification in two methods: hazard identification through operational observations and hazard identification through process analysis. Both methods are valid, but the more common method used in the real world is identification through operational observations. This study is focused in the hazard report that is a method of hazard identification through operational observations.

Identification of hazards is not new, but SMS brings certain attributes to this method, including rigor, consistency, and flexibility (Stolzer et al., 2008). Because of the complexity of the mechanism to identify hazards, rigor is required to collect data and strong consistency is a key to gather all the information into a useful database. Finally,
the system must be flexible enough to store detailed information not easily classified within a common taxonomy.

According to Stolzer et al. (2008), identification equals classification. O’Connor and O’Dea (2007) studied the U.S. Navy’s Aviation Safety program. They identified that the purpose of the Hazard Report is not only an early detection of hazards to take positive actions to avoid a failure, but to share information with other organizations and to allow the building of a database for future studies. As indicated by Lu, Bos and Caldwell (2007), the purposes of hazard identification is data categorization, meaning that some type of classification of hazards is necessary. Choosing the taxonomy to be used in the identification of hazards is an important step and must be analyzed carefully.

According to Transport Canada (2008), at a minimum, report forms should allow for a full description of the event and provide space for the reporter to offer suggestions as to possible solutions to the problem being reported. The reports should employ a common and clearly understood taxonomy of error classifications, facilitating trend analysis of the events.

Stolzer et al. (2008) consider that adopting a common taxonomy for use in SMS is a high priority action item. However, in the Safety Management Manual, ICAO (2009) does not present or suggest any specific taxonomy. There is only a mention that it is important to translate raw operational safety information into hazard-related knowledge. CENIPA (2009) does not disseminate to the BAF safety managers any type of classification of the hazards. The only classification system used in BAF is for aircraft accident investigation and it is too complex and time consuming for a practical application in hazard identification.
Stolzer et al. (2008) analyzed different taxonomies to verify the best model to apply in safety management systems. They examined the Aviation Safety Reporting System (ASRS), the British Airways Safety Information System (BASIS), the Accident/Incident Reporting Data System (ADREP), the Aviation Causal Contributors for Event Reporting Systems (ACCCERS), the Human Factors Analysis and Classification System (HFACS), and Threat and Error Management Model (TEM). HFACS and TEM were considered the most promising taxonomies for hazard classification in SMS because both are based on James Reason’s model of human error and made distinction between human failures and latent failures.

Stolzer et al. (2008) chose TEM because it uses a simple classification that may be completed in a short period of time and based on information available in the cockpit. HFACS instead supports data collection and classification process as completed during accident investigations. This process requires more time and often includes multiple sources of information.

However, for the purpose of this study HFACS is more useful. The reporter, even within the cockpit, just needs to describe the situation with his own words. The categorization will be made later by the safety manager and it is desirable that he uses other sources to verify the event. The fact that TEM is too simple, not allowing multi-level framework of connections of factors is a significant limitation. Finally, the possibility of HFACS to be used as a support tool during accident investigation brings an important advantage against TEM. The same safety managers who are responsible for accident investigation are responsible for the HAZREP process. The possibility in the future to conduct accident investigation and hazard identification under a standardized
taxonomy represent a significant benefit for the Brazilian Air Force.

Wiegmann and Shappel (2003) analyzed hundreds of accident reports with thousands of human causal factors, using over 300 naval aviation accidents from the U.S. Naval Safety Center in order to develop the HFACS. They later refined this classification system with data from the U.S. Air Force, U.S. Army Safety Center, National Transportation Safety Board (NTSB), and the FAA. The resulting work proved to be effective within both military and civil aviation.

The reliability of HFACS has been repeatedly tested, proving its value as a tool for recognition and analysis of human factor safety issues (Shappell & Wiegmann, 2000). The HFACS model has been used not only to improve accident and incident investigations, but to foster a safety culture within the aviation industry. It is also possible to apply HFACS in already existent safety databases such as the CENIPA accident investigation database.

Human Factors Analysis and Classification System is a system safety tool which can be used to systematically examine underlying human causal factors in order to increase safety (Shappell & Wiegmann, 2000). Basically, what Wiegmann and Shappel (2003) did was objectively describe the *holes in the cheese* of the Reason model, presenting the flaws in the systems barriers classified by four levels (see Figure 3). Each level corresponds to one of the four layers described in the Reason model. The four levels are unsafe acts, preconditions for unsafe acts, unsafe supervision, and organizational influences.
Wiegmann and Shappell (2003) then describe the holes for each level. It is not the purpose of this study to perform an extensive explanation of the HFACS model, but to show the advantages of adopting such model as the fundamental taxonomy to be used within the hazard reporting systems. Table 1 shows the detailed classification model developed by Wiegmann and Shappell.

According to Wiegmann and Shappell (2003), HFACS can be modified and adapted to accommodate the particular needs of an organization. Some examples of this flexibility are the Canadian Forces with the CF-HFACS, the air traffic control model (HFACS-ATC), the aircraft maintenance model (HFACS-ME), and the medicine model (HFACS-MD).

Reviewing the advantages of the HFACS model, it is important to say that this
classification system was tested and improved many times. It is based on Reason model and has been used by different organizations all over the world. It can be used to classify and analyze hazards as well as aircraft accidents, be applied to existing databases and be adapted to satisfy the needs of the organization.

Table 1

The classification model of Human Factors and Classification System (HFACS).

<table>
<thead>
<tr>
<th>ORGANIZATIONAL INFLUENCES</th>
<th>Resource Management</th>
<th>Organizational Climate</th>
<th>Organizational Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNSAFE SUPERVISION</td>
<td>Inadequate Supervision</td>
<td>Planned Inappropriate Operations</td>
<td>Failure to Correct a Known Problem</td>
</tr>
<tr>
<td>PRECONDITIONS FOR UNSAFE ACTS</td>
<td>ENVIRONMENTAL</td>
<td>CONDITION OF OPERATORS</td>
<td>PERSONNEL FACTORS</td>
</tr>
<tr>
<td>Physical Environment</td>
<td>Technological Environment</td>
<td>Adverse Mental States</td>
<td>Adverse Physiological States</td>
</tr>
<tr>
<td>UNSAFE ACTS</td>
<td>ERRORS</td>
<td>VIOLATIONS</td>
<td></td>
</tr>
<tr>
<td>Skill-based Errors</td>
<td>Decision Errors</td>
<td>Perceptual Errors</td>
<td>Routine</td>
</tr>
</tbody>
</table>

Note. This table is based on Human Error Approach to Aviation Accident Analysis (Wiegmann & Shappell, 2003).

Another important aspect to identify hazards is the use of analytical tools to
investigate all the factors related to a reported hazard. The value of these tools is to help the safety managers conduct a detailed analysis of the event and to provide effective counter-measures (Lu, Bos & Caldwell, 2007). Vincoli (2006) presented a list of system safety analysis tools that can be used to assist safety managers such as Failure Mode Effect Analysis (FMEA), Fault Tree Analysis (FTA), and Management Oversight and Risk Tree (MORT).

As Lu, Wetmore and Przetak (2006) demonstrated in the study Another Approach to Enhance Airline Safety: Using Management Safety Tools, the use of these techniques is feasible. More importantly, they showed the value of these tools to detect risk factors, design more effective countermeasures, and reduce the consequences of hazards.

CENIPA does not present any safety tool to be used by the safety managers in the HAZREP process (CENIPA, 2008b). The investigation of the perceptions of safety specialists regarding this matter is important to verify whether the tools are needed and adequate to the Brazilian Air Force squadron environment.

**Second step – risk assessment.** According to Stolzer et al. (2008), the risk assessment should be understood as the “valuation of the potential loss associated with a risk, as compared with the cost of effectively controlling that risk” (p. 131). ICAO (2009) clarifies this concept when it shows that the objective of safety risk management is to provide the foundation for a balanced allocation of resources to those risks that the control and mitigation are viable. The value of this view resides in the data driven approach to resource allocation, thus defensible and easier to explain.

In order to begin this process, it is important to remember the definition of safety risk. According to ICAO (2009), safety risk is defined as “the assessment, expressed in
terms of predicted probability and severity, of the consequences of a hazard, taking as reference the worst foreseeable situation” (p. 5-2). This concept highlights the two factors that are presented in the risk matrix used in SMS: probability and severity.

Therefore, the process of risk assessment starts evaluating the probability that the consequences of hazards materialize during operations. This is known as assessing the safety risk probability and basically is the likelihood that an unsafe event or condition might occur (ICAO, 2009). In order to make informed decisions, ICAO considers it very important, when assessing the safety risk probability, to consult the historical data contained in the safety library of the organization.

Table 2 presents a typical safety risk probability table, in this case, a five-point table. This table is an example presented by ICAO for educational purposes only. Although this table, as well as the severity table and the risk assessment and tolerability matrixes discussed in the following paragraphs are, conceptually speaking, industry standards, the level of detail and complexity of tables and matrixes must be adapted and commensurate with the particular needs and complexities of different organizations.

Table 2

<table>
<thead>
<tr>
<th></th>
<th>Meaning</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequent</strong></td>
<td>Likely to occur many times (has occurred frequently)</td>
<td>5</td>
</tr>
<tr>
<td><strong>Occasional</strong></td>
<td>Likely to occur sometimes (has occurred infrequently)</td>
<td>4</td>
</tr>
<tr>
<td><strong>Remote</strong></td>
<td>Unlikely to occur, but possible (has occurred rarely)</td>
<td>3</td>
</tr>
<tr>
<td><strong>Improbable</strong></td>
<td>Very unlikely to occur (not known to have occurred)</td>
<td>2</td>
</tr>
<tr>
<td><strong>Extremely improbable</strong></td>
<td>Almost inconceivable that the event will occur</td>
<td>1</td>
</tr>
</tbody>
</table>

Note. This table is based on the Safety Management Manual (ICAO, 2009).
After assessing the safety risk probability, the second step is the assessment of the severity of the consequences of the hazard. This is known as assessing the safety risk severity and is defined as the “possible consequences of an unsafe event or condition, taking as reference the worst foreseeable situation” (ICAO, 2009, p. 5-7). Table 3 presents a typical five-point safety risk severity table. This table is an example presented for educational purposes only.

Table 3

Safety risk severity.

<table>
<thead>
<tr>
<th>Severity of occurrence</th>
<th>Meaning</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Catastrophic</strong></td>
<td>— Equipment destroyed</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>— Multiple deaths</td>
<td></td>
</tr>
<tr>
<td><strong>Hazardous</strong></td>
<td>— A large reduction in safety margins, physical distress or a workload such that the operators cannot be relied upon to perform their tasks accurately or completely</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>— Serious injury</td>
<td></td>
</tr>
<tr>
<td></td>
<td>— Major equipment damage</td>
<td></td>
</tr>
<tr>
<td><strong>Major</strong></td>
<td>— A significant reduction in safety margins, a reduction in the ability of the operators to cope with adverse operating conditions as a result of increase in workload, or as a result of conditions impairing their efficiency</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>— Serious incident</td>
<td></td>
</tr>
<tr>
<td></td>
<td>— Injury to persons</td>
<td></td>
</tr>
<tr>
<td><strong>Minor</strong></td>
<td>— Nuisance</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>— Operating limitations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>— Use of emergency procedures</td>
<td></td>
</tr>
<tr>
<td></td>
<td>— Minor incident</td>
<td></td>
</tr>
<tr>
<td><strong>Negligible</strong></td>
<td>— Little consequences</td>
<td>E</td>
</tr>
</tbody>
</table>

*Note*: This table is based on the Safety Management Manual (ICAO, 2009).

The third step in the process is the assessment of the tolerability of the consequences of the hazard. This is known as assessing safety risk tolerability. First, it is
necessary to obtain an overall assessment of the safety risk, combining the safety risk probability and safety risk severity tables into a safety risk assessment matrix (ICAO, 2009). For example, if the risk probability of a reported hazard was considered *frequent* and the risk severity was considered *catastrophic*, combining these two values in a matrix will result in a safety risk index of 5A (see Table 4). Again, this matrix is only an example and the organization may define a different matrix.

Table 4

*Example of matrix severity x probability.*

<table>
<thead>
<tr>
<th>Risk probability</th>
<th>Risk severity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Catastrophic A</td>
</tr>
<tr>
<td>Frequent 5</td>
<td>5A</td>
</tr>
<tr>
<td>Occasional 4</td>
<td>4A</td>
</tr>
<tr>
<td>Remote 3</td>
<td>3A</td>
</tr>
<tr>
<td>Improbable 2</td>
<td>2A</td>
</tr>
<tr>
<td>Extremely improbable 1</td>
<td>1A</td>
</tr>
</tbody>
</table>

*Note.* This table is based on the Safety Management Manual (ICAO, 2009).

After the safety risk index was obtained then the resulting value will be exported to a safety risk tolerability matrix (see Table 5). This matrix presents the tolerability criteria adopted by ICAO in the safety Management Manual (ICAO, 2009). In the example cited before, a safety risk 5A is considered intolerable according to the matrix presented in Table 5.
Table 5

Example of safety risk tolerability matrix.

<table>
<thead>
<tr>
<th>Suggested criteria</th>
<th>Assessment risk index</th>
<th>Suggested criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intolerable region</td>
<td>5A,5B,5C 4A,4B,3A</td>
<td>Unacceptable under the existing circumstances</td>
</tr>
<tr>
<td>Tolerable region</td>
<td>5D,5E,4C,4D 4E,3B,3C,3D 2A,2B,2C</td>
<td>Acceptable based on risk mitigation. It may require management decision</td>
</tr>
<tr>
<td>Acceptable region</td>
<td>3E,2D,2E,1A 1B,1C,1D,1E</td>
<td>Acceptable</td>
</tr>
</tbody>
</table>

*Note.* This table is based on the Safety Management Manual (ICAO, 2009).

If the safety risks assessed are located within the intolerable region, they are unacceptable under the existing circumstances. The probability and/or severity of the consequences of the hazards are of such a magnitude that immediate mitigation action is required. In this case the organization must allocate resources to reduce the safety risk or, if mitigation is not possible, cancel the operation. Safety risks assessed that are located within the tolerable region are acceptable, provided mitigation strategies already in place guarantee that the probability and/or severity of the consequences of hazards are kept under organizational control (ICAO, 2009).

ICAO (2009) considers that the safety risk must be reduced to a level that is “as low as reasonably practicable” (ALARP) (p. 5-4). This means that consideration should be given both to the cost and the technical feasibility of further reducing the safety risk. If the safety risk in a system is ALARP, it means that “any further risk reduction is either
impracticable or grossly outweighed by the cost” (p. 5-4).

On the other hand, when an organization accepts a safety risk, this does not mean that the safety risk has been eliminated. The residual level of safety risk remains, but the organization “has accepted that the residual safety risk is sufficiently low that it is outweighed by the benefits” (ICAO, 2009, p. 5-4).

The purpose of this brief review of the risk assessment process is to assist the reader to understand the role that it plays in safety risk management. According to Stolzer et al. (2008), the risk matrix can be applied in two different contexts for the decision-making purposes: during the system design process and during operational decision-making process. In both contexts the use of a risk matrix is important to orientate the decision process to establish the controls that will be implemented. Figure 4 presents the process of safety risk management in graphic format.

According to ICAO (2009) and represented in this graphic, the assessment of the risk is made twice. The first use is to define the risk level to verify whether it is acceptable. This procedure will help the decision-making process and the establishment of the controls. Then, after the definition of the controls that will be developed, a second assessment is made to verify whether the residual level of safety risk is acceptable.

According to CENIPA (2008b), the purpose of risk management is to orientate a balanced allocation of the organization resources against all threats, allowing a reasonable control of the risks. CENIPA suggests the use of the same matrix that is being used by ICAO.
It appears that CENIPA adopted the same process as ICAO to assess the safety risk, although the Systemic Regulation from Aeronautical Command 3-3: Management of Operational Safety does not present details about the steps to conduct the assessment (CENIPA, 2008b). However, the HAZREP form (see Appendix A) contains a field to record the risk level only at the end of the process, suggesting that the assessment is performed only after the establishment of the controls. In this case, the initial safety risk level assessment that drives the decision-making process and helps the reasonable allocation of resources is missing. Although this may simplify the whole process, an important part of the assessment of the risk is missing which may prejudice the
management of safety.

**Third step– risk control.** After assessing the risk, the final step in the safety risk management is to control the risk. According to ICAO (2009), control and mitigation are terms that can be used interchangeably. Both are meant to designate measures that address the hazard and bring under organizational control the safety risk probability and severity of the consequences of the hazard. The control of hazards is the ultimate objective of safety risk management and it deserves considerable attention (Stolzer et al., 2008).

According to ICAO (2009), there are three generic strategies for safety risk control: avoidance, reduction, and segregation of exposure. Avoidance is when the operation or activity is cancelled because safety risks exceed the benefits of continuing the operation. Reduction is when the frequency of the operation is reduced, or action is taken to reduce the magnitude of the consequences. Finally, segregation of exposure is when action is taken to isolate the effects of the consequences or redundancy is build to protect against them.

However, more important is to keep in mind that not all alternatives for safety risk mitigation have the same potential for reducing risks. The effectiveness of each specific alternative needs to be evaluated before a decision can be made (ICAO, 2009).

ICAO (2009) defines three alternatives to mitigate safety risk accordingly to its effectiveness: engineering mitigations, control mitigations, and personnel mitigations. Brauer (2006) organized the controls in hierarchical order, from the most to the least effective in controlling the hazards. Both are very similar, but Brauer divides the personnel mitigations into three distinct alternatives. This study used the Brauer approach
because it is more detailed and provides an easier method for safety managers to develop controls.

According to Brauer (2006), the most effective way of controlling a hazard is to eliminate or avoid it. The second alternative is to reduce the hazard level by reducing the likelihood or the severity of the event. The third alternative is to provide safety devices that do not remove hazards, but can reduce their effect with features that prevent the exposure of people to the hazards. The next alternative is to provide warnings or advisories to protect people from hazards. Finally, the least effective alternative is to provide safety procedures to reduce the risk.

The safety risk control/mitigation strategies are mostly based on the deployment of additional safety defenses or the reinforcement of existing ones. Basically, the defenses in the aviation system can be grouped under three general categories: technology, training, and regulations. The most effective mitigations such as engineering solutions are usually more expensive. Mitigations like training are less expensive and more frequent, but less effective (ICAO, 2009). After the implementation of the controls, the effectiveness and efficiency of the mitigation/control strategies must be confirmed. The last step in the safety risk mitigation/control process is accepting the mitigation of the safety risk.

According to the FAA (2006), once these controls are in place, quality management techniques can be used to provide a structured process for ensuring that they achieve their intended objectives. Safety management can be thought of as quality management of safety related operational and support processes to achieve safety goals. Perhaps the chief benefit of the risk management concept is that it forces managers to
allocate resources to control the risks, allowing informed and intelligent decisions (Wood, 2003).

CENIPA (2008b) does not mention in the Systemic Regulation from Aeronautical Command 3-3: Management of Operational Safety any type of hierarchy in the establishment of controls. The document states the benefits of incorporating concepts from SMS in general terms without detailing the procedures more precisely. Again, the practical and effective approach of SMS to the development of controls may provide some good insights to improve the HAZREP Program of the Brazilian Air Force.

**Characteristics of effective reporting systems.** It is important to review some aspects that are considered essentials to an effective reporting system under the SMS perspective.

According to ICAO (2009), an effective way to promote safe operations is to ensure that an operator has developed an operational environment where all personnel feel responsible for safety. This way of thinking must be so deep-rooted in their activities that all decisions, whether by the senior management or operational personnel, need to consider the implications on safety.

According to the FAA (2006), the organization must do what it can to cultivate a reporting culture that is the willingness of its personnel to contribute to the organization’s knowledge base. Reason stressed the need for a just culture, where the personnel have the confidence that the organization will treat them fairly, but they will be held accountable for their actions.

ICAO (2009) asserts that such environment must be generated from the top-down and relies on a high degree of trust and respect between operational personnel and senior
management. Operational personnel must believe that they will be supported by senior
managers when making decisions in the interest of safety, but they must also understand
that intentional breaches of safety will not be tolerated.

In SMS it is clear that the ultimate responsibility for the establishment and
adherence to safety practices rests with the directors and managers of the organization
(ICAQ, 2009). This top-down approach is so important that it demands an explicit safety
policy statement from the chief executive officer (CEO). This formal statement includes
the commitment to establish and operate hazard identification and risk management
processes, including a hazard reporting system. The statement must ensure protection to
the personnel “who discloses a safety concern through the hazard reporting system,
unless such disclosure indicates, beyond any reasonable doubt, an illegal act, gross
negligence, or a deliberate or willful disregard of regulations or procedures” (p. 8-5).

The fundamental key in a hazard reporting program is a strong belief that it is a
communication instrument for safety enhancement. Lima (2007) illustrated in a study that
users believe in the HAZREP as a reliable tool. Some of the goals to enhance safety
proposed by the Brazilian Air Force Hazard Report Program have been achieved.
However, one of the threats to the program was identified as the fear of punishment,
showing the need to guarantee some kind of immunity to the reporters that may be
subject to the possibilities of the military discipline (Lima, 2007).

CENIPA (2008b) established in the Systemic Regulation from Aeronautical
Command 3-3: Management of Operational Safety that the safety managers should
preserve the identity of the reporter, but this is a general declaration without specific
criteria. As a result the safety managers could be confused about the limits of their
In a recent study, Lupoli (2006) investigated the safety perceptions of the Brazilian Air Force squadron commanders. Lupoli discovered that the squadron commanders are committed to safety, but they have limited knowledge of advanced safety theories such as the Reason model and they use empirical means to make decisions related to safety. The SMS approach to safety risk management with its decision-making process could be very helpful for the squadron commanders in Brazilian Air Force.

According to CENIPA (2008b), the senior management is mainly responsible for accident prevention and they should avoid the use of disciplinary actions to punish human errors. SMS requires that the senior manager must guarantee that safety data is properly safeguarded to make the reporters feel more confident that the hazard reporting will not have other uses than for which it was implemented (ICAO, 2009). This normally requires a statement from senior management indicating this guarantee. Upon initial evaluation, it appears that CENIPA has the same perspective as ICAO in these issues, but they differ in the method to achieve them. ICAO relies in a statement from the CEO and the definition of policies and procedures to address the problem. CENIPA (2008b) relies in a generic statement in the regulations (Systemic Regulation from Aeronautical Command 3-3: Management of Operational Safety). There is no specific non-punitive rule in the HAZREP regulation and there is no suggestion for the commanders to make a formal statement about safety and volunteer reporting.

This situation could result in some uncertainties to the operational personnel and reduce the number of hazard reports. Here again the HAZREP Program could receive benefits from SMS perspective. A statement of the commander of the organization
supporting safety initiatives and the HAZREP could be a powerful tool to develop trust among the operational personnel. The description of the events when a HAZREP form should be filled must be clear to all personnel in the organization. They must understand that senior management will treat them fairly but they are accountable for their actions. The safety policy should actively encourage effective safety reporting and, by defining the line between acceptable performance (often unintended errors) and unacceptable performance (such as negligence, recklessness, violations or sabotage), provide fair protection to reporters.

ICAO (2009) believes that effective safety reporting of hazards by operational personnel is the cornerstone of the management of safety. An operational environment in which operational personnel have been trained and are encouraged to report hazards is a prerequisite for effective safety reporting.

According to Wells and Rodrigues (2003), effective accident prevention is directly attached to effective organization management and senior management must provide strong and visible leadership in a safety program for it to succeed. The management’s safety culture is reflected in the attitudes of all employees. As a result, if senior management does not show a genuine interest in safety, nobody within the organization will give attention to this area.

According to ICAO (2009), the senior management of any organization is responsible to develop some basic attributes to improve the effectiveness of the reporting system. First the senior management must place a strong emphasis on hazard identification and as a consequence there is an awareness of the importance of communicating hazard information at all levels of the organization. Senior management
and operational personnel must have a realistic view of the hazards faced by the organization and establish realistic rules relating to hazards and potential sources of damage. Then the operational requirements must be established to support active hazard reporting and senior management must ensure the proper safeguard and use of safety data. Finally, operational personnel must be formally trained to recognize the hazards and to report them.

These attributes are responsible for the development of five basic traits associated with an effective reporting system (ICAO, 2009). The basic traits are: willingness to report hazards, operational errors, and personal experiences; knowledge about the human, technical and organizational factors that determine the safety of the system as a whole; flexibility to adapt the hazard reporting when facing unusual circumstances; competence to draw conclusions from safety information systems, and the will to implement major reforms; and the accountability to provide essential safety information related to hazards with a clear understanding of the line that differentiates between acceptable and unacceptable operational performance.

However, ICAO (2009) states that effective safety reporting can be achieved in many different ways and following many different strategies. How it is achieved should be left to the preferences, possibilities and constraints of the specific operational contexts.

Summary of the Literature Review

This literature review was intended to clarify some terms and present theories that may help people to understand the purpose and directions taken in this study. It addresses the significance of the research to the Brazilian Air Force.

The review included a brief overview of the history of safety, from the first
approaches until the rise of Safety Management System. The importance that SMS has for many organizations and countries was identified as the new way to increase safety in aviation.

The reporting systems with some of the concepts and characteristics that are necessary to have a good understanding of these systems were presented. Then the Brazilian Air Force’s Hazard Report Program was shown with its particularities and some important questions that will have an impact in this study.

Finally, the SMS perspective to reporting systems was compared with the Brazilian Air Force Hazard Report Program to point out some differences and concepts that will guide future data acquisition. The safety risk management process was extensively explained and finally, the specific characteristics of effective reporting systems were discussed in order to organize the knowledge to conduct this study.
CHAPTER 3
METHODOLOGY

Overview

The purpose of this study is not only to verify the need to revise the Hazard Report Program for the Brazilian Air Force using the SMS perspective, but to highlight the most important concepts that could be used in this review. To accomplish this purpose a useful set of data must be collected, analyzed, and interpreted to permit clarifying this problem.

The research consisted of a survey administered to the CENIPA and SERIPA’s safety specialists to assess their perceptions related to the necessity of revising the Brazilian Air Force Hazard Report Program using the SMS perspective. According to Swanson and Holton (1999), the investigation of perceptions represents a challenge because individuals may believe in them, but they still can be wrong. The investigative technique focused first on evaluation of safety theories, hazard report issues, and the SMS concepts related to reporting systems. In the literature review these concepts were identified as potentially useful to revise the HAZREP Program. Now it is necessary to verify the perceptions of safety specialists in relation to these concepts and if they can be applied in BAF Hazard Report Program.

Formal research requires a systematic approach to the investigative process (Leedy & Ormrod, 2005). This chapter presents the population and sample used in this study with the respective selection techniques and justifications. The research design is presented with an explanation to support the model used. Other aspects discussed are the data collection instrument, and methodology, with enough information to permit the
reader to understand these elements. Finally, the methodology used to analyze the data collected is shown, providing a clear view of all the aspects needed to replicate the study.

**Population and Sample**

The population addressed in this study was the safety specialists of CENIPA and SERIPA. They are officers and sergeants of the Brazilian Air Force who received training from CENIPA to work as safety managers or assistants in safety activities to prevent and investigate aircraft accidents. Only the safety personnel who are currently working at CENIPA and SERIPA were considered for the study.

The reason the study is limited to the population of active specialists in safety areas within the CENIPA and SERIPA is justifiable. Safety Management System is a recent issue in the Brazilian Air Force. The latest rules revision from CENIPA was in 2008 and it incorporated the first concepts based on SMS (CENIPA, 2008b). The first SMS course to the Brazilian Air Force safety managers occurred in 2009, according to CENIPA. Therefore, SMS is a new concept in the BAF and most of the safety personnel never have had the opportunity to receive the SMS training. CENIPA (2009a) considers that some of the concepts of SMS have great potential in order to modernize the Brazilian Air Force Safety Program. How SMS will be implemented in the BAF is still under analysis.

CENIPA (2008c) is in charge of all aspects related to aeronautical safety in Brazil including the BAF. It is responsible for the development of the safety program regulations and the training of all personnel that will work in accident prevention within BAF. CENIPA has seven regional offices known as SERIPA to address regional safety issues. Therefore, a significant part of the personnel with safety expertise are employed
by CENIPA and SERIPA. They have more people trained in SMS than any other organization within BAF, and some of them are currently working to review the BAF Safety Program using SMS concepts. All the instructors of SMS in BAF belong to CENIPA/SERIPA.

Any attempt to revise the Hazard Report Program using new concepts included in SMS must assess the perceptions of professionals with large experience and much knowledge in this area. This is the reason that this study targeted specifically the safety specialists from CENIPA and SERIPA: because of their knowledge in safety issues and because they are more familiar with SMS than safety personnel from other organizations in BAF.

The targeted population (N) for this research was the safety specialists working in CENIPA and all seven SERIPA. A census was performed in the beginning of data collection and determined that the population size was 124 subjects. According to Gay and Airasian (2003), if the population is small there is no point in sampling and it is necessary to survey the entire population. All the safety specialists working in CENIPA and SERIPA were surveyed.

**Research Design**

The approach to the research design should take into account the problem that the study addresses and the researcher`s skill in research (Leedy & Ormrod, 2005). As stated in Chapter 1, this study intended to assess the perceptions of CENIPA/SERIPA`s safety specialists on the need to revise the Hazard Report Program using the SMS perspective.

According to Leedy and Ormrod (2005), to assess perceptions from a population some questions need to be formulated and directed to them, allowing the interpretation of
their experiences and opinions. Survey research involves collecting information about
groups of people, usually related to their opinions, perceptions and attitudes, by asking
them questions and tabulating their answers. Surveys allow the researcher to collect data
at relatively low cost, and are adequate tools to assess safety cultures (Swanson &
Holton, 1999). The descriptive research does not try to determine cause-and-effect or
change the situation under investigation (Leedy & Ormrod, 2005). Rather the objective is
to examine a situation as it appears. In order to capture the perceptions of safety
specialists, a quantitative-descriptive survey research design was used in this study.

**Data Collection Instrument**

In order to assess the perceptions of the safety specialists, an anonymous self-
administered questionnaire (see Appendix B) was developed. It contains the explanation
of the purpose of the study, benefits expected from the research, and procedures to
protect participants’ anonymity. The explanation part of the questionnaire survey
contains directions to allow the safety specialists to easily understand how to fill it out,
what is expected from them, and how to send the answers directly to the researcher by e-
mail.

The proposed questionnaire was designed with the objective to assess the
participants’ perceptions about the need to revise the HAZREP, to evaluate the hazard
report practices that have been used in the BAF and to assess the SMS concepts that
could be useful improve the HAZREP Program.

The initial part of the questionnaire with instructions and a brief explanation of
the SMS were adapted from Lima (2007) and Mendonça (2008). Questions were
constructed following procedures stated by Leedy and Ormrod (2005), being formulated
in ways that did not give clues about preferred or more desirable responses. The questions were based on publications about aviation safety, regarding safety theories, Safety Management System requirements, government documents and regulations, and several books of significant importance to aviation safety presented in Chapter 2. The questionnaire has 37 closed-ended and 3 open-ended questions, and should take about 15 minutes for completion.

Following procedures adopted by Patten (2002) and Lima (2007) aiming to enhance the reliability of the instrument, two Brazilian aviation safety specialists, both of them with master degrees at UCM, revised the questionnaire for improvements. The suggestions and adjustments were incorporated into the final version of the questionnaire. The Portuguese version of the questionnaire (see Appendix C) was revised by one professor of Portuguese language in Brazil, helping to eliminate ambiguous terms and reducing the possibility of misinterpretation.

The instrument was divided into five parts (see Table 6). The first part was designed to provide clear instructions and introductory comments about the questionnaire and a brief explanation of the SMS. The second part was designed to verify the demographic profile (Schuman & Presser, 1996) of the participants, to assess their safety experience, and to determine if they had attended CENIPA`s safety course. The third part addressed questions about the attributes that the HAZREP Program should have to be an effective safety tool. The fourth part addressed questions regarding hazard identification and the adoption of a taxonomy to classify hazards. The fifth part addressed questions to the process of risk assessment and the establishment of controls to the risks.
Table 6

**Distribution of questions of the survey instrument.**

<table>
<thead>
<tr>
<th>Parts</th>
<th>Sources</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional Background</td>
<td>Schuman and Presser (1996)</td>
<td>1 through 5</td>
</tr>
<tr>
<td>Hazard Identification</td>
<td>CENIPA (2008b), ICAO (2009), Lu et al. (2006), Stolzer et al. (2008), Wiegmann and Shappell (2003).</td>
<td>18 through 29</td>
</tr>
</tbody>
</table>

In the last three parts of the instrument, a Likert scale (Leedy & Ormrod, 2005) was proposed to register the perceptions of the respondents in five levels, being 5 – Strongly Agree; 4 – Agree; 3 – Do not Agree or Disagree; 2 – Disagree; and 1 – Strongly Disagree. To answer the questionnaire, the safety specialists were asked to choose the number in the scale that best suited their perception about a given statement. According to Alreck and Settle (1995), some of the advantages of using a Likert scale are economy, reduced time for completion, and the easy comparability of responses.

Closed questions may be easier to analyze (Schuman & Presser, 1996), but open-ended questions can provide better qualitative data from the perception of the safety specialists by allowing them to express their opinions about some issues (Lupoli, 2006). With this in mind, at the end of the last three parts of the questionnaire, a space for comments was provided, and participants were invited to make comments and
suggestions.

In order to assure validity and reliability, and again following Leedy and Ormrod (2005), a pilot test was conducted with other safety specialists of Brazilian Air Force that did not participate in the study. They indicated adjustments for enhancing the readability and content of the questionnaire that were incorporated in the final version of the instrument.

**Data Collection Methodology**

U.S. regulation mandates that research involving human subjects must follow some requirements and the research instrument must be reviewed and approved by an Institutional Review Board (IRB) to protect human subjects who participate in research from being harmed, treated unfairly, or disrespected. At UCM, the IRB is the Human Subjects Review Committee (HSRC).

In order to proceed with the formal research involving human subjects, the first step to collect data is to get the approval of the HSRC. An exempt level of review was proposed because of the minimal risk to harm the human subject due to the use of anonymous surveys and special procedures to guarantee the confidentiality. The questions in the survey are related to SMS perspectives to revise the Hazard Report Program. Those things are technical issues that all safety specialists know well and deal with on a daily basis, which will not cause emotional distress. There are no questions about personal, potentially embarrassing, or illegal activities. Finally, the demographic data and other information that could identify the respondent were kept locked in the researcher’s database and the participants were informed about these procedures.

However, permission for applying the research within the CENIPA/SERIPA was
also necessary. Prior to sending the request to the Human Subjects Review Committee, the researcher formally asked permission for conducting the research to the CENIPA’s Department of Prevention and Control. The Chief of CENIPA wrote a formal authorization for the study within the CENIPA and regional offices (SERIPA) (see Appendix D).

Finally, in Brazil, research studies involving human subjects have to follow the guidelines stated by the National Council of Ethics in Research. The Brazilian regulations are similar to the U.S. regulations and the proposed study complied with all Brazilian and United States requirements on conducting research involving human subjects. After analyzing all the documents submitted, the HSRC approved the research instrument in September 20, 2010 (see Appendix E).

After receipt of these authorizations, the survey was sent to the Department of Prevention and Control in CENIPA and all prevention sections of the SERIPA by email with a letter of explanation of the objectives of the survey and with response directions (see Appendix F). The letter asked the department/section to monitor distribution to all eligible personnel within their organizations, and to request the safety specialists to return the answered surveys directly to the researcher by email.

The method used to deliver and receive questionnaires was the Internet because of the cost and practicality. According to Lu (2003), researchers should take advantage of the Internet to save time and cost. Following Lupoli (2006) and Mendonça (2008), a Microsoft Word program was selected because it allows the file to be locked, preventing the questionnaires from being changed. Another advantage is the possibility to create fields for open-ended questions, making it easier for the safety specialists to type without
having to worry about the format of the entire document since the space increases as they type and the document adjusts itself.

Since participation occurred on an anonymous, voluntary basis, participants were provided with detailed information of what the study entailed, and organizational benefits as a consequence of research results. There was an explanation as a part of the questionnaire survey so that the safety specialists easily understood how to fill it out and what was expected from them. The survey data collection process was designed to be simple and not to disturb the participants’ routines, in order to prevent the respondents from creating a reaction to the study which could compromise the participant’s responses’ validity (Leedy & Ormrod, 2005).

According to Leedy and Ormrod (2005), one of the problems involving questionnaires is related to a low return rate. Since this could affect the conclusions and the validity of the study itself, a follow-up procedure was implemented. The instrument was sent again after 20 days as a follow-up. Telephone calls and email messages were used to increase the response. As suggested by Altschuld and Lower (1984), the topic importance of this study for the current safety specialists enhanced the return rate.

The surveys had no identification and, after receiving them from the participants, they were separated from the message and saved in a common file, identified only with numbers, for not allowing future recognition of the person who responded the survey. After receiving the surveys, they were managed only by the researcher, ensuring confidentiality for the subjects.

An electronic spreadsheet was created to process the return of surveys and to insert data into the database. After the insertion of all data, a sample of the returned
instrument was randomly selected to compare the responses and the data inserted in order to verify possible data entry errors.

**Data Analysis Methodology**

Descriptive statistics were used to measure the users’ perception about HAZREP. The collected data was organized according to each question before analysis using a computer spreadsheet. The participants’ responses were compiled in a Microsoft Excel worksheet, which was used to present the data in tables and charts.

The safety specialists were placed in the left column of the table in order of arrival. As stated before, they were identified only with numbers, not allowing future recognition of the person who responded the survey. The questions’ numbers were listed in the top row of the table.

Direct counting was used in the demographic part of the questionnaire. Questions 1 to 5 had the number of responses for each possibility totaled from the questionnaires, without any additional procedure. More complex procedures were applied for the survey questions from 6 to 40.

The data collected through the closed-ended scaling questions was tabulated to verify the users’ beliefs, their frequency, and the percentages of these perceptions from the total related to each question and compared with the theories and literature presented. The mean score was used to determine the central tendency. The standard deviation was not calculated because this measure is most appropriate for normally distributed data (Leedy & Ormrod, 2005), but the majority of answers were concentrated in strongly agree and agree. Instead, the scores were arranged into a frequency distribution to verify trends, and graphics were included showing the distribution of answers. Comparisons
between answers were conducted to verify the possible existence of response correlation and their importance in the overall context.

Finally, the qualitative data gathered through the open response questions were analyzed for collecting participants’ perceptions, motivations, and suggestions towards the SMS perspective to enhance the hazard report as a safety tool. All statements were organized by subject and analyzed to verify possible correlation with research questions.

The overall information obtained and analyzed was used to evaluate the responses and draw conclusions about the respondents’ perceptions of the usefulness of SMS concepts to revise the HAZREP Program of the Brazilian Air Force. The conclusions will be forwarded to all organizations that participated in the study so that they can improve the reporting systems within them. Since CENIPA is the regulator of safety issues to the Brazilian Air Force and civil aviation, the benefits of this study may spread away to all air operators in Brazil.

**Summary**

The purpose of this chapter was to present the methodology used in the study to clarify the reader on how the research was conducted. According to Leedy and Ormrod (2005), universality and replication are two criteria that must be built into the research project during the planning phase. All the elements of this chapter were developed to allow any other researcher to replicate this study.

The first section of this chapter showed the particularities of the population addressed in this study, which involves the CENIPA/SERIPA’s safety specialists. It was explained how the process was conducted to select the population and the reasons beneath the choice.
The second section presented the research design for the study. Since the data that need to be collected are the perceptions of safety specialists, quantitative-descriptive research was proposed. Therefore, a descriptive survey design was proposed to be used in this study.

The next item discussed was the description of the data collection instrument. A mix of closed-ended and open-ended questions was presented to collect the perceptions of the safety specialists. The instrument was divided into five parts, with an introduction about the questionnaire. The second part was designed to verify the demographic profile, the third part addressed questions to the attributes that the HAZREP Program should have to be an effective safety tool, the fourth part addressed questions about hazard identification, and finally, the fifth part addressed questions regarding the process of risk assessment and the establishment of controls to the risks.

The procedures to collect data were presented. The process began with the authorization of CENIPA’s Chief and the approval of the Human Subjects Review Committee of UCM to conduct research involving human subjects. The procedures to protect human subjects who participate in research from being harmed, treated unfairly, or disrespected were presented. The procedures used to send the questionnaires to the safety specialists and the follow-up were also considered to achieve an adequate return rate.

Finally, the methodology used to analyze the data was presented. Descriptive statistics was used to measure the participants’ perceptions about HAZREP, and with a computer spreadsheet, trends and correlations were made to attempt to answer the research questions.
CHAPTER 4
RESULTS

Overview

The purpose of this study was to verify the need to revise the Hazard Report Program for the Brazilian Air Force using SMS perspective and to highlight the most important concepts that could be used in this review. Aiming to acquire a better understanding on this issue, a descriptive survey was conducted involving the safety specialists from CENIPA and SERIPA. The investigative technique was chosen in order to assess perceptions of these specialists with known experience and expertise in the safety area.

This chapter presents data collected in a raw format with statistical considerations, reflecting the safety specialists’ answers for the survey. The return rate, the personal background and the closed-ended questions are presented. Comments to open-ended questions are summarized and grouped based on similarity.

Return Rate

The survey instrument was sent to the Department of Prevention of CENIPA and seven regional offices (SERIPA) on October 6, 2010. The Department/Section of Prevention from each organization reported the eligible people from its organization and forwarded the questionnaires to them.

The first answers were received from October 7 until October 27, 2010. A total of 68 answers were received, corresponding to a return rate of 54.8 %. On October 28, a follow-up was sent to all participants’ organizations, and the last answer was received on November 03. From the targeted population of 124 subjects, a total of 103 answers were
received, corresponding to a return rate of 83%. According to Patten (2002), for a population (N) of 124 subjects a sample size (n) of 95 was necessary. Five questionnaires were considered invalid according to the delimitations of the study, resulting in a valid return rate of 79%. It is important to clarify that some participants omitted the answer for one or more closed-ended questions, particularly for the question 39.

**Personal Background of Respondents**

The first five questions of the instrument required respondents to identify their personal experience in safety, their background training in safety, and the organizations to which they belong.

Question 1 asked about the respondents’ experience in the safety area. The safety specialists who replied to the survey questionnaire were predominantly experienced professionals. In the Brazilian Air Force it is a common practice to change functions in less than five years, but a significant number of respondents (48 participants) reported a high experience level in safety, corresponding to 49% of the participants (see Figure 5). Among the respondents, 41% had between two and five years of experience (40 participants) and only 10% had less than two years of experience (10 participants).

Professional experience is important, but the theoretical knowledge is also a fundamental factor to determine the validity of the answers. Question 2 and 3 asked about the participation in a CENIPA safety course and whether they had a credential granted by CENIPA. These questions are related to the delimitations of the study on Chapter 1, requiring an affirmative answer to be considered in the research. Five respondents answered negatively to this question, and their questionnaires were considered invalid. A total of 98 participants were considered valid, and their answers were used in this study.
Question 4 asked the participants if they had attended an SMS course. A total of 41 respondents (42%) answered that they had attended an SMS course, showing that 58% of the safety specialists of CENIPA and SERIPA had limited knowledge in SMS theories (see Figure 6).

Figure 5. Respondents’ safety experience.

Figure 6. Participation in SMS course.

Question 5 asked the participants to identify to which organization the respondent belongs. Only safety specialists from CENIPA and SERIPA Offices one to seven were considered in this study, and all the participants were considered valid. This question was also used during the data collection phase to verify whether one specific organization
needed more follow up to achieve an adequate response rate. As stated in the
delimitations of this study, there was no intention to determine the safety level within or
between participant organizations.

**Closed-ended Questions**

The closed-ended questions, comprising 32 multiple choice questions, required
participants to identify the level of agreement with each statement. They were conceived
with the aim to quantify the opinions of safety specialists about the perspective of SMS to
the attributes of a hazard report program, the process of hazard identification, and the
assessment and control of the risk.

Most of the questions had a high mean score and small variability (answers
concentrated in *strongly agree* and *agree*). When the mean score was low or the answers
were not concentrated, a second statistical analysis was performed with the 42%
participants with SMS course. This procedure was adopted to reduce possible bias to the
study. The objective was to verify if a more technical question could have been
misunderstood by the participants without SMS course.

Question 6 asked the safety specialists if they consider the HAZREP an important
tool to identify hazards and prevent accidents. With a mean score of 4.79, the answers
varied from *strongly agree* (82.65%) to *agree* (15.31%), *do not agree or disagree*
(1.02%), and *disagree* (1.02%). The result was expected because the HAZREP has been
effectively used in Brazilian Air Force for many years as a safety tool to identify hazards.
Results can be seen in Figure 7.
Figure 7. HAZREP importance as safety tool.

Question 7 asked the participants if an effective safety environment requires that all personnel feel responsible for safety and are willing to report hazards. The participants agreed with a mean score of 4.81; the high level of agreement varied between strongly agree (82.65%), agree (15.31%), and do not agree nor disagree (2.04%). See results in Figure 8.

Figure 8. Effective safety environment.

Question 8 asked the safety specialists if a just culture is important to promote
safety. Participants agreed with a mean score of 4.62, and the high level of agreement varied between strongly agree (65.98%), agree (30.93%), and do not agree nor disagree (3.09%) (see Figure 9). One participant did not answer this question (97 answers total).

**Figure 9.** Importance of just culture to promote safety.

Question 9 was designed to verify whether the confidence of the operational personnel in the organization should be generated from the senior management. The just culture and top-down approach are important concepts in Safety Management Systems. The majority of the participants agreed with the statement with a mean score of 4.51. Answers varied between strongly agree (61.22%) to agree (30.61%), do not agree or disagree (6.12%), and disagree (2.04%). See results in Figure 10.
Question 10 stated that the commander commitment to safety must be formally expressed through a safety policy. The majority of safety specialists agreed with this statement, with a mean score of 4.38, ranging from strongly agree (58.16%) to agree (29.59%) and do not agree or disagree (5.10%). However, 6.12% disagree and 1.02% strongly disagree with the statement. See results in Figure 11.

The rejection of these seven participants who disagree and strongly disagree was
further investigated to verify whether it may be the result of a misunderstanding of concepts. The concept of a formal statement of the commander could not have been completely understood by the safety specialists who had not attended an SMS course, resulting in potential bias. To reduce the possibility of bias in the questions when more technical concepts are investigated, a second analysis was performed only with the respondents who had attended an SMS course. In this case the mean score increased to 4.51 and only one participant disagrees (2.44%) and one strongly disagrees (2.44%).

Question 11 stated that the ultimate responsibility for safety rests with the commanders and managers of the organization. The participants agreed with a mean score of 4.26; the level of agreement varied between strongly agree (56.70%), agree (25.77%), do not agree nor disagree (6.18%), disagree (9.28%), and strongly disagree (2.06%). See results in Figure 12. One participant did not answer this question. Again a second analysis was performed only with the respondents who had attended an SMS course. In this case the mean was 4.5, and there was only one participant who disagrees (2.50%).

![Figure 12. Responsibility of commanders and managers.](image-url)
Question 12 asked whether the fear of punishment is a threat to the HAZREP and could reduce the number of reports. Participants agreed with the statement, and the mean score was 4.64. Answers varied between *strongly agree* (74.49%), *agree* (19.39%), *do not agree nor disagree* (2.04%), and *disagree* (4.08). See results in Figure 13.

![Figure 13. Fear of punishment.](image)

Another attribute investigated was the need for the commanders to formally express their commitment to safety through a safety policy. Question 13 asked about the importance of a written statement of the commander ensuring the safeguard of safety data to generate confidence among the personnel. The participants agreed with a mean score of 4.24. Answers varied between *strongly agree* (47.96%), *agree* (37.76%), *do not agree nor disagree* (7.14%), *disagree* (5.10%), and *strongly disagree* (2.04%) (see Figure 14). A second analysis with only the respondents who had attended to an SMS course resulted in a mean score of 4.29; *disagree* represents 4.88% and *strongly disagree* 2.44%.
Question 14 was designed to verify whether safety specialists believe that the written statement should guarantee a non-punitive environment for unintentional errors. With a mean score of 4.45, participants answers varied from strongly agree (58.16%), agree (31.63%), do not agree nor disagree (7.14%), and disagree (3.06%). See results in Figure 15.

Respondents demonstrated the necessity to provide clear guidelines to
differentiate between acceptable and unacceptable performance in the safety policy, agreeing with the statement in question 15. The mean score was 4.57, with answers varying between strongly agree (64.95%), agree (9.28%), do not agree nor disagree (2.06%), and disagree (3.09%). One participant did not answer this question. See results in Figure 16.

![Figure 16. The use of guidelines to differentiate between acceptable and unacceptable performance.](image)

In question 16 the safety specialists demonstrated that they believe in the use of SMS concepts to improve the effectiveness of the Hazard Report Program of the Brazilian Air Force. With a mean score of 4.16, replies ranged from strongly agree (41.24%), agree (34.02%), and do not agree nor disagree (24.74%). See results in Figure 17.
The significant number of participants (24) who chose *do not agree nor disagree* could be the result of lack of knowledge in SMS concepts. When considering only the participants with an SMS course the mean score increased to 4.56. One participant did not answer this question.

Question 18 addressed the training of the operational personnel to recognize a situation that requires the use of a HAZREP form. The safety specialists believe that the operational personnel in BAF are *not* well trained to recognize situations that require the use of HAZREP, according to the answers to question 18. The mean score was just 2.89, with answers varying between *strongly agree* (3.09%), *agree* (27.83%), *do not agree nor disagree* (30.93%), *disagree* (31.96%), and *strongly disagree* (6.18%) (see Figure 18). One participant did not answer this question.

The question did not require SMS knowledge, but a second analysis was performed to verify whether there was a difference in the group with SMS course. The results were very similar with a mean score of 3.02, indicating that the training of the operational personnel is less than adequate to identify the situations that a HAZREP is
required. *Disagree* answers reduced to 22.5% and *strongly disagree* to 2.5%.

**Figure 18.** Operational personnel training.

Question 19 asked participants whether the safety managers must investigate the validity of any reported information involving safety. Participants agreed with the statement with a mean score of 4.37. Answers varied from *strongly agree* (54.08%), *agree* (36.73%), *do not agree nor disagree* (3.06%), *disagree* (4.08%), and *strongly disagree* (2.04%). See results in Figure 19.

**Figure 19.** Investigation of the validity of reports.
Question 20 was designed to verify whether it is important to identify the causes affecting a reported situation. Participants recognized the importance with a mean score of 4.48. Answers varied from strongly agree (58.16%), agree (36.73%), do not agree nor disagree (1.02%), disagree (3.06%), and strongly disagree (1.02%) (see Figure 20).

![Bar chart showing frequency distribution of responses to Q20](image)

**Figure 20.** Identification of the causal factors of hazard reports.

Question 21 addressed the need to use investigative techniques to identify the causal factors and to develop the mitigation actions involving a reported situation. Participants massively agreed with the need to establish an investigative tool for the HAZREP, with answers varying from strongly agree (62.24%), agree (33.67%), do not agree nor disagree (3.06%), and disagree (1.02%). The mean score was 4.57 (see Figure 21).
Question 22 asked about the need to transform a hazard reported into valid safety data using an adequate classification system. The majority of respondents strongly agreed (54.08%) with the statement and 41.84% agreed. Only 3.06% do not agree nor disagree and 1.02% disagree. The mean score was considerably high (4.49). See results in Figure 22.

Question 23 stated that a classification using common taxonomy is important to
disseminate the information to other organizations. The statement is correct according to the majority of safety specialists. The mean score was 4.48, with answers varying from strongly agree (55.10%), agree (39.79%), do not agree nor disagree (3.06%), and disagree (2.04%). See results in Figure 23.

![Figure 23. The use of a common taxonomy to disseminate information.](image)

Question 24 was developed to verify whether a database of hazards classified with a common taxonomy could help to perform trend analysis. Again a massive number of respondents agreed with the statement, and the mean score was 4.5. Answers varied from strongly agree (55.10%), agree (40.82%), do not agree nor disagree (3.06%), and disagree (1.02%). See results in Figure 24.
Question 25 asked whether it is desirable that the taxonomy used to classify hazards could also be used in accident investigation. A significant number of participants answered positively to this question, with 56.12% responding strongly agree and 38.77% agree. Only 3.06% do not agree nor disagree and 2.04% disagree (see Figure 25). The mean score in this question was 4.49.

Figure 24. The use of a common taxonomy to develop trend analysis.

Figure 25. The use of a common taxonomy to hazard classification and accident investigation.
Question 26 stated that a good taxonomy should be able to address human errors and must be supported by modern safety theories. The statement was considered correct according to the majority of safety specialists. The mean score was 4.34, with answers varying between strongly agree (47.96%), agree (41.84%), do not agree nor disagree (6.12%), and disagree (4.08%). See results in Figure 26.

![Figure 26](image)

**Figure 26.** The taxonomy related to human error and modern safety theories.

Question 27 was designed to verify whether it is important for the taxonomy be able to be adapted to the particular needs of an organization. A significant number of participants believed that this is a desirable characteristic for the taxonomy. With a mean score of 4.1, answers varied from strongly agree (40.21%), agree (36.08%), do not agree nor disagree (17.52%), and disagree (6.18%) (see Figure 27). One participant did not answer this question. When considering only the safety specialists with SMS course, the mean score improves to 4.27, and there were no disagree answers.
Question 28 asked whether the taxonomy should be able to be applied in already existent safety databases. This question is important because CENIPA and other organizations have large databases. Compatibility with the taxonomy used in hazard identification could represent a significant advantage, allowing performing trend analysis in these databases. Accordingly, most of the safety specialists agreed with the statement and the mean score was 4.31. Answers varied between strongly agree (44.90%), agree (44.90%), do not agree nor disagree (7.14%), disagree (2.04%), and strongly disagree (1.02%). See results in Figure 28.
Figure 28. The use of taxonomy in existent databases.

Question 30 stated that it is important to evaluate the probability of the consequences of the hazard. According to ICAO (2009), this is the first step in the process of risk assessment, and a massive number of safety specialists agreed. The mean score was 4.62, with answers varying from strongly agree (65.98%), agree (30.93%), do not agree nor disagree (2.06%), and disagree (1.03%) (see Figure 29). One participant did not answer this question.

Figure 29. The importance of evaluating the probability.
Question 31 was designed to verify the importance of evaluating the severity of the consequences of the hazard. This is the second step in the process of risk assessment (ICAO, 2009). Again a significant number of safety specialists agreed. The mean score was 4.61, with answers varying between strongly agree (64.28%), agree (34.69%), and strongly disagree (1.02%). See results in Figure 30.

![Figure 30. The importance of evaluating the severity.

Question 32 stated that a matrix of probability versus severity could be a helpful tool to evaluate a hazard. Keeping consistency with the two previous questions, the majority of participants agreed with the statement. Answers varied between strongly agree (43.88%), agree (47.96%), do not agree nor disagree (5.10%), disagree (2.04%), and strongly disagree (1.02%). The mean score was 4.32 (see Figure 31).
Question 33 asked about the tolerability evaluation of the consequences of the hazard. With a mean of 4.34, the safety specialists agreed with the importance to determine the tolerability of the consequences of the hazards. Answers varied from strongly agree (48.98%), agree (41.84%), do not agree nor disagree (5.10%), disagree (2.04%), and strongly disagree (1.02%). See results in Figure 32. Considering only respondents with SMS course the mean score increase to 4.56.
When asked in question 34 whether the tolerability evaluation could help to establish priorities and adequate mitigation actions, a significant number of participants answered affirmatively. Answers varied between strongly agree (48.45%), agree (47.42%), do not agree nor disagree (2.06%), disagree (1.03%), and strongly disagree (1.03%). The mean score was 4.41 and the results are presented in Figure 33. One participant did not answer this question.

![Figure 33](image)

**Figure 33.** The tolerability evaluation importance for the decision-making process.

Question 35 stated that a second tolerability evaluation, after the mitigation actions are established, could help to verify whether the residual risk is acceptable. According to ICAO (2009), a tolerability evaluation must be performed twice, once in beginning of the process of risk assessment and once at the end. Participants agreed with the statement with a mean score of 4.32. Answers varied between strongly agree (45.36%), agree (43.30%), do not agree nor disagree (9.28%), and disagree (2.06%) (see Figure 34). One participant did not answer this question.
Figure 34. The second tolerability evaluation.

Question 36 was designed to verify the importance of evaluating the effectiveness of the controls or mitigation actions. A massive number of safety specialists answered positively. The mean score was 4.59, with answers varying between strongly agree (59.79%), agree (39.17%), and only 1.03% do not agree nor disagree. One participant did not answer this question. See results in Figure 35.

Figure 35. The evaluation of controls effectiveness.

According to the statement in question 37, the most effective mitigation action
should be considered first by the safety managers and then other controls until the last effective mitigation action. Prioritizing controls according to its effectiveness is also a concept from SMS (ICAO, 2009). Most respondents agreed with the statement, and the mean score was 4.28. Answers varied between strongly agree (48.45%), agree (36.08%), do not agree nor disagree (11.34%), disagree (3.09%), and strongly disagree (1.03%). Results are presented in Figure 36, and one participant did not answer this question.

![Figure 36. Prioritizing controls according to its effectiveness.](image)

Again this concept could be misunderstood by a participant without an SMS course. Considering only the answers from respondents with SMS course, the mean score increased to 4.46, and there were no disagree or strongly disagree answer.

Question 38 asked whether the cost of implementing the controls should be considered when evaluating possible solutions. ICAO (2009) considers this concept essential to manage the resources available in any organization, but CENIPA (2008b) did not include cost consideration to establish controls in the HAZARD Program regulation. This situation could lead to significant differences in the answers. Surprisingly, most safety specialists agreed with the statement with a mean score of 4.11. Answers varied
from strongly agree (39.17%), agree (42.27%), do not agree nor disagree (9.28%), and disagree (9.28%). When considering only the answers from respondents with an SMS course, the mean score increased to 4.39. One participant did not answer this question. See results in Figure 37.

![Figure 37](image)

**Figure 37.** Evaluating the costs of controls.

Question 39 was designed to verify whether the safety specialists received adequate training to perform the risk assessment and to establish mitigation actions when managing hazards. The mean score of 3 was the second lowest in this study (only above question 18), and three participants did not answer this question. Responses varied from strongly agree (7.37%), agree (29.47%), do not agree nor disagree (27.37%), disagree (27.37%), and strongly disagree (8.42%). When considering only the answers from respondents with an SMS course, the mean score had a minimal increase to 3.3. See results in Figure 38.
Open-ended Questions

The open-ended questions were designed to collect suggestions and comments from the safety specialists about the hazard report. It was a free space for the participants to give their opinions with no restriction of length. The answers to these questions were summarized and grouped based on similarity.

Question 17 provided space for the participants to collect their suggestions to revise the Hazard Report Program. The answers are the following:

“Giving an adequate feedback to the reporters is as important as the solution to the problem reported;”

“The willingness to fill an HAZREP form is affected by the lack of feedback;”

“The HAZREP should be more advertised;”

“I believe that the importance of the hazard report should be exhaustively reinforced in seminars and forums for pilots to increase the number of reports;”

“The corrective actions should be advertised to the operational personnel;”
“The HAZREP should be more advertised by the CENIPA. The advertisement only by regional offices is weakening the tool;”

“Lectures should be implemented to advertise the importance of the HAZREP;”

“I believe that is important to have more courses about SMS and to refresh safety knowledge;”

“Most of the pilots of the civil aviation do not know this tool and the number of hazards reported is surprisingly low;”

“I suggest that the HAZREP should be more advertised. It is necessary to motivate the aviation professional to increase the number of reports;”

“It is important to have a clear difference between error and violation, not allowing that subjective interpretation could result in unjust punishment;”

“It is important to distinguish between violations and errors. Violations not punished are bad example. SMS makes this differentiation but the HAZREP does not;”

“Errors must not be punished for the safety program to work, but violations should be punished rigorously;”

“When a violation is reported, the safety manager must investigate the psychological factors contributing to the event;”

“I believe that not always the violation should be punished. Sometimes a violation is the result of the organizational culture and should not be punished;”

“It is important to investigate the violations to clarify the contributing factors, enhancing the safety;”
“Not only the HAZREP deserves attention, but the internal safety policy should also be considered to make the prevention process more effective and participative;”

“The HAZREP must be viewed by the commanders as a powerful tool for hazard identification and to enhance safety within the organizations;”

“The safety policy should be based on the commitment of senior management and must be formalized. The difference between errors and violations must be well known by all personnel;”

“The entire organization is responsible for safety, not only the senior management;”

“The commander commitment to safety should be reflected in the adherence to safety program more than a simple written document;”

“The commanders must receive orientations to motivate the operational personnel to fill HAZREP form. An environment that values safety is important to accomplish the mission of the organization without unnecessary risks;”

“A written statement of the commander is not enough, it is necessary to develop the safety culture in all levels;”

“The HAZREP should be considered confidential to minimize the fear of punishment;”

“The HAZREP should be forwarded when the problem is common to other organizations;”

“The HAZREP process to wait a response from other organizations is too slow;”
“The HAZREP should be available in electronic format in all sections of the organization;”

“I suggest the establishment of safety doctrine classes with weekly frequency;”

“The HAZREP form should have a space to insert suggestions to reduce the risk;”

“More important than protecting the reporters is to develop an environment of confidence and understanding of the importance of the HAZREP;”

“I suggest the establishment of other forms of reporting hazards than the written report;”

“The same HAZREP form is used for the report, analysis, and solutions. This compromises the confidentiality because the document can be accessed by persons without credential;”

“The analysis and mitigation actions should be included in a different document than the HAZREP form to avoid the disclosure of the reporter;”

“I suggest the development of a phone service to report hazards;”

“I believe that using SMS is an excellent way to enhance safety;”

“A scientific approach should be used to map the fragility of each system and organization;”

“Congratulations for both aspects investigated in the research;”

Question 29 provided space for the participants to collect their comments about the hazard identification. The answers are the following:
“I believe that the hazard identification is a responsibility of the safety managers;”

“I believe that FOQA, LOSA, and CRM could be used to create a good database of hazards;”

“The hazard classification should be based in a colored code (green, yellow, and red);”

“The actual database in use does not support a good taxonomy;”

“The hazard situations should generate a database to help the further identification of risk factors;”

“The hazard classification could lead to neglecting the lower levels of hazards;”

“In the BAF there is a good technical formation, but lack of training to identify hazards;”

“A database of the reports makes it easy to develop standardized procedures to avoid future hazards;”

“I suggest the standardization of the accepted safety levels within each type of aviation;”

“The tool used to identify/classify the hazard is subjected to the level of safety culture of the organization;”

“It is important to have lectures about hazards and their consequences;”

“All the situations reported must be investigated, not only those considered valid;”
“The safety specialist should investigate the information, not the validity of the information;”

“The most important thing is the training of SMS;”

“The HAZREP form should contain the safety policy and the signature of the commander;”

“The violations of superiors reported in HAZREP may not be investigated if there is no support from the commander;”

“I suggest the use of an online HAZREP form in the CENIPA’s site to avoid interference from the commanders;”

“It is difficult to perform trend analysis to develop safety policies because of the lack of a common taxonomy. We need a common taxonomy especially in military aviation or this tool will continue to be underutilized;”

“A common taxonomy for hazard identification and accident investigation is difficult to achieve. It could overload the taxonomy because of the many unique factors that may be related to an accident;”

“A standardized taxonomy is important in all situations, but it must be simple and definitions must be clear;”

“I am favor of a common taxonomy to HAZREP and accident investigation. Only this way a valid trend analysis can be developed;”

“A common taxonomy is too difficult to be developed;”

“It is essential the use of taxonomy in the HAZREP Program;”

“A good taxonomy does not need to be simple if enough training is provided;”
“I believe that it is very difficult to develop a taxonomy for human error;”

“I suggest the use of HFACS as the taxonomy to be used in hazard identification;”

“The taxonomy used by ICAO in accident investigation is adequate and could be used for hazard classification.”

Question 40 provided space for the participants to collect their comments about risk assessment and risk control. The answers are the following:

“The hazards must be classified with a common taxonomy, but the risk and the mitigation actions may vary from one organization to another;”

“The risk assessment tool should be more objective, avoiding the subjectivity of the safety manager;”

“I believe that the assessment of the risk should be based on previous experiences;”

“The risk assessment suggested in the SMS requires more safety personnel than the number available today in BAF and other organizations;”

“The difference between hazards and risks should be more explained in the CENIPA’s courses;”

“The risk assessment and risk control should be considered priorities to reduce accidents caused by hazards reported;”

“The risk assessment must be clear and well documented to be used for future assessment;”

“The risk assessment for a military organization will depend on the operational environment and the importance of the mission;”
“A complex study is necessary to perform a good risk assessment and to develop effective mitigation actions;”

“We should adopt a risk matrix to assess the situation reported and urgency of the mitigation actions;”

“Each organization should have an adequate risk matrix;”

“A matrix of probability versus severity is difficult to use and requires technical personnel;”

“The mitigation actions should be assessed and chosen by the senior management with the help of the safety manager;”

“I believe that all mitigation actions should receive the same high priority level to avoid future events;”

“All the mitigation actions should be implemented independently of the cost;”

“The advantage of SMS against the SIPAER is that the cost of implementing the mitigation actions is considered. It is not realistic to think that the actions will be implemented independent of the cost/benefit;”

“The priority of the mitigation actions should consider the estimated efficacy of the actions compared with the cost/benefits of the implementation;”

“I believe that the actual requirements of the Civil Aviation Agency for the safety personnel to perform the risk assessment and establishment of control are insufficient;”

“CENIPA is disseminating the theory of SMS, but the tools are not being used;”
“There is no activity developed by the BAF Commands to foster the training of the risk assessment and risk control;”

“The training of the risk assessment should be disseminated to all personnel within the organization;”

“I liked the risk assessment and risk control process as a way to enhance safety;”

Summary

In this chapter, the data collected through the survey were presented and analyzed in an attempt to clarify the safety specialists’ perceptions about the applicability of some aspects of the SMS concepts to revise the Brazilian Air Force Hazard Report Program. A quantitative approach was used to score these perceptions in order to seek answers for the research questions proposed in this study.

The data collected were presented with statistical considerations and graphics, reflecting the participants’ answers for the survey. The return rate, the personal background and the closed-ended questions were presented. The comments of the open-ended questions were summarized and grouped based on their similarity.
CHAPTER 5
DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

This chapter of the study discusses the research questions based on the data collected, summarizing the relevant findings of the study. The chapter also lists the research conclusions and presents recommendations regarding the SMS perspective to the Brazilian Air Force Hazard Report Program.

Discussion

The statement of the problem presented the expectation that SMS concepts could constitute an important contribution to recognize the need for revision of the Brazilian Air Force’s HAZREP Program, but there was no study to verify the applicability of these concepts. The purpose of this study was to verify the need for a revision of the Hazard Report Program using the SMS perspective and to highlight the most important aspects that should be considered in this review.

The results presented in Chapter 4 demonstrated the need to revise the Brazilian Air Force’s HAZREP Program and the applicability of Safety Management System concepts in this revision. The overall acceptance of the SMS concepts indicated their usefulness to improve the reporting systems and aviation safety. The result is even more important when considering that the target population consisted of safety specialists with knowledge and experience in the area of aviation safety.

The first research question was:

1. What are the perceptions of the CENIPA/SERIPA safety specialists about the need to revise the HAZREP Program using the SMS perspective for reporting systems?
In order to answer that question it is important to analyze some issues affecting the HAZREP Program, beginning with the fear of punishment. According to Wood (2003), the fear of punishment inhibits internal communications and compromises the ability to manage a successful safety program. Lima (2007) identified that, despite the trustful atmosphere surrounding the reporting program, the possibility of being punished for something reported was a concern among operational personnel in BAF. In this study, the safety specialists confirmed that the fear of punishment was still a problem in the Brazilian Air Force that could limit the number of reports.

The approach of CENIPA to prevent the fear of punishment is a general declaration in the regulation. The Systemic Regulation from Aeronautical Command 3-3 states that the safety managers must “preserve the identity of the reporter aiming to ensure the confidentiality of the process” (CENIPA, 2008b, p. 33). The SMS approach to the fear of punishment is more thorough. It involves the concept of just culture developed by Reason to create confidence in the organization, a top-down approach to generate the confidence from the senior management to the operational personnel, and a written safety policy to establish how the organization manages the safety. The acceptance of these concepts by the safety specialists indicates their usefulness to improve the HAZREP and reduce the fear of punishment.

The difference between the two approaches reveals another important issue affecting the HAZREP Program. The revision of the regulations in 2008 was supposed to incorporate the SMS perspective, but many of the SMS concepts were not incorporated and the concepts that were included in the CENIPA’s regulation are mostly general.
declarations. This incomplete revision of the regulation resulted in little impact to enhance aviation safety.

The need to revise the HAZREP Program is also related to the benefits of incorporating the SMS concepts. A significant number of participants agreed that one possible benefit of incorporating SMS concepts is to increase the effectiveness of the HAZREP. The mean scores of the answers (except for the two questions addressing training) were very high, and they represent a clear indication of the acceptance of the SMS concepts.

Therefore, the HAZREP Program should be revised because of the problems presented and the possible benefits of using SMS concepts. The fear of punishment and the incomplete revision of the regulation in 2008 are issues that should be corrected. The benefits of using SMS concepts are promising considering the overall acceptance of these concepts to improve the effectiveness of the HAZREP. Due to the importance of the HAZREP Program to identify and mitigate hazards, CENIPA might consider a more thorough assimilation of the SMS concepts in a future revision of its regulation, taking full benefits of these concepts to enhance safety within the Brazilian Air Force.

The second research question was:

2. Which aspects of the SMS related to reporting systems should be used to review the HAZREP Program?

In order to answer this question the results were grouped and discussed in four areas covering the HAZREP Program attributes, the hazard identification, the risk assessment and risk control processes, and the training to use and manage the HAZREP.

**HAZREP program attributes.** The importance of the HAZREP as a safety tool
and the recognition that an effective safety environment requires the participation of all personnel to report hazards scored high in the survey. The results were expected because these concepts were disseminated for many years by different authors such as Reason (1997), Wood (2003), and Stolzer et al. (2008). The incorporation of these concepts in the CENIPA’s regulation and in the ICAO’s Safety Management Manual was appropriate and well accepted by the safety community. The perspectives of CENIPA and ICAO in these issues are very similar, requiring no further discussion. The differences are more evident in other concepts that are incorporated in the SMS perspective for the reporting systems.

The *just culture* concept (Reason, 1997), the *top-down* approach for safety (ICAO, 2009), and the responsibility of the senior management for the *establishment and adherence to safety practices* (ICAO, 2009) are the basis for a high degree of trust and respect between operational personnel and senior management. They are the foundation for the confidence necessary to develop an effective reporting system, and ICAO puts a strong emphasis on these concepts. However, in the CENIPA’s regulation they are vaguely cited with no practical consequence. The results obtained in the survey showed that the safety specialists considered these concepts important to promote safety and they should be incorporated in the regulation and disseminated throughout the Brazilian Air Force.

ICAO goes further requiring that senior management formally expresses their commitment to safety through a safety policy statement (ICAO, 2009). CENIPA does not require a written safety policy by the air squadrons’ commanders which may create doubts among the operational personnel, reducing the number of reports. The safety
specialists answered favorably to the importance of a safety policy to assure the commitment of the commanders to safety. CENIPA should consider a way to require that the commanders establish a written safety policy for their organizations at the beginning of the command period.

Three questions were designed to investigate the content of the proposed written safety policy. The three aspects investigated were the need to ensure that safety data is properly safeguarded, the need to provide a non-punitive environment for unintentional errors, and the need to provide clear guidelines to differentiate between acceptable and unacceptable behavior by the operational personnel.

According to ICAO (2009), it is important to protect safety data for other uses than to improve safety in the organization. A study conducted by Lima (2007) showed that there is no effective policy to enforce de-identification or to preserve anonymity in reports. The current regulation from CENIPA only requires that the safety managers protect the identity of the reporter (CENIPA, 2008b). The safety specialists believe in the importance of a written statement by the air squadrons’ commanders to protect the use of safety data.

The participants also support the need to provide a non-punitive environment for unintentional errors within the safety policy. This is important to develop confidence among operational personnel. In the SMS perspective, human errors are accepted as a normal component of any system where humans and technology interact (ICAO, 2009). In this context, operational safety strategies are put into practice to control human errors instead of punishing those responsible (a less effective approach).

The need to provide clear guidelines to differentiate between acceptable and
unacceptable behavior by the operational personnel is another aspect that should be incorporated in the safety policy. An unintentional error is considered acceptable performance, but if the deviation from the established procedures is intentional (violation) the behavior is unacceptable. ICAO (2009) considers it important to provide clear guidelines to differentiate these behaviors. It is a way to inform the operational personnel what is expected from them, and the safety specialists agreed with need to incorporate this issue in the written safety policy. Several comments addressed the need to differentiate unintentional errors and violations, showing the concern of the participants in this issue.

**Hazard identification.** The first step for the safety manager after receiving a safety report is to investigate the validity of the information. Wood (2003) considered it important to receive any concern about safety from the operational personnel, but reserving the right to reject the reports that are not in the scope of safety. CENIPA (2008b) does not specifically mention this step, but only states that a feedback must be provided to the reporter when the situation is not safety related. The answers from safety specialists approving this step is an indication that CENIPA should define more clearly the process of hazard identification, thus avoiding misinterpretations.

The investigation of the causes of the safety problem reported is the next step. The majority of the participants agreed with the importance of the use of an investigative technique to identify the factors involving a reported situation. The current regulation does not establish any investigative technique to be used in the HAZREP process. Further studies will be required to select the best investigative technique, but CENIPA should determine which technique will be used and include it in the regulation.
The last aspect considered in this part of the survey was the use of a common taxonomy. Again CENIPA does not provide any taxonomy to be used in the HAZREP Program, but the definition of how data are collected is an important issue for SMS (Stolzer et al., 2008). The result of the questionnaire indicated that the safety specialists agreed with the need to transform a hazard report into valid safety data using a proper classification. They considered the use of a common taxonomy important to disseminate the information to other organizations and to develop trend analysis with the safety database. Many comments addressed the problem of a common taxonomy, showing the importance for the safety specialists, but some concerns about the difficulties to develop the taxonomy were expressed.

The characteristics of the proposed common taxonomy were also investigated. The basic characteristics addressed were an ease to use taxonomy for hazard identification that could also be applied for and accident investigation. The taxonomy should be based in modern safety theories and able to address human errors. The taxonomy should be adaptable to the particular needs of an organization, and able to be applied in already existent safety databases.

The taxonomy used in this study and explained in Chapter 2 was the Human Factors Analysis and Classification System developed by Wiegmann and Shappel (2003). The agreement of the safety specialists with the four proposed characteristics of a good taxonomy represents an important indication favorable to the adoption of HFACS as the common taxonomy in the Brazilian Air Force. HFACS has an additional advantage because it could be used as an investigative technique to analyze the factors involving reported hazards. It was not the purpose of this study to determine a specific taxonomy
for potential use, but since HFACS presents all the proposed characteristics, it is a natural candidate for the Brazilian Air Force.

**Risk assessment and risk control.** The last main part of the questionnaire was designed to address the process of risk assessment and risk control, using the expertise of the participants to evaluate the applicability of each concept in the HAZREP Program. The risk assessment evaluates the probability and severity of the consequences of a reported hazard. These two fundamental components of the risk assessment are the same for ICAO and CENIPA. Both organizations use the same matrix of probability versus severity as a tool to help the evaluation of the consequences of the hazard. After this first assessment, it is calculated whether the risk is acceptable the way it appears or a mitigation action is required to reduce the risk. This is known as assessing safety risk tolerability.

CENIPA adopted the same process and the safety specialists agreed that these steps are important during the decision-making process to establish priorities and adequate mitigation actions. After the mitigation actions are established a second safety risk tolerability must be performed to verify whether the residual risk is tolerable or not. The whole process of risk assessment received support from the participants, showing the importance and applicability of these concepts.

Since CENIPA uses the same process as established by ICAO, the regulation should contain clear guidelines for the risk assessment. The problem is that the Systemic Regulation from Aeronautical Command 3-3: Management of Operational Safety (CENIPA, 2008b) does not present details about the risk assessment and it is somewhat vague and confusing. The HAZREP form presents an error in the risk assessment process
because the field to record the risk level only appears at the end of the process (see Appendix A). This may lead to a false interpretation that only the second assessment is performed, which is not true according to CENIPA (2008b). The risk assessment is considered very important for a significant number of safety specialists, thus a revision of the HAZREP regulation and the HAZREP form is necessary to clarify this issue.

The last issue addressed was the development of mitigation actions or controls. They designate measures that address the hazard and bring safety risk under organizational control. ICAO (2009) considers it important to evaluate the effectiveness of each specific alternative before a decision can be made, thus a prioritization of the controls is required. The cost of implementing controls is another important aspect to be considered when evaluating the possible mitigation actions because the resources available are limited in any organization. A significant number of safety specialists agreed with these evaluations, confirming the importance of these issues when establishing controls.

CENIPA (2008b) does not mention in the Systemic Regulation from Aeronautical Command 3-3: Management of Operational Safety any type of consideration about the effectiveness of controls or the establishment of a hierarchy of controls. Based on the answers provided by the safety specialists, the practical and effective approach of SMS to the development of controls should be incorporated in the HAZREP Program. The method developed by Brauer (2006) and presented in Chapter 2 provides an easy approach to the development of controls and should be considered by CENIPA to improve the HAZREP, but further studies will be required in this issue.
The evaluation of the costs when implementing controls is not considered in the Systemic Regulation from Aeronautical Command 3-3: Management of Operational Safety (CENIPA, 2008b). According to ICAO (2009), the resources must be carefully balanced between the “production goals (delivery of services) and the protection goals (safety)” (p. 3.2). Normally, the most effective mitigations such as engineering solutions are usually more expensive while mitigations like training are less expensive, but also less effective (ICAO, 2009). ICAO states that the objective of safety risk management is to provide the foundation for a balanced allocation of resources to those risks that the control and mitigation are viable. CENIPA (2008b) agrees with the importance of a balanced allocation of the organization’s resources, but the lack of orientation in its regulation may suggest that the cost is not a factor to be considered when establishing controls. The results obtained from the survey showed the importance of evaluating the cost of controls and suggests it should be considered as another issue to be reviewed in the CENIPA’s regulation.

**Training to use and manage the HAZREP.** The survey addressed the qualification of the operational personnel to recognize a situation that requires the use of HAZREP and the qualification of the safety specialists to perform the risk assessment and establishment of risk control to mitigate hazards. The purpose of assessing the qualification of these professionals was to investigate their level of confidence in performing activities related to the HAZREP process. These issues received the lowest mean scores of the entire survey.

Lima (2007) considered in his study that a deficiency in educating operational personnel of the Brazilian Air Force towards the use of the HAZREP was a real issue.
The low mean score obtained in this survey suggests that the problem still exists, and an improvement of the safety training focused on operational personnel is necessary to increase the use of HAZREP.

The safety specialist’s training also needs to be reviewed. The SMS course provided by CENIPA to the safety specialists was the same course approved by ICAO, but a significant number of participants believe that they have not received adequate training to perform the risk assessment of hazards and establish risk controls. This indicates a potential problem with the practical part of the course, involving the risk assessment and development of controls. Since the SMS course format is established by ICAO, it is important that CENIPA provides complementary training for their personnel if the existent format is not enough to achieve the desired level of knowledge.

Conclusions

The following conclusions were based upon analysis of data collected in responses to the survey questionnaire addressing the HAZREP Program:

1. The HAZREP Program is an important tool for the Brazilian Air Force effort to identify and mitigate hazards.

2. The HAZREP Program needs to be revised to incorporate the SMS concepts for reporting systems.

3. The effectiveness of the HAZREP Program can be improved using SMS concepts.

4. The 2008 revision of CENIPA’s regulation did not incorporate many SMS concepts important to the HAZREP Program, and those concepts incorporated are mostly general declarations, resulting in little impact for the enhancement of aviation safety.
5. The fear of punishment remains a problem in the Brazilian Air Force that inhibits internal communications and compromises the ability to manage a successful safety program.

6. The SMS approach to the fear of punishment includes the concepts of just culture, a top-down approach to safety, and a written safety policy to establish how the organization manages the safety. The incorporation of these concepts would reduce the fear of punishment and improve the use of the HAZREP.

7. A safety policy should ensure that safety data are properly safeguarded, provide a non-punitive environment for unintentional errors, and provide clear guidelines to differentiate between acceptable and unacceptable behavior for the operational personnel.

8. The ultimate responsibility for the establishment and adherence to safety practices rests with the senior management of the organization.

9. The use of an investigative technique and a common taxonomy is important to assist the safety managers to identify factors involving a reported situation, to disseminate safety information to other organizations, and to develop trend analysis.

10. The taxonomy used for hazard identification must be based on modern safety theories addressing human errors, be capable to be adapted to the particular needs of an organization, be able to be applied in already existent safety databases, and be easy to use.

11. The processes of risk assessment and risk control as described in the ICAO Safety Management Manual are important to enhance aviation safety.

12. Prioritizing controls according to their effectiveness and the assessment of the cost are important when evaluating the alternatives of mitigation actions available.
13. The training of operational personnel to recognize a situation that requires the use of HAZREP, and the training for the safety specialists to perform the risk assessment and risk controls require improvement.

14. The risk assessment process of the HAZREP form is incomplete, according to the CENIPA regulation and the Safety Management Manual.

**Recommendations and Future Research**

Based on the analysis of data collected and the conclusions presented in this chapter, the following recommendations are proposed:

1. CENIPA should revise the Hazard Report Program regulation to incorporate the SMS concepts for reporting systems as described in the ICAO Safety Management Manual.

2. CENIPA should develop measures to reduce the fear of punishment within the Brazilian Air Force by promoting the concepts of *just culture* and *top-down* approach to safety.

3. CENIPA should require a written statement by the air squadron commanders at the beginning of the command period, containing the safety policy to ensure the safeguard of the safety data, to provide a non-punitive environment for unintentional errors, and to provide clear guidelines to differentiate between acceptable and unacceptable behavior for operational personnel.

4. CENIPA should develop a common taxonomy to be used in the HAZREP Program, aiming to disseminate safety information to other organizations and to develop trend analysis. The taxonomy should be adapted to the particular needs of the Brazilian Air Force; the taxonomy should be based on modern safety theories addressing human
errors; the taxonomy should able to be applied in already existent safety databases and be easy to use.

5. CENIPA should revise the training program for the safety specialists, providing additional practical exercises to perform the risk assessment and risk control.

6. CENIPA should provide tools and guidelines to the safety managers to improve the HAZREP training for the operational personnel.

7. CENIPA should revise the HAZREP form to correct the risk assessment process, including the first assessment in accordance with ICAO Safety Management Manual.

8. The Brazilian Air Force and the CENIPA should consider a more complete assimilation of SMS concepts, including other areas not related to the HAZREP Program in a future revision of its regulation in order to obtain the full benefits of these concepts to improve safety.

9. CENIPA should conduct further study to select an appropriate investigative technique to assist the safety managers to identify factors involving a reported hazard.

10. CENIPA should conduct further study to select the best method to establish a hierarchy of controls for use in the HAZREP Program, considering the effectiveness of controls and the cost analysis.

11. Future research may be conducted by CENIPA to corroborate the findings of this study and also to evaluate other SMS concepts with potential to enhance aviation safety.

This research provided a detailed analysis of the SMS concepts related to reporting systems and investigated their applicability in the Brazilian Air Force
environment. The study is presented for use by CENIPA as a basic guide when conducting the necessary revision of the Hazard Report Program and it represents a starting point to incorporate the SMS perspective for reporting systems. However, the universal use of reporting systems in the aviation industry introduces another important meaning for this study. The results, analysis, and conclusions may be applied to many other military and civilian organizations worldwide to improve their reporting systems. Safety Management System is fostered by some governments, but is still not widely accepted or used by aircraft operators. The favorable result obtained in this study involving a group of safety specialists may emphasize the usefulness of SMS, stimulating the development of these systems and improving the aviation safety.
REFERENCES


Centro de Investigação e Prevenção de Acidentes Aeronáuticos [Aeronautical Accidents Investigation and Prevention Center]. (2008a). *Norma Sistêmica do Comando da Aeronáutica 3-1: Conceituações de vocábulos, expressões e siglas de uso no SIPAER* [Systemic Regulation from Aeronautical Command 3-1: Conceptualizations of words, expressions and acronyms in use in the SIPAER]. Brasília, Brazil: Author.


Englewood, CO: Jeppesen Sanderson.
De acordo com as regulamentações brasileiras, este relato (ou parte dele) somente será usado para a prevenção de acidentes aeronáuticos, a fim de aumentar a segurança operacional. Este relato não precisa ser identificado, se o for, o relator será informado sobre as medidas adotadas.

In accordance with Brazilian regulations, this report (or any part of it) shall only be used for preventing aeronautical accidents, and has the sole purpose of enhancing safety. This report does not need to be identified. Should the reporter, however, choose to identify him/her, he/she will be informed on the measures adopted.
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**AÇÕES RECOMENDADAS PELO ELO-SIPAER**

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APPENDIX B
QUESTIONNAIRE – ENGLISH VERSION

Dear Flight Safety Specialist,

This Questionnaire is part of a scientific research project designed by Fernando Luis Volkmer, a graduate student at the University of Central Missouri – USA. The questionnaire seeks data to allow a better understanding of two aspects:

1) The possibility of a revision of the Hazard Report Program using Safety Management System (SMS); and

2) The applicability of SMS concepts to revise the Hazard Report Program.

There is no intention to evaluate the safety level of your organization or determine any personal success or failure. The completion of the questionnaire is anonymous and voluntary, and the answers will be kept confidential. Your participation is very important for the success of this study, but you can decide not to participate at any time, even if you already have examined questions inserted on it.

SMS is defined by the International Civil Aviation Authority (ICAO) as an organized approach to managing safety, including the necessary organizational structures, accountabilities, policies and procedures. It is essentially a quality management approach to controlling risks, also providing the organization with the organizational framework to support safety culture. The SMS incorporates internal evaluation and quality assurance concepts that can result in more structured management and continuous improvement of operational processes. More information about SMS can be found in the ICAO Safety Management Manual (Document 9859-AN/474), available at http://www.icao.int/anb/safetymanagement/Documents.html.

This questionnaire was designed to, based on your opinions and perceptions,
acquire a better understanding about the hazard report as a safety tool and the possibility
to use SMS perspective to review the Hazard Report Program. It is important to remind
you that there is no right or expected answer in the questionnaire. For answering the
multiple choice questions, which takes fifteen minutes to be completed, you just have to
put the cursor over the box near the item you want to mark and press the mouse button. It
will create an “X” inside the box and, in case you want to change the answer, all you
have to do is to click again in the marked box, and the “X” will disappear. For the essay
questions, you just have to put the cursor over the shaded area below the question and
click with the mouse button. This will immediately activate the field with no size limits
for the text you want to insert.

You are one of the most important parts in keeping the safety engine running
adequately within your organization. Thank you in advance for your attention and for
devoting your time to support this project which, with your experience and knowledge,
will surely help to improve the Hazard Report Program.

Please, after completing your questionnaire, attached it to an e-mail and send your
answers directly to the researcher’s e-mail flvolkmer@gmail.com at your earliest
convenience. The entire process must be conducted with confidentially. After receiving
your questionnaire, the message will be deleted and no record will be kept that allow
further identification of the respondent.

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<th>PROFESSIONAL BACKGROUND</th>
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<tr>
<td>1. How long have you been working with safety?</td>
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</table>
2. Have you ever attended any safety course from CENIPA? | Yes ☐ No ☐
---|---
3. Do you have any credentials granted by CENIPA? | Yes ☐ No ☐
---|---
4. Have you ever attended an SMS course? | Yes ☐ No ☐
---|---
5. In which organization do you work? | CENIPA ☐ SERIPA1 ☐ SERIPA2 ☐ SERIPA3 ☐ SERIPA4 ☐ SERIPA5 ☐ SERIPA6 ☐ SERIPA7 ☐
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For each statement, please check one of the following choices that best matches with your own opinion.

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<tr>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Do not Agree or Disagree</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
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**HAZREP PROGRAM ATTRIBUTES**

6. The HAZREP is an important tool to identify hazards and prevent accidents. | 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐
---|---
7. An effective safety environment requires that all personnel feel responsible for safety and are willing to report hazards. | 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐
---|---
8. A “fair culture,” where employees have confidence that the organization will treat them fairly is important to promote safety. | 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐
---|---
9. The confidence cited in 8 should be generated from the top-management to the employees. | 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐
---|---
10. The commander commitment to safety must be formally expressed through a safety policy. | 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐
11. The ultimate responsibility for the establishment and adherence to safety practices rests with the commanders and managers of the organization.  

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12. The fear of punishment is a threat to the HAZREP and could reduce the number of reports.  

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13. A chief or director’s written statement ensuring that the safety data will be properly safeguarded is important to make the reporters feel more confident.  

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14. The statement cited in 13 should also guarantee a non-punitive environment to reports involving unintentional errors.  

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15. An organization’s safety policy should provide clear guidelines to differentiate between acceptable performance (unintentional errors) and unacceptable performance (such as negligence and violations), providing fair protection to reporters and reducing the fear of punishment.  

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16. Some aspects and concepts of the SMS could represent a valuable source to revise the HAZREP Program, in order to make it more effective.  

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17. The space below is provided for any suggestions or comments to revise the HAZREP program.
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<tr>
<th>HAZARD IDENTIFICATION</th>
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<tbody>
<tr>
<td>18. The operational personnel in the Brazilian Air Force are well trained to recognize a situation that requires the use of HAZREP.</td>
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<tr>
<td>19. When a situation involving safety is reported, the safety manager must investigate the validity of the information.</td>
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<tr>
<td>20. It is also important for the safety manager to identify the causes or factors affecting the situation reported.</td>
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<tr>
<td>21. Investigative techniques (tools) should be used to help safety managers to identify the factors involving a reported situation and to assess possible mitigation actions.</td>
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<tr>
<td>22. The hazards reported should be transformed into valid safety data following a proper classification.</td>
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<tr>
<td>23. Classification of hazards using a common taxonomy is important to disseminate information to other organizations.</td>
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<td>24. A database of hazards classified with a common and appropriate taxonomy could help to develop trend analysis within the organization.</td>
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<td>25. An easy taxonomy to classify hazards that could also be used in accident investigation is desirable.</td>
</tr>
<tr>
<td>26. A good taxonomy should address human errors and be supported by modern safety theories.</td>
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<td>27. A good taxonomy should be able to be adapted to the particular needs of an organization.</td>
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<td>28. A good taxonomy should be able to be applied in already existent safety databases.</td>
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<td>29. The space below is provided for any comments about hazard identification.</td>
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**RISK ASSESSMENT AND RISK CONTROL**

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<td>30. Once the hazard is identified, it is important to evaluate the probability that an incident or accident might occur as a consequence of the hazard.</td>
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<td>31. It is important to evaluate the severity of the hazard’ consequences.</td>
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<td>32. A matrix of probability versus severity could be a helpful tool for the safety manager to evaluate a hazard.</td>
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<td>33. After evaluating a hazard according to its probability X severity, it is important to determine if the hazard is tolerable, tolerable with mitigation, or intolerable (can we accept the risk as it is or we must do something?).</td>
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<td>34. A tolerability evaluation of hazards could help the safety managers in the decision-making process to establish priorities and adequate mitigation actions.</td>
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<td>35. After the mitigation actions are established, another tolerability evaluation could help determine if the residual risk is tolerable (can we accept the risk after the mitigation actions are in place?).</td>
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<td><strong>36.</strong> When establishing controls or mitigation actions, it is important to evaluate their effectiveness.</td>
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<td><strong>37.</strong> When establishing mitigation actions, the most effective should be considered first and then other controls until the least effective.</td>
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<td><strong>38.</strong> The cost of implementing the mitigation actions should also be considered when evaluating possible solutions.</td>
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<td><strong>39.</strong> I have received adequate training to perform the hazards’ risk assessment and to establish risk controls to mitigate them in my organization.</td>
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<td><strong>40.</strong> The space below is provided for any comments about the process of risk assessment and risk control.</td>
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Prezado profissional de segurança operacional,

Este questionário é parte de um projeto de pesquisa científico elaborado por

Fernando Luís Volkmer, mestrando na Universidade Central do Missouri (UCM) - EUA.

O questionário procura dados para permitir uma compreensão melhor de dois aspectos:

1) A possibilidade de uma revisão do Programa de Relatório de Prevenção usando gerenciamento de segurança operacional (Safety Management System – SMS); e

2) A aplicabilidade de alguns conceitos de SMS na revisão do relatório de prevenção (RELPREV).

Não há nenhuma intenção de avaliar o nível de segurança de sua organização ou verificar qualquer caso de sucesso ou falha pessoal. O preenchimento do questionário é anônimo e voluntário e as respostas serão mantidas confidenciais. Sua participação é muito importante para o sucesso deste estudo, mas você pode decidir a qualquer momento, por não participar dele, mesmo se você já tenha começado a responder as perguntas.

SMS é definido pela Organização da Aviação Civil Internacional (ICAO) como uma abordagem organizada para o gerenciamento da segurança operacional, incluindo as estruturas organizacionais necessárias, as responsabilidades, as políticas de segurança e os procedimentos a serem adotados. É essencialmente uma aplicação da gestão da
qualidade para o controle dos riscos, que fornece, também, uma estrutura que suporte a cultura organizacional de segurança.


Este questionário foi desenvolvido para, baseado nas suas opiniões e perspectivas, adquirir um melhor entendimento sobre o relatório de prevenção como uma ferramenta de segurança operacional e a possibilidade de usar conceitos do SMS para revisar o Programa do Relatório de Prevenção. É importante lembrá-lo de que não há uma resposta correta ou esperada no questionário. Para responder às perguntas de múltipla escolha, o que deve levar cerca de quinze minutos, você precisa apenas pôr o cursor sobre a caixa que deseja marcar e clicar. Isto irá criar um “X” dentro da caixa e, caso você queira mudar a resposta, basta clicar outra vez na caixa marcada, e o “X” desaparecerá. Para as perguntas abertas, você precisa apenas pôr o cursor na área protegida abaixo da pergunta e clicar. Isto ativará imediatamente um campo, sem limites de texto, para você escrever o que desejar.

Você é uma das partes mais importantes para manter a segurança operacional funcionando adequadamente dentro de sua organização. Obrigado pela sua atenção e pelo seu tempo para ajudar neste projeto que, com seus conhecimento e experiência, certamente permitirá uma melhoria no Programa de Relatório de Prevenção.
Por favor, após terminar o seu questionário, adicione-o a uma mensagem de e-mail e envie diretamente para flvolkmer@gmail.com na primeira oportunidade possível. Todo o processo deve ser conduzido com confidencialidade. Depois de receber o seu questionário, a mensagem será apagada e nenhum arquivo será mantido que permita uma futura identificação da pessoa que respondeu.

**EXPERIÊNCIA PROFISSIONAL**

| 1. Há quanto tempo você trabalha na área de segurança de voo? | Menos de 2 anos ☐ 2 a 5 anos ☐ Mais de 5 anos ☐ |
| 2. Você já participou de algum curso do CENIPA na área de segurança de voo? | Sim ☐ Não ☐ |
| 3. Você possui alguma credencial emitida pelo CENIPA? | Sim ☐ Não ☐ |
| 4. Você já participou de algum curso de SMS? | Sim ☐ Não ☐ |
| 5. Em qual organização você trabalha? | CENIPA ☐ SERIPA1 ☐ SERIPA2 ☐ SERIPA3 ☐ SERIPA4 ☐ SERIPA5 ☐ SERIPA6 ☐ SERIPA7 ☐ |

Para cada declaração a seguir, escolha uma das opções que melhor expresse a sua opinião.

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<td>Não Concordo nem Discordo</td>
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**ATRIBUTOS DO RELATÓRIO DE PREVENÇÃO**

| 6. O relatório de prevenção é uma importante ferramenta para identificar | 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐ |
perigos e prevenir acidentes.

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<td>7. Um ambiente favorável à segurança de voo requer que todo o pessoal se sinta responsável pela segurança e tenha vontade de participar fazendo relatórios de prevenção.</td>
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<td>8. Um ambiente de “cultura justa,” onde o pessoal tenha plena confiança de que a organização irá tratar seus funcionários com justiça, diferenciando os comportamentos aceitáveis e inaceitáveis, é importante para promover a segurança de voo.</td>
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<td>4</td>
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<tr>
<td>9. A confiança citada em 8 deve ser gerada do alto escalão da organização para os funcionários (abordagem de cima para baixo).</td>
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<tr>
<td>10. O compromisso do comandante com a segurança de voo deve ser <strong>formalmente</strong> expresso através de um documento contendo a política de segurança da organização.</td>
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<td>11. A responsabilidade final pelo estabelecimento e aderência às práticas de segurança de voo reside no comandante e alto escalão de uma organização.</td>
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<td>12. O medo de punição é uma ameaça ao relatório de prevenção e pode reduzir o número de relatos.</td>
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<td>13. Uma declaração por escrito do comandante, chefe ou diretor que assegure que a informação de segurança de voo será adequadamente salvaguardada (protegida contra uso diferente do que prevenção de acidentes) é importante para fazer os funcionários se sentirem mais confiantes em reportar.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
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</tbody>
</table>
14. A declaração citada em 13 deve também garantir um ambiente não punitivo para reportes de **erros não intencionais** (quando não há intenção deliberada de violar uma regra de segurança de voo).

15. A política de segurança de voo de uma organização deveria prover linhas claras para diferenciar entre comportamento aceitável (erros não intencionais) e comportamento inaceitável (tais como violações), provendo uma proteção justa aos relatores e reduzindo o medo de punição.

16. Alguns aspectos e conceitos do SMS podem representar uma fonte valiosa para revisar o Programa de Relatório de Prevenção, de forma a torná-lo mais efetivo.

17. O espaço abaixo pode ser usado para escrever qualquer comentário ou sugestão para revisar o Programa de Relatório de Prevenção.

### IDENTIFICAÇÃO DE PERIGOS

18. O pessoal operacional da Força Aérea Brasileira é bem treinado para reconhecer uma situação que requeira o uso do relatório de prevenção.

19. Quando uma situação envolvendo segurança de voo é reportada, o oficial de segurança de voo deve investigar a
validade da informação.

20. Também é importante que o oficial de segurança de voo identifique as causas ou fatores afetando a situação reportada.

21. Técnicas investigativas (ferramentas de investigação) deveriam ser usadas para ajudar os oficiais de segurança de voo a identificar os fatores envolvendo uma situação reportada e avaliar as possíveis ações mitigadoras.

22. Os perigos reportados deveriam ser transformados em informação válida de segurança de voo através de uma apropriada classificação.

23. A classificação dos perigos usando uma taxonomia comum (linguagem padronizada) é importante para disseminar a informação de segurança de voo para outras organizações.

24. Um banco de dados de perigos classificados com uma taxonomia comum (linguagem padronizada) e apropriada poderia ajudar a desenvolver análises de tendências dentro da organização.

25. É desejável que a taxonomia usada para classificar os perigos seja simples e que possa também ser usada na investigação de acidentes.

26. Uma boa taxonomia deveria ser capaz de classificar erros humanos e ser baseada em modernas teorias de segurança de voo.

27. Uma boa taxonomia deveria ser capaz de se adaptar às necessidades particulares de cada organização.

28. Uma boa taxonomia deveria ser capaz de ser aplicada em bancos de dados de
segurança de voo já existentes.

29. O espaço abaixo pode ser usado para escrever qualquer comentário sobre identificação de perigo.

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<tr>
<th>AVALIAÇÃO DE RISCO E CONTROLE DO RISCO</th>
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<tr>
<td>30. Uma vez identificado o perigo, é importante avaliar a probabilidade que um incidente ou acidente possa ocorrer como consequência do perigo.</td>
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<tr>
<td>31. É importante avaliar a severidade de um perigo (quais seriam os danos causados se o perigo resultar em um incidente ou acidente?).</td>
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<tr>
<td>32. Uma matriz (tabela) de probabilidade versus severidade poderia ser uma ferramenta útil para o oficial de segurança de voo avaliar um perigo.</td>
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<tr>
<td>33. Depois de avaliar um perigo de acordo com sua probabilidade X severidade, é importante determinar se o perigo é tolerável, tolerável somente após desenvolver alguma ação mitigadora, ou intolerável (podemos aceitar o risco como está ou devemos fazer alguma coisa?).</td>
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<tr>
<td>34. A avaliação de tolerabilidade de um perigo poderia ajudar o oficial de segurança de voo no processo de decisão para estabelecer prioridades e ações de</td>
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mitigação adequadas.

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<tr>
<th>35. Após as ações de mitigação serem estabelecidas, uma segunda avaliação de tolerabilidade poderia ajudar a determinar se o risco residual é tolerável (podemos aceitar o risco depois de colocar em prática as ações de mitigação?).</th>
<th>5 4 3 2 1</th>
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<tr>
<th>36. Quando estabelecendo controles ou ações mitigadoras é importante avaliar a efetividade dessas medidas.</th>
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<tr>
<th>37. Quando estabelecendo ações mitigadoras, as mais efetivas deveriam ser consideradas em primeiro lugar e assim por diante até a menos efetiva.</th>
<th>5 4 3 2 1</th>
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<tr>
<th>38. O custo de implementação de ações mitigadoras também deveria ser considerado quando avaliando as possíveis soluções.</th>
<th>5 4 3 2 1</th>
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<tr>
<th>39. Eu tenho recebido treinamento adequado para realizar a avaliação do risco e para estabelecer controles para mitigar os riscos em minha organização.</th>
<th>5 4 3 2 1</th>
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| 40. O espaço abaixo pode ser usado para escrever qualquer comentário sobre o processo de avaliação do risco e controle do risco. | --- |
APPENDIX D
AUTHORIZATION LETTER FROM CENIPA

Brasília, 8 de setembro de 2010.

Dr. Janice Putnam
University of Central Missouri
Human Subjects REview Board
Ward Edwards 1800
Warrensburg, MO 64093

Dear Dr. Putnam,

CENIPA is honored for being chosen as part of a scientific research project regarding SMS perspectives to Brazilian Air Force (BAF) Hazard Report Program. The project is to be performed by Fernando Luís Volkmer, a Brazilian international student at the University of Central Missouri. We know the contents and the objectives of this research project, which may improve the hazard report system and may contribute to overall aviation safety within BAF. I authorize this research and the necessary procedures to gather the opinions of safety specialists from CENIPA and SERIPAs. If you have any doubts or need any extra information, please feel free to contact Lt Col Uberacy Marcos Tottoli da Silva at (55-61) 33648819 or email uberacyms@cenipa.aer.mil.br.

Sincerely,

No Imp  
Brig Ar José Pompeu dos Magalhães Brasil Filho
Ch do CENIPA

LUIZ CLAUDIO MAGALHÃES BASTOS Cel Av
APPENDIX E
HUMAN SUBJECT REVIEW COMMITTEE APPROVAL

9/20/2010

Fernando Volkmer
1217 Vest Dr Apt B
Warrensburg, MO /64093

Dear Mr Fernando Volkmer,


Please note that you are required to notify the committee in writing of any changes in your research project and that you may not implement changes without prior approval of the committee. You must also notify the committee in writing of any change in the nature or the status of the risks of participating in this research project.

Should any adverse events occur in the course of your research (such as harm to a research participant), you must notify the committee in writing immediately. In the case of any adverse event, you are required to stop the research immediately unless stopping the research would cause more harm to the participants than continuing with it.

At the conclusion of your project, you will need to submit a completed Project Status Form to this office. You must also submit the Project Status Form if you wish to continue your research project beyond its initial expiration date.

If you have any questions, please feel free to contact me at the number above.

Sincerely,

Janice Putnam Ph.D., RN
Associate Dean of The Graduate School
putnam@ucmo.edu

cc: Dr. John W. Horine
APPENDIX F
PRESENTATION LETTER AND DIRECTIONS

Dear Flight Safety Officer,

This survey is part of a scientific research conducted by Fernando Luís Volkmer, a graduate student at the University of Central Missouri – USA, under supervision of Dr. John Horine from the Aviation Department.

An instrument survey was designed to, based on your opinions and perceptions, acquire a better understanding about the hazard report as a safety tool and the possibility to use SMS perspective to review the Hazard Report Program. The completion of the questionnaire is anonymous. In consequence, the accomplishment of this project requires the contribution of the most precious resource available to your organization, its employees.

The questionnaire should be filled out only by sergeants and officers from CENIPA/SERIPAs that have received training from CENIPA to work as safety managers or assistants in safety activities to prevent and investigate aircraft accidents. The completion of the survey is voluntary, it should not be identified, and it does not aim to determine the current level of flight safety existing in the organization. All necessary orientation for the participants on how to fill out the questionnaires is provided in the beginning of them.

It is desired that the Prevention Department/Section of your organization keep the responsibility for the distribution of questionnaires to all eligible personnel and require them to send them back directly to the researcher’s e-mail flvolkmer@gmail.com. The entire process must be conducted with confidentially.
This is a unique opportunity to be part of a pioneering scientific research. Many safety benefits are expected as a final result for this effort not only for your organization, but for all the Brazilian Air Force.

The success of this endeavor depends on the voluntary participation of your organization’s personnel. In case of any questions, suggestions or comments, you can contact me through my e-mail or at 1(660)747-8537. Thank you for taking your time to help me to review this important safety tool.

Fernando Luis Volkmer
Graduate Student – Aviation Safety