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ICAO SAFETY MANAGEMENT SYSTEMS (SMS) DEVELOPMENT IN
ENVIRONMENTAL CONTEXTS: A FIELD STUDY OF GREATER CHINA

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ICAO SAFETY MANAGEMENT SYSTEMS (SMS) DEVELOPMENT IN
ENVIRONMENTAL CONTEXTS: A FIELD STUDY OF GREATER CHINA

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TABLE OF CONTENTS

| | Page |
|--|------|
| LIST OF TABLES..... | vii |
| LIST OF FIGURES..... | viii |
| ABSTRACT..... | ix |
| CHAPTER 1. INTRODUCTION..... | 1 |
| 1.1 Statement of the Problem..... | 1 |
| 1.2 Research Questions..... | 4 |
| 1.3 Significance of the Problem..... | 6 |
| 1.4 Statement of Purpose..... | 7 |
| 1.5 Definitions..... | 7 |
| 1.6 Assumptions..... | 8 |
| 1.7 Limitations..... | 9 |
| 1.8 Delimitations..... | 10 |
| 1.9 Summary..... | 11 |
| CHAPTER 2. REVIEW OF LITERATURE..... | 12 |
| 2.1 Safety Management Systems & Safety Culture..... | 12 |
| 2.1.1 Development of Safety Management Systems as a Standard..... | 12 |
| 2.1.2 System Safety Tools and Models..... | 16 |
| 2.1.3 Defining and Understanding Safety Culture..... | 21 |
| 2.1.4 Safety Sub-Cultures..... | 23 |
| 2.1.5 Safety Climate..... | 25 |
| 2.1.6 Measuring Safety Culture..... | 26 |
| 2.2 Organizations and Environmental Influence..... | 30 |
| 2.2.1 Conceptualizing Organizational Structure..... | 31 |
| 2.2.2 Accommodating Cultural Influence in Theory and Practice..... | 33 |
| 2.2.3 Legitimacy and Institutional Theory..... | 38 |
| 2.2.4 Isomorphism..... | 41 |
| 2.2.5 Fundamental Concepts of Legitimacy..... | 42 |
| 2.2.6 Organizational Constraints from Within..... | 45 |
| 2.3 Cultural Dimensions..... | 48 |
| 2.3.1 Power Distance..... | 48 |

| | Page |
|--|-----------|
| 2.3.2 Uncertainty Avoidance | 49 |
| 2.3.3 Individualism/Collectivism..... | 49 |
| 2.3.4 Masculinity/Femininity | 50 |
| 2.3.5 Long-Term Orientation | 51 |
| 2.4 Summary..... | 52 |
| CHAPTER 3. METHODOLOGY | 53 |
| 3.1 Research Type and Framework | 53 |
| 3.2 Approvals..... | 55 |
| 3.3 Sample | 55 |
| 3.3.1 Sample Determination on the First Level | 55 |
| 3.3.2 Sample Determination on the Second Level | 56 |
| 3.3.3 Participants | 58 |
| 3.3.4 Sample Size | 58 |
| 3.4 Threats to Validity | 59 |
| 3.5 Data Collection Tools | 61 |
| 3.5.1 Regulatory Environment..... | 64 |
| 3.6 Data Collection Process | 65 |
| 3.7 Data Analysis | 67 |
| 3.7.1 Multi-Level Model..... | 67 |
| 3.7.2 Quantitative Analysis..... | 69 |
| 3.7.3 Qualitative Analysis..... | 71 |
| 3.8 Answering the Research Questions | 73 |
| 3.8.1 Research Question 1..... | 73 |
| 3.8.2 Research Question 2..... | 74 |
| 3.8.3 Research Question 3..... | 74 |
| 3.8.4 Research Question 4..... | 75 |
| 3.9 Summary..... | 75 |
| CHAPTER 4. ANALYSIS AND FINDINGS | 76 |
| 4.1 Sample | 76 |
| 4.2 Review of Research Questions and Concepts..... | 79 |
| 4.3 Research Question 1: “What is the Status of SMS Implementation in Greater China?” | 80 |
| 4.3.1 Research Question 1.1: “What is the level of compliance of safety policy and objectives with respect to ICAO standards?”..... | 81 |
| 4.3.2 Research Questions 1.2 and 1.5: “To What Extent is Safety Risk Management Incorporated into the Region’s Safety Programs?” and “To What Extent do Organizational Members Participate in Aviation Safety?” | 83 |
| 4.3.3 Research Question 1.3: “How is Safety Promoted Within the Organization?” | 86 |

| | Page |
|--|------|
| 4.3.4 Research Question 1.4: “What is the extent of Safety Assurance and How is it Conducted?” | 89 |
| 4.3.5 Overall Findings for Research Question 1 | 91 |
| 4.4 Research Question 2: “How is the External Environmental Context Associated with the Status of SMS Implementation in Greater China?” | 95 |
| 4.4.1 Research Question 2.1: “What Are the Local Cultural Dimensions?” | 96 |
| 4.4.2 Research Question 2.2: “What are the legal regulations (national and local) SMS requirements?” | 99 |
| 4.4.3 Research Question 2.3: “What is the Perception of Isomorphic Tendency of SMS Development?” | 104 |
| 4.4.4 Research Question 4.2: “What is the Relationship Between Local Cultural Values and National/Local Safety Regulations” and Research Question 4.3: “What is the Relationship Between the Perception of Isomorphism and Local Cultural Values?” | 105 |
| 4.4.5 Overall Findings for Research Question 2 | 106 |
| 4.5 Research Question 3: “How is the Internal Environmental Context Associated with SMS Development in Greater China?” | 110 |
| 4.5.1 Research Question 3.1: “What is the Safety Culture Among Individuals at Their Organizations in Greater China?” | 111 |
| 4.5.2 Research Question 3.2: “What is the Extent of Individuals’ Perceived Legitimacy of their SMS?” | 112 |
| 4.5.3 Research Question 4.1: “What is the Relationship Between Safety Culture and Internal Legitimacy?” | 113 |
| 4.5.4 Overall Findings for Research Question 3 | 114 |
| 4.6 Research Question 4: “ What is the Relationship Between Certain Elements Within the Internal and External Environments?” | 116 |
| 4.6.1 Research Question 4.4: “What is the Relationship Between Safety Culture and Local Cultural Values?” | 117 |
| 4.6.2 Overall Findings for Research Question 4 | 119 |
| 4.7 Summary | 120 |
| CHAPTER 5. CONCLUSIONS, DISCUSSION, AND RECOMMENDATIONS | 121 |
| 5.1 Conclusions | 121 |
| 5.2 Discussion and Recommendations | 123 |
| 5.2.1 Goal-Oriented SMS Policy | 124 |
| 5.2.2 Understanding Culture | 126 |
| 5.2.3 Future Study of Environmental Interaction | 128 |
| 5.2.4 Methodological Considerations in Foreign Research Environments..... | 131 |
| 5.3 Summary | 133 |
| REFERENCES | 134 |

| | Page |
|--|------|
| APPENDICES | |
| Appendix A: Cultural Dimensions Assessment Tool | 139 |
| Appendix B: Additional Survey Items | 141 |
| Appendix C: List of Open-Ended Survey Questions for Participants | 142 |
| Appendix D: Survey to Participants in Chinese..... | 143 |
| Appendix E: Coding Schemes for the Regulatory Environment and SMS Implementation Status | 150 |
| VITA | 151 |

LIST OF TABLES

| Table | Page |
|---|------|
| Table 3.1. Division of Provinces and Sub-Regions into Regions for the Sample | 57 |
| Table 3.2. Sample Interview Questions and Follow-Up Questions | 64 |
| Table 4.1. Regional Diversity of Participants | 76 |
| Table 4.2. Groupings of the Sample Population | 78 |
| Table 4.3. Coded Responses for Safety Policy and Objectives | 82 |
| Table 4.4. Coded Responses for Safety Risk Management | 86 |
| Table 4.5. Coded Responses for Safety Promotion | 88 |
| Table 4.6. Coded Responses for Safety Assurance | 90 |
| Table 4.7. SMS Implementation Status Comparison by Region | 91 |
| Table 4.8. Average Cronbach's Alpha Values Across Regions | 96 |
| Table 4.9. Homogeneity of Variance Values | 97 |
| Table 4.10. ANOVA Results for Cultural Metrics | 98 |
| Table 4.11. Consistency of Regulatory Environments with SMM Standards | 103 |
| Table 4.12. Correlations Between Isomorphism and Local Cultural Values..... | 106 |
| Table 4.13. Summary of Significant Relationships Between Regions by Cultural Value | 108 |
| Table 4.14. Correlations Between Safety Culture and Legitimacy..... | 113 |
| Table 4.15. Correlations Between Safety Culture and Local Cultural Values | 117 |
| Table 4.16. Research Question 4 Findings | 120 |
| Table 5.1. Summary of Environmental Associations to SMS Implementation Status ... | 122 |

LIST OF FIGURES

| Figure | Page |
|---|------|
| Figure 3.1. Research Framework for the Dissertation | 54 |
| Figure 4.1. Visual Representation of Participating Provinces/Administrative Areas..... | 77 |
| Figure 4.2. Conceptual Overview of Relationships | 80 |
| Figure 4.3. Visual Representation of SMS Implementation Status by Region..... | 92 |
| Figure 4.4. SMS Component Adherence by Region..... | 94 |
| Figure 4.5. Summary of External Environment Associations to SMS Implementation | 107 |
| Figure 4.6. Overall Correlation Between Safety Culture and Legitimacy..... | 114 |
| Figure 4.7 Apparent Internal Environment Association to Overall SMS Compliance... | 116 |
| Figure 4.8. Apparent Expression of External Concepts through the Internal Environment | 119 |
| Figure 5.1. Visual Summary of Findings..... | 122 |
| Figure 5.2. Application of Structuration Theory to SMS Implementation in Environmental Context | 129 |

ABSTRACT

Leib, Steven M. Ph.D., Purdue University, May 2014. ICAO Safety Management Systems (SMS) Development in Environmental Contexts: A Field Study of Greater China. Major Professor: Chien-tsung Lu.

This was a mixed-methods exploratory study to investigate association between environmental context and the implementation status of Safety Management Systems (SMS) at airports in Greater China. Using a framework of Institutional Theory, this study looked at three regions of Greater China and explored internal and external environments of SMS at airports within each region. It used ICAO standards to evaluate the implementation status of SMS at those airports based on the perceptions of 126 participants. This research also employed snowballing technique to spread a survey tool to participants in Greater China through several key gatekeepers, and then applied the Delphi method for interviews with key gatekeepers themselves. Analysis of the data suggested several associations between various sub-concepts of the external environment and different components of SMS in the three regions. In addition, the data suggested a relationship between the internal environment as a whole and the overall status of SMS implementation in each region. Lastly, the study makes several recommendations for future research regarding global standards implemented in local environments, the evaluation of SMS implementation status, and the theoretical implications of this study.

CHAPTER 1. INTRODUCTION

This chapter presents an overview and background of the topics and merits related to this dissertation. Specifically, it introduces the background of Safety Management Systems (SMS), their development in the global aviation system, and the paradoxical nature of standardization across varying environments and cultures. This section contains detailed information on the problem that this dissertation will address as well as statements of purpose, research questions, assumptions, and limitations.

1.1. Statement of the Problem

Aviation is inherently a global industry, and in order to promote and ensure the safety, reliability, and efficiency of worldwide travel, standardization is a necessity. The issue of standardization is complicated by the world's vast variation of cultures as well as economic and political environments. After World War II, various worldwide agencies, most notably the International Civil Aviation Organization (ICAO) and the International Air Transport Association (IATA) were formed to champion the development of standardized regulations to reduce the variance of safety, security, and business practice of the global aviation industry. In the past ten years, ICAO has developed an international standard for comprehensive safety management including all international airlines and airports: Safety Management Systems (SMS) (ICAO, 2013a). ICAO's 191 members have accepted this standard.

SMS is comprehensive in that it ties together previously scattered concepts of safety management, such as safety promotion campaigns, hazard reporting systems, and safety risk analysis. However, the quality and performance of Safety Management Systems are highly dependent on the successful development of a “safety culture” in which people are proactive about participating in the SMS on an individual level (which can be measured in several specific ways) (Guldenmund, 2010; ICAO, 2013a; Wiegmann et al., 2004). In fact, the concept of safety culture can be examined in different ways. One perspective, from a behavioral standpoint, breaks safety culture (in the context of aviation safety management) down into four subcultures. A “just culture” is one that evaluates actions fairly and avoids assigning blame and punishment in the wake of genuine mistakes. An “informed culture” is one in which individuals are aware of safety concepts and attitudes, and are kept in the loop on safety related issues. The third subculture is a “learning culture” in which people are appropriately informed and trained to participate actively in safety management at the organization, both initially and periodically. Fourth, a “reporting culture” describes the willingness of people to participate in Safety Management Systems by actually reporting threats to safety to management (Leib & Lu, 2013; Reason, 1997). The last subculture, identified by the SMM is a “flexible” culture. In this cultural subset, individuals are able to shift from an established mode of procedures to a direct mode of conscious evaluating and decision-making to take appropriate actions in unusual circumstances (ICAO, 2013a).

The ICAO SMM (in its most recent edition) conceptualizes safety culture as being the product of the intersection of three cultures represented by the individuals in the SMS. The first, organizational (safety) culture, refers to the beliefs and practices within

the organization entity itself. This is critical to a healthy SMS, and “a safety culture cannot be effective unless it is embedded within an organization’s own culture” (ICAO, 2013a, p. 2-10).

Another culture that contributes to overall safety culture is professional culture. Professional culture is the differentiation of behaviors and attitudes based on the type of work being done; for example, pilots and flight attendants have differing professional cultures. The third culture is that of national culture, which is the summation of characteristics of individuals based on the country and society in which they were raised.

These different methods of conceptualizing safety culture highlight two aspects of building an effective safety culture. First, the composition of a safety culture has not been fully determined, though it is considered to be a critical aspect of SMS. Secondly, several values need to be appreciated on the individual level to actually create an effective safety culture. But individuals are already members of one or more local cultures, and the values emphasized by Safety Management Systems development are not necessarily congruent. Because of the potential for certain safety subcultures of SMS to be influenced by different groups of cultural values, research needs to address what those effects might be. Although some US-based research has investigated various lessons learned with US SMS from an implementation standpoint (Aviation Cooperative Research Program, 2012), the interaction of safety culture and local cultural and their subsequent effects on the successful implementation of Safety Management Systems in cultures worldwide is widely unknown and has not been addressed. Furthermore, the extent to which the regulatory and economic environments of sovereign nations influence or moderate SMS development is also unknown.

Understanding the context of aviation development worldwide is also important. One of the fastest growing areas in the world for aviation is Asia, and specifically China. Forecasts indicate China has one of the fastest growing aviation markets worldwide (U.S. Department of Transportation, 2012). This predicted growth highlights the continued need to understand how aviation safety is developing worldwide, especially in non-Western cultures where cultural values may conflict with safety management.

There are many questions that can be asked about how local culture influences, promotes, and/or hinders the development of Safety Management Systems at aviation organizations within them. This dissertation addresses these issues in the context of an environment, which, for the purpose of this study, has a distinct definition and implications. It consists of the group of normative, regulative, and cognitive attitudes, procedures, and policies that constitute individuals' and organizations' sources of influence. This dissertation identifies some aspects of these concepts and seeks, through theory-guided hypothesizing and data collection, to help explain them.

1.2. Research Questions

Because SMS is a product of Western thought in response to primarily Western-based data and attitudes, the issue of SMS development worldwide in the context of cultural differences is researchable. It is simply because “ignoring culture can be a costly mistake, a considerable drain on resources and a serious threat to the long-term success of an international venture” (Helmreich & Merritt, 1998, p. 212). The overarching research question for this dissertation is centered on the development of SMS in a non-Western

culture and includes several sub-questions which attempt to address various aspects of SMS. Specifically, they are:

1. What is the status of SMS implementation in Greater China?

Sub-question 1: What is the level of compliance of safety policy with respect to ICAO standards?

Sub-question 2: To what extent is safety risk management incorporated into the organizations' safety program?

Sub-question 3: How is safety promoted to members within the organizations?

Sub-question 4: What is the extent of safety assurance and how is it conducted?

Sub-question 5: To what extent do organizational members participate in aviation safety?

2. How does the external environmental context associate with SMS development in Greater China?

Sub-question 1: What are the local cultural dimensions?

Sub-question 2: What are the legal regulations (national and local) regarding SMS requirements?

Sub-question 3: What is the perception of isomorphic tendency of SMS development?

3. How does the internal environmental context associate with Safety Management Systems development in Greater China?

Sub-question 1: What is the Safety Culture Among Individuals at Their Organizations in Greater China?

Sub-question 2: What is the extent of individuals' perceived legitimacy of their SMS?

4. What is the relationship between certain elements within the internal and external environments?

Sub-question 1: What is the relationship between safety culture and internal legitimacy?

Sub-question 2: What is the relationship between local cultural values and national/local safety regulations?

Sub-question 3: What is the relationship between the perception of organizational isomorphism and local cultural values?

Sub-question 4: What is the relationship between safety culture and local cultural values?

1.3. Significance of the Problem

With the expectation that airlines and airports across the world implement Safety Management Systems, it is critical to ensure that time and money is not wasted in pursuit of compliance with international standards if an entirely uniform SMS is not a realistic expectation based on environmental variation, including the cultural orientation of the individuals within its organization. Whether a global standard is the most effective way to promote and ensure aviation safety depends on the extent to which vastly differing environments influence the ability for SMS to accomplish that which it intends. This issue has already begun to be addressed by ICAO with the addition of ICAO Annex 19: International Standards and Recommended Practices (ICAO, 2013b), which provides

certain insight about ways that SMS implementation can be flexible. As maintaining a safe operation is the top priority of any aviation organization, much research needs to be done to ensure the steps taken to do so are appropriate given these realistic constraints.

1.4. Statement of Purpose

The purpose of this study is to understand Safety Management Systems development in the Greater China region with respect to environmental constraints and cultural contexts. Using theories of organizational structure and influence, this research seeks to not only assess the implementation status of Safety Management Systems in Greater China, but also to understand components of local culture and their influence on the context of the aviation organization environment. For example, with a greater understanding of how an airport's environmental factors affect its development and operation of an internationally standardized safety program, future international standards can be developed to further assure their success. And for the purpose of financing large-scale Safety Management Systems implementation projects, this understanding can help mitigate investment risks and encourage successful outcomes.

1.5. Definitions

For the purpose of clarity and simplicity, many unique and/or complex terms and phrases will be used in this dissertation and are defined as follows:

Culture – an abstract concept representing the collection of practices, attitudes, values, and behaviors common to a group of individuals (Hofstede, 1984).

Environment – the set of normative, social, regulatory, and cognitive frameworks in which an organization, individual, or group is embedded (Hanson, 2001).

Greater China – a region describing Mainland China (People’s Republic of China), Taiwan (Republic of China), Hong Kong Special Administrative Region, and Macau Special Administrative Region (Lei & Yao, 2009).

Institution – a long-lasting social framework that is resistant to change (Weerakkody, Dwivedi, & Irani, 2009).

Isomorphism – the tendency for organizations situated in similar environments to meet their needs in similar ways and converge (Fernandez-Alles & Valle-Cabrera, 2006).

Internal legitimacy – the perception of members within an organization that its existence is justified, important, relevant, or necessary (Suchman, 1995).

Safety Management Systems – A specific kind of safety management programs defined by the International Civil Aviation Organization and described in the ICAO Safety Management Manual (SMM) (ICAO, 2013a).

Safety program – the collection of procedures, documents, materials, and policies that govern the management of safety as well as participation in safety management at a particular organization (ICAO, 2013A).

1.6. Assumptions

To conduct this research in a practical way, this dissertation must assert the following assumptions:

1. The regulatory authorities of Greater China intend to implement fully functioning SMS programs at airlines and airports that are compliant with international standards.
2. Participants accurately and genuinely represent the local culture.
3. Participants will respond accurately, honestly, and thoroughly to all interview, focus group, and survey questions (as deemed appropriate by the methodology).
4. The number of participants is sufficient to describe Greater China with respect to environmental influence on SMS development and operation.
5. The theories used in this dissertation are appropriate and valid for describing organizations, institutions, environmental influences, and SMS development in Greater China.
6. All aviation organizations equally appreciate the value of safety and share similar goals of providing for the safest possible operations.
7. All aviation organizations prioritize safety and safety management regardless of cultural, political, and economic factors.
8. The components of SMS are independent from each other and can be independently assessed and described.

1.7. Limitations

The following are limits to this study and may threaten the interpretability or accuracy of the results from conducting this research:

1. This study will only address a sample of three regions of Greater China, which may have a wide variation of SMS compliance statuses.

2. Only select theories and theoretical perspectives will be used to understand the relationship of local environment and SMS development and implementation. It is possible that other theories could provide different insights regarding this relationship.
3. Culture is an abstract concept that can be described and/or quantified in a variety of ways. This dissertation will use previously validated cultural assessment tools that address only specific and thoroughly defined dimensions of culture.
4. This study is limited by the accuracy of any measurement tools, such as surveys, or statistical analyses.
5. Certain measurements taken in this dissertation cannot be observed empirically; for example, those that relate to safety culture and the effects of safety promotion.
6. This dissertation does not consider airport-level differences, and aggregates data to the regional level. Some airports could have vastly different implementation levels of SMS within the same region, a level of detail that was beyond the scope of this study.

1.8. Delimitations

The following delimitations are applicable to this dissertation and may limit the scope of this research:

1. Participants are airport employees or airport-based organization employees.
2. Individuals who participate in the study in Greater China come from different organizations and may not represent the full variety of SMS at organizations in Greater China.

3. Time spent seeking and communicating with participants and gatekeepers, depends on the size of the sample, the willingness of the participants, and availability of resources.
4. A period of two academic semesters in Greater China was sufficient to complete this dissertation.

1.9. Summary

This chapter has introduced the foundation of this dissertation. It has outlined the background and significance of the problem, and the purpose of this study. In addition, it has presented the assumptions, limitations, and delimitations associate with this research.

CHAPTER 2. REVIEW OF LITERATURE

This chapter provides a thorough review of relevant literature and prior research related to a variety of subjects. It includes a history of ICAO's Safety Management Systems, with special emphasis on safety culture and associated subcultures. It also includes a thorough discussion of organization communication theories that are (or can be) used to describe the nature of environmental interactions on organizations and institutions, as well as related examples of applications within Asia.

2.1. Safety Management Systems and Safety Culture

This section provides a comprehensive look at the history and development of Safety Management Systems. It also describes other relevant tools for managing system safety that may be included as part of a robust SMS. Lastly, it describes in depth the concepts of safety culture (and related sub-cultures) and safety climate.

2.1.1. Development of Safety Management Systems as a Standard

The formalized concept of Safety Management Systems in aviation is relatively new, but draws upon the idea that organizational accidents have a distinct nature from individual accidents (Reason, 1997). A single accident or failure in the context of an organization is usually the result of a vast network of errors, deficiencies, and decisions (both active and latent) that potentially span large tracts of time – perhaps even the life of

the organization in the case of culture (Reason, 1997). From this idea came a variety of research and models that try to understand how accidents occur and how deficiencies lead to failures.

Reason (1997) popularized a now well-known model called the “Swiss Cheese Model”. This particular model shows how organizations apply various layers of defenses, from regulation, to operating standards and procedures, to employee training. When those layers have gaps, hazards can penetrate the various levels. In a disastrous scenario, those particular gaps align such that a hazard can evolve fully into an accident or other large-scale loss.

This model has two implications: first, that for every single large-scale event, there are hundreds of potential underlying hazards that are stopped by a level of defense. The disastrous outcomes that we see (such as an accident in the aviation industry) are the rare instances when a hazard has penetrated ALL of the layers of defense to become a loss. The other implication is that no *single* failure is responsible for a hazard developing into a much more significant event. This concept has precipitated the interest in developing a comprehensive complete top-down approach to managing safety, as opposed to a collection of various safety management tools and programs.

Since Reason (1997), there have been several attempts to develop aviation safety models from a holistic perspective. Wood (2003) is among numerous safety management resources that have identified several of the needs of a comprehensive safety management program. These include determining who is in charge, deciding the scope of the program, and outlining goals and objectives (Wood, 2003). Other resources have explored other relevant concepts in aviation safety management, including the human

component, and developed numerous other models similar to Reason's Swiss Cheese Model such as the 5-M model and the SHELL model (Wells & Rodrigues, 2004). At the same time, aviation organizations have been adopting various smaller-scale aviation safety management tools to help manage various aspects of the organization's safety, including several tools that will be discussed later. Lu, Bos, and Caldwell (2007) provide a good example of combining system safety tools to form a safety management program, while Lu, Schreckengast, and Jia (2011) suggest excellent contemporary example of possible solutions for SMS scaled to smaller airports with limited financial resources. The state of aviation safety at this point in time is perhaps best summed up by Harms-Ringdahl (2004), noting: "Safety is a prominent feature in complex systems, and there is an abundance of different traditions how to deal with this [*sic*]" (p. 13).

Eventually, regulatory agencies became interested in a broad proactive approach to safety management. Recognizing that safety management is an important issue for aviation worldwide, the International Civil Aviation Organization (ICAO) took the lead in creating the first guide to comprehensive safety management: The Safety Management Manual (SMM) (ICAO, 2013A).

In addition to a review of the aforementioned accident prevention models and a variety of system safety tools, the SMM also incorporates the concepts of non-punitive reporting systems for data collection and very standardized procedures for risk analysis and risk assurance through monitoring and auditing. SMM also focuses (heavily) on the development of safety culture and methods of promoting safety to all members of the organization (ICAO, 2013A). Lastly, SMM includes an implementation procedure with specific levels and outcomes.

Because ICAO is a specialized agency of the United Nations with no enforcement authority over its member states, the SMM is intended to provide a foundation for developing SMS at aviation organizations so as to conform to the safety requirements of their state's safety program (SSP). The SMM has since been adopted as the international safety standard, and many countries require its compliance as part of their regulatory oversight (ICAO, 2013A). In the United States, however, there is no formal regulation requiring the development and implementation of Safety Management Systems.

Despite the lack of regulation, the Federal Aviation Administration (FAA) has been unofficially proactive about promoting Safety Management Systems in the United States. It has published Advisory Circulars (ACs), which are non-regulatory channels for information and best practices sharing, regarding SMS and implementation strategies (FAA, 2006; 2007). In addition, the FAA has published several orders which have defined SMS in the airport environment as well as how the FAA would be involved in an aviation organization's SMS (FAA, 2008; 2010). This is the current situation of Safety Management Systems in the US, although it is possible (and likely) that future legislation will require the incorporation of SMS in American aviation organizations.

Because SMS is being implemented in many countries, there have been some rich opportunities to study SMS at aviation organizations with varying cultural and regulatory contexts. Research is now exploring the successes and challenges faced by an international standard in such environments. Leib et al. (in press) and Hale (2011) are two such examples of exploring the nature of SMS in non-US aviation organizations. Results have found that there are indeed challenges to such implementation and strongly suggest further study into this phenomenon.

2.1.2. System Safety Tools and Models

While it is important to understand the background and current situation of SMS with respect to global and domestic aviation organizations, it is also important to understand and describe thoroughly some important system safety tools that have contributed to the development of SMS. Although these tools are neither necessarily nor explicitly a part of SMS as defined by ICAO, these are early system safety concepts that have contributed to the overall aim of safety management that SMS seeks to reach.

There are many different methods and tools for analyzing procedures and operations to determine where hazards lie and how to minimize risks. While all of them have various strengths and weaknesses, several are especially valuable to the operations and tasks of a large aviation organization, which can incorporate various physical hazardous operations as well as detailed and intricate job tasks. The following is a discussion of four separate system safety tools that can be an important part of healthy Safety Management Systems: Preliminary Hazard Assessment, Job Safety Analysis, Fault Tree Analysis, and Management Oversight Risk Tree. While these three tools are not required to be incorporated into an organization's safety management program specifically, they have been chosen for this discussion based on their ability to support Safety Management Systems by helping identify risks systematically, and providing standardized frameworks and processes for doing so.

Processing data concerning safety issues is just as important as collecting it. One of the best methods for processing and understanding threats is Preliminary Hazard Analysis (PHA), which can be a very important safety tool a high-risk industry such as aviation (Vincoli, 1993). The advantage of Preliminary Hazard Analysis is to determine

what potential hazards exist within the organization, and carefully analyze both their likely frequency of occurrence as well as their destructive potential. This is accomplished using a tool called a Risk Assessment Matrix (Reason, 1997). Using a Risk Assessment Matrix allows an organization to assign specific levels of risk to different activities and map them against the potential frequency of occurrence. This classification system helps determine what risks are acceptable, which risks require mitigation, and which risks are unacceptable.

The value of collecting and reporting data in this fashion is that it can be coded using a Risk Assessment Code (RAC) (Vincoli, 1993). This code assigns specific threat levels to hazards, which is valuable for determining a threshold of risk acceptability for various hazards in different areas of the operation. If the RAC lies above the risk threshold, steps will be taken to reduce either the severity or the frequency. Once the extent of the risk is known, other risk management tools to mitigate it can be implemented. But using PHA can be a valuable tool for the purpose of identification, which makes it a critically important addition to Safety Management Systems.

Job safety analysis (JSA) is another useful system safety tool that is critical for an organization involving, potentially high-risk activities (Vincoli, 1993). JSA involves investigating specific tasks and processes to understand what risks they incorporate and how they can be mitigated. In order to determine which processes or tasks merit a JSA review, the organization can rely on certain RACs, which again emphasizes the importance of performing a preliminary hazard analysis and incorporating these tools together.

After identifying a particular task, safety managers can implement a JSA review.

This typically includes the following steps, adapted from Vincoli (1993):

1. Observe the task performed by multiple employees
2. Create a flowchart of all the steps necessary to complete the task
3. Determine hazard potentials associated with each step
4. Develop corrective measures for the hazards found on each step
5. Review the findings with the employees for confirmation of appropriateness
6. Implement changes to reduce or eliminate the hazards for the task

The fifth step is particularly important to propagating a strong safety culture, as previously discussed, because it helps empower individual employees and gives them a sense that they are strongly involved in safety at the organization. Beyond that, it provides perspective from someone who actually has to perform the job and ought to be included in a review of the task.

Fault tree analysis (FTA) is another excellent system safety tool for a large aviation organization, especially those conducting maintenance and engineering operations. The purpose of FTA is to understand through logical reasoning how certain events waterfall and lead to other events, which in turn contribute to breakdowns in a safe operation, including accidents and incidents (Vincoli, 1993). While this is traditionally a system safety tool found on the reactive side of safety management, FTA also can be combined with a risk assessment matrix and applied proactively to help assess how likely deficiencies can lead to failures. This is especially important for organizations with maintenance operations, for example, because multiple tasks are performed on the same

aircraft (and systems interact considerably). Therefore, doing an analysis of how different events and errors contribute to an overall loss is very meaningful. Beyond the work on an aircraft, there is considerable cooperation required just to do simple tasks such as bringing an airplane into the hangar, marshalling it to and from a gate, and other operations related to airlines, maintenance facilities, and airports. These tasks carry considerable risks and FTA is a valuable tool for determining what factors will contribute to a loss.

FTA works by first identifying the “top” event – which is the primary event of investigation. A top event might be an accident, wingtip strike, or a “softer event” such as a delay or flight cancellation. Once the top event is identified, the next task is to identify “cut sets”. This is perhaps the most important aspect of FTA, as it identifies which groups of events must occur in order to guarantee the top event to occur. The benefit to FTA is that this process can be done mathematically, to realistically understand the likelihood that hazards will combine and stack to contribute to the top event (Grimaldi & Simonds, 1989). Once cut sets are established, measures can be placed in the system to avoid having all events occur at the same time, and will therefore prevent the top events.

This example highlights the importance of a fault tree analysis and the valuable knowledge that SMS can draw from it. Used properly, FTA can be a significant tool for reducing risk in an aviation organization.

The last system safety tool in this discussion is the Management Oversight Risk Tree (MORT). The purpose of MORT is to tie together the previously mentioned (and other) safety tools and provide a model of how management is meeting the safety needs

of the organization. A predecessor to the managerial oversight in an SMS program developed in the 1970s, MORT is described by Vincoli (1993) as, “designed to prevent safety-related oversights, errors, and/or omissions by providing relatively simple decision points in an accident analysis or a safety program evaluation” (p. 152). The MORT model is able to describe how management is meeting safety needs exhibited through a map of information flow through the organization based on how problems lead to catastrophic events. MORT has the power to show where management is meeting safety needs as well as how management is lacking in other possible areas of risk assessment and decision-making. Vincoli (1993) continues, “The end results of programmatic MORT implementation are the identification, assessment, and referral of residual risks to the proper management levels for appropriate action” (p. 152). Essentially, MORT takes the concepts of process mapping introduced by Fault Tree Analysis, and applies them on a meta-level to explore how the organization is prepared to handle the development of deficiencies and issues that lead to top level events.

From a meta-level, MORT can essentially trace “energy” that moves through an organization with regards to managing safety decisions, identifying hazards, and mitigating risks. Using the MORT tree, management can consider changes in their safety management strategies, and consider the possible consequences of such changes. Vincoli (1993) concludes: “In order for MORT to be truly comprehensive, all related and seemingly unrelated events in the management system must be examined for possible contribution to the top event” (p. 155).

These are several examples of safety tools that can be used in conjunction with an SMS and are by no means an exhaustive list of all the possibilities. Together, they help

strengthen the defenses of the organization (to put it in Reason's terms) and help close the holes in the Swiss Cheese Model to reduce the likelihood that a hazard will become a loss. Incorporation of these various techniques in an aviation organization can lead to robust, proactive, and effective Safety Management Systems.

2.1.3. Defining and Understanding Safety Culture

Safety culture has a multitude of varying definitions across many industries (especially those that are high-risk), but the idea of a safety culture can be traced as far back as the Chernobyl nuclear accident in the Soviet Union in 1986 (Guldenmund, 2010). The complexity of the disaster and the failure of multiple systems indicated that systemic errors and deep rooted established norms of behaviors contributed to the accident long before the day it occurred. Since then, the concept of understanding, developing, and measuring a safety culture has grown to be included in contemporary organizations. Wiegmann, et al. (2004) and Guldenmund (2010) explore commonalities in various definitions of safety culture, ranging from the nuclear power industry to the military, to simply theoretical definitions. However, it is important to note that there is not a sense of continuity as to the impressionability of safety culture; Reason (1997) argues that it can be socially constructed and developed in an existing organization, whereas Guldenmund (2010) takes a more conservative approach to cultural change: "...organizational culture is a product of social ecology, and it is quite reasonable to assume that such effective changes settle into the organizational collective as (basic) assumptions about how things generally work" (p. 1474). In the aviation industry, perhaps the most appropriate definition of safety culture comes directly from the International Civil Aviation

Organization (ICAO) in its 2006 Safety Management Manual: “Safety culture is a natural bi-product of corporate culture. The corporate attitude towards safety influences the employees’ collective approach to safety. Safety culture consists of shared beliefs, practices and attitudes” (p. 4-13). The following discussion explores safety culture and how it can be measured.

Regardless of the industry considered, there are some distinct commonalities present in the idea of a safety culture. First, there is employee involvement at the individual level, with emphasis on shared norms, patterns of behavior, and common beliefs. Second, there is well-defined management support and encouragement. Finally, there is a psychological component of having an atmosphere that encourages attention to safety issues, and creates a value system of attitudes and opinions of safety. Because safety culture is a relatively broad concept, ICAO (2006) has further defined how to achieve what it considers a “positive safety culture” (p. 4-15) and how it can be constructed. Some of the values that the SMM specifically discusses are the development of trust and good faith between management and lower-level employees, adoption of a pragmatic approach to how hazards threaten safety in the long and short term, and of course, develop proper training.

ICAO, (2006) Reason, (1997) and the Federal Aviation Administration (FAA) (2007) emphasize specifically the role of management in the development of a positive safety culture. The successful development and operation of Safety Management Systems, as a top-down approach to safety management, is linked directly with managerial actions and values. Specifically, management is responsible for emphasizing safety as a need to control risk and minimize loss (damage), encouraging free and open

discussion regarding safety issues, and fostering an environment which is non-punitive in which there will be no retribution for information sharing and disclosure in the interest of building safer operation. A strong and proactive approach from management can help develop a safety culture in which risk-taking behaviors are minimized as the product of genuine positive attitudes toward safety (as opposed to the threat of punishment for getting caught making a mistake) (ICAO, 2013A). Similarly, the FAA (2007) explains, “The attitudes, decisions and methods of operation at the policy-making level, demonstrate the priority given to safety” (p. 2).

2.1.4. Safety Sub-Cultures

Because safety culture is such large concept, it can be deconstructed and described as the product of four distinct subcultures (Leib & Lu, 2013; Reason, 1997). The first, *informed culture* refers to awareness about safety issues, and addresses aspects of awareness on both the organizational and individual levels. On the individual level, informed culture suggests a need for organizational members and employees to be aware of the risks and hazards in their particular part of the operation and how, if those hazards go unchecked, they can develop into losses. This very basic aspect of safety culture is in part the product of proper training, both in safe operating practices as well as threat identification and mitigation (ICAO, 2013A). On the organizational level, informed culture refers to the organizations need to structurally provide for the collection, analysis, and dissemination of safety information and standardized, well-defined procedures for doing so (Reason, 1997).

Similarly, safety culture is in part the product of a *learning culture*. The concept of this sub-culture is that knowledge and education go beyond just training seminars for employees (new and recurrent) and inspire an attitude of learning. This is intended to describe attitudes toward safety values and behaviors, but is not exclusive of other types of professional development, highlighting that it is in fact a culture of learning, not just a policy or job requirement (Reason, 1997).

Addressing a critical component of Safety Management Systems directly, the concept of a *reporting culture* describes the necessity of having proper channels for collecting safety information about risks and hazards so that they can be addressed properly by the SMS. This means that not only does management have the responsibility to design and operate a hazard reporting system, but also it has the more difficult task of motivating people to use it. This is a good example of where trust between the upper and lower levels of the organization is essential. According to Reason (1997), “Any safety information system depends crucially on the willing participation of the workforce, the people in direct contact with the hazards” (p. 195). The fact that participation in a hazard reporting system is inherently a decision on the part of the employee implies, once again, that it is culturally rooted and moderated by concepts such as trust and confidence.

The final sub-category of safety culture is *just culture*. This refers to a sense of relative morality among organizational members in that they agree on what is considered unacceptable and acceptable behaviors. This means that the existence of non-punitive Safety Management Systems, while important for disclosing and discussing safety related information in the name of safety improvement, is not an excuse for violations and negligent behaviors. A just culture is one that emphasizes fairness: genuine errors,

mistakes, and accidents would not result in punishment if they were made earnestly, but the culture should have no tolerance for intentional violations or negligence (Reason, 1997). Such behavior is destructive to the development of mutual trust and threatens not only the safety of the organization, but also the proper operation of Safety Management Systems. Part of strengthening this relationship includes setting reasonable goals for behavioral expectations to facilitate a good rapport between supervisors and subordinates. Lu, Schreckengast, and Chen (2011) explored the development of safety culture at an organization in Taiwan. The study found, among other conclusions, “Most respondents understood the difference between an intentional and unintentional act. Thus, most of them accepted discipline, including punishments, when an undesired event was due to an intentional act” (Lu et al, 2011, p. 37). Because safety culture is based so strongly on trust and respect, development of a healthy safety culture is a complicated process, but nonetheless critical for Safety Management Systems.

2.1.5. Safety Climate

An important concept related to safety culture is safety climate. The difference between safety culture and safety climate is that safety climate is the collective perception towards safety at an organization (Zohar, 2009). This distinction reflects the idea that many aspects of Safety Management Systems are perceptive, and Zohar (2009) noted the organizational members’ perception of safety (regardless of reality) is important: “Given the availability and variety of perception-based constructs in safety management research (e.g. risk perception, management style, organizational flexibility), climate perceptions must be distinguished from other types of organizational perceptions”

(p. 1517). It is important to note that safety climate does not necessarily reflect the true condition of safety management. In fact, even well managed Safety Management Systems suffer losses, and in the case of an accident or incident, the quality of the SMS might remain unchanged even if the safety climate might be poor.

A discussion of safety climate is important because it is one concept that researchers can observe and measure to try to describe one aspect of the greater theoretical phenomenon that is safety culture. However, for exactly the aforementioned possibility of a disparity between safety culture and safety climate, measuring safety culture is a complicated process and requires multiple angles of observation. The remainder of this discussion addresses how to measure safety culture and what has been done in previous research.

2.1.6. Measuring Safety Culture

Weigmann (2004) introduces measuring the strength of a safety culture, qualitatively and quantitatively. It is not surprising that employee observations, interviews, surveys, and case studies are part of qualitative measurements. Weigmann (2004) also addresses construct validity with measurement tools as being necessary to ensure a safety culture tool measures what it intends to and how well it can differentiate between organizations which present different levels of safety, respectively.

Because SMS is so comprehensive, studies have attempted to observe the outcome of SMS implementation through a variety of methods simultaneously (triangulation). Based on the core values of SMS as outlined by the SMM (ICAO, 2013A), there are a variety of measurable outcomes that researchers can empirically and

indirectly study to draw conclusions about aspects of SMS. Triangulation is especially important for SMS research, as there is often not enough data from a single source to draw reasonable conclusions about the SMS independently.

One study used questionnaires to measure safety climate (the perception of safety culture at any given time) across multiple organizations to determine if there was a consistent set of factors by which to evaluate it. Coyle, Sleeman, and Adams (1995) were able to analyze questionnaires from two different organizations using factor analysis to conclude that there is not a unifying set of important concepts that determine the safety climate. This is a good example of a limited methodology (a single channel approach) that limits the scope of the conclusions only to safety climate. Similarly, another study, Remawi, Bates, & Dix (2011) investigated how the establishment of Safety Management Systems will inherently impact safety culture. Using a methodology of surveying employees' perceptions of safety culture (safety climate) the researchers concluded, "the introduction of an SMS will influence the attitude of employees" (Remawi et al., 2011) and positively impacted safety culture. Again, these are examples of investigative studies that seek to understand one aspect of the nature of SMS.

Another study used triangulation to assess the overall level of compliance with the ICAO SMM of various aviation organizations in China. Leib, Lu, Sun, & Spence (2012) used several data collection techniques, including surveys and focus groups, to better understand the nature of Chinese SMS and explore how local culture affected the implementation and operation of the SMS. Similarly, Leib & Lu (2013), performed a case study at a major airport in Taiwan to assess the level of compliance with ICAO standards (from the SMM). That study employed a variety of methodologies, including

surveys, focus groups, interviews, and direct observation of SMS related materials, publications, and promotions. The study investigated the airport's SMS from the perspectives of three large, on-site airport stakeholders: a ground services provider, the airport management company, and air traffic controllers. For understanding SMS, a case study is a useful approach to doing research because SMS is centered on a single aviation organization (airport, air carrier, etc.) and operational details of an SMS will vary from organization to organization. Therefore, studies rarely take a cross-organizational approach to understanding the nature of SMS outside of the theoretical arena (such as, for example, reviewing documents of different Safety Management Systems to deduce the meaning of a theoretical construct such as safety culture). One exception to this was Leib et al. (2012) which assessed SMS programs across several aviation organizations in China (to identify a larger sample size) to see how they were affected by general Chinese culture and did not assess the specific operational details of individual SMS programs.

Because SMS research resides usually in mixed methods approaches and depends heavily on testimonial data (commentary, interviews, focus groups, etc.), it is very important to apply quality controls to research methods. One very useful approach to SMS research is the Delphi Method. The purpose of the Delphi Method, as defined by Sproull (1995) is "to gather a consensus of experts' opinions using several rounds of questionnaires or interviews" (p. 242). Basically, it relies on the assumption that if data is being collected longitudinally from a group of experts who are aware of each other's responses, their answers as a whole will converge toward a more reliable answer. So as experts are interviewed, researchers share the results from other experts and allow the interviewee to consider what other experts have said. This is intended to refine the

interviewee's own response and provide for a more informed response. Of course, this method does remove independence of responses (rendering test-retest reliability irrelevant) but the researcher expects this. It is also important to note that in order for the Delphi method to be effective, researchers should take care to identify legitimate experts on the research subject. According to Okoli and Pawlowski (2004), "The questions that a Delphi study investigates are those of high uncertainty and speculation. Thus, a general population, or even a narrow subset of a general population might not be sufficiently knowledgeable to answer the questions accurately" (p. 19). Fortunately, aviation safety research lends itself to this method for two reasons. First, safety managers and upper management employees are unquestionably experts about their organization's SMS. Second, the numbers of these experts within a single organization are usually insufficient as a sample alone for a survey or interview method, and allowing participants to hear other responses and revise their own adds to the validity of the study: "Studies have consistently shown that for questions requiring expert judgment, the average of individual responses is inferior to the averages produced by group decision processes; research has explicitly shown that the Delphi method bears this out" (Okoli & Pawlowski, 2004, p. 19). Based on the assumptions and goals of the Delphi Method, aviation safety and SMS evaluation appears to be a good environment for this particular method.

Overall, safety culture is a massive and complicated concept, and there is a lot of potential subjectivity associated with cultural investigative research. This is especially true given that there may be differences between the western ideal of a safety culture and other areas of the world. Nonetheless, it is a crucial phenomenon to study with regard to

aviation safety, as safety culture is the foundation upon which a healthy SMS sits. Lowe (2008) strongly emphasizes the human component of SMS, demonstrating this idea:

It is the people in the SMS that ultimately provide the safety function, rather than any technologies or procedures. Any safety procedure or technology will have been designed and tested by humans. Therefore, people are already at the centre of the SMS. (p. 10)

Because of the complexity of safety culture, measuring safety performance of Safety Management Systems is a challenging task. However, through careful selection of research methodology, proper triangulation of data sources, and use of specialized techniques such as Delphi Method, it is possible to rigorously approach measuring and drawing reasonable conclusions about safety performance in SMS.

2.2 Organizations and Environmental Influence

This section describes theories and current applications of how environments interact and influence the structure of organizations embedded within them. This section also describes various concepts related to how organizations function within that environment. These concepts are important to research questions 2, 3, and 4, in that they address how Safety Management Systems at airports in China are addressed by internal and external environments, as well as how concepts within those environments are related. The latter issue is especially important to address because the internal and external environments may not be mutually exclusive and may influence each other.

Therefore, exploring concepts between the two is important to gain a better understanding of how these two environments are related.

2.2.1 Conceptualizing Organizational Structure

When considering the influence of culture on organizational structure, it is important to first acknowledge that the phenomenon of organizational structure can be conceptualized in multiple ways (Johnson, 1993). In addition, there are multiple theories and constructs that address the interface between environments and organizations, as well as constructs that describe how culture is incorporated and manifested in an organization. This discussion will first review concepts of organizational structure followed by a review of some of the prominent communication theories that address the organization-environment relationship. In addition there will be a discussion of directions that research has taken to understand how and to what extent culture has influenced organizational structure.

Traditionally, organizational structure has been measured by a group of dimensions that attempt to classify properties that describe how organizations operate (McPhee & Poole, 2001). One such dimension is “organizational pattern”, which describes the configuration of agents in the organization. Organizational pattern can then be observed by investigating several sub-dimensions. These include horizontal differentiation, which is characterized by specialization of activities and duties. Another is simply sheer size, which addresses the magnitude of an organization as well as implications for how communication methods and quality are affected by it. A third dimension, vertical hierarchy, describes the levels of power within the organization

(McPhee & Poole, 2001). Other classic dimensions used to describe organizations include formalization, the concept related to how much of the rules and procedures of the organization are explicitly stated. In addition, centralization refers to how concentrated the decision making process is in the organization.

Since the introduction of these dimensions to categorize organizations in various ways, other researchers have shifted to alternative approaches for conceptualizing organizational structure. These new approaches redefine the structure of organizations as the “overall pattern resulting from the structural dimensions of relationships, entities, and context...” (Johnson, 1993, p. 18), and are described as “organizational configurations”. Several organizational configurations have emerged in literature, and have expanded into even newer forms that incorporate information technology, alternative hierarchies, and other non-traditional organizational attributes (McPhee & Poole, 2001).

A third perspective toward organizational structure revisits the traditional dimensions of categorization and expands their scope to include such advancements as information technology and multi-level analysis. This expansion has provided researchers with additional understanding not only as to how organizations are structured, but also how communication itself is related to that structure (McPhee & Poole, 2001).

The notion of communication as structure itself has led to the fourth and most recent conceptualization of organizational structure: structure as the result of communication. This approach takes the perspective that structure forms around communication, and has begun to investigate how other organizational processes have influenced organizational structure and vice versa. McPhee and Poole (2001) note that

throughout these paradigm shifts, the role of communication in organizational structure has evolved from peripheral to central.

2.2.2. Accommodating Cultural Influence in Theory and Practice

There are many theories and constructs that address various aspects of organizational communication, and some of them have specifically addressed the role of environment (including culture) to an organization's development and structure. The following is a discussion of some theories that have either directly linked or allowed for the exploration of organizational structure and cultural contexts, including various applications of these concepts with special emphasis on Asian context.

One theory that explores the mutual influence of agency and structure is structuration theory. Structuration theory, developed by Anthony Giddens (1984) describes the duality of structure: the idea that agency can consciously influence structure yet is the product of structure (Conrad and Haynes, 2001). Because organizational members are grounded in one or more cultures, structuration theory accommodates the possibility that cultural overtones can impact communicative structures in organizations. Johnson (1993) identifies at least one example of cultural influence on the communicative framework of an organization through the idea of a ritual. Rituals, according to Johnson (1993), are "events in which much of a culture surfaces due to their behavioral groundings....in addition to being reflections of culture, are also elements of communication structure" (p. 79). Exploring the connection between culture and communicative strategies within an organization from a structuration theory perspective yields the possibility that culture is indeed linked to organizational structure.

This connection has been demonstrated and explored through various research studies. Gao and Li (2010) analyzed changes to the Chinese telecommunications industry from a structuration theory approach to understand the connection between phases of the industry's reform (actions) and changes to its structure. While the researchers did not directly link culture and organizational structure, they argue that the process of telecommunications reform itself is rooted in Chinese culture and China's political environment: "China's ideological and political system favours that the state economy should control communications" (Gao & Li, 2010, p. 262). Ultimately the study concluded that structuration theory provided a good framework for understanding how a culturally-moderated process for organizational reform could be linked to structural change of an industry.

Another theory that explores organizational development and function in environmental contexts is Institutional Theory. According to Weerakkody, Dwivedi, and Irani (2009), an institution is "a social structure that is made up of a collection of individuals or organizations within which collectives exercise action or orientations in a constrained environment that will be continuously altered over time" (p. 355). Environmental influence and constraint is a major concept for Institutional Theory, and because culture can be considered one aspect of environment, it is important to have a thorough understanding of how the theory categorizes environmental constraints.

According to the theory, institutions receive constant influence from environmental entities rooted in three basic conceptual pillars: normative, regulative, and cognitive. (Hanson, 2001). The normative pillar influences and constrains institutions on the basis of societal norms and values. This is closely related to culture and provides an

avenue for cultural influence on an institution. The regulative pillar describes legal and regulatory influence on institutions, which can also serve as an indirect channel for cultural influence (Gao & Li, 2010). Lastly, the cognitive pillar impacts how people view reality as shaped by the structure and pressure of the institution. This reversal of pressure suggests that Institutional Theory incorporates some of the similar ideas of mutual influence that structuration theory describes. Overall, Institutional Theory looks at how institutions function and various concepts related to their nature, influence, and response to change. Summed up: "Institutional theory represents a body of thought that identifies, emphasizes, and explores the forces that constrain organizations from changing" (Hanson, 2001, p. 653).

Institutional Theory describes three major ways in which environments can influence institutions (Hanson, 2001): environmental shift, environmental regression, and environmental shock. Environmental shift explores how changes in the social or political environment influence an institution. The second environmental influence on an institution, environmental regression, is the result of an institution disconnecting from its environment. Institutions that encounter environmental regression can quickly lose societal support (legitimacy) because the institution has lost its usefulness to society (it is no longer responsive to societal pressures). The third environmental interaction with an institution is environmental shock. Environmental shock occurs when the environment is changing so rapidly that institutions cannot accommodate the changes. These concepts, as well as many more aspects of Institutional Theory, will be further developed in later discussion. However, these aspects of Institutional Theory are worth mentioning now

because culture can be a moderating factor in any of these environments. In fact, Dacin (1997) provides a concise explanation of the link between environment and culture:

Organizations are subject to influence from societal and cultural expectations within the larger social system. These prescriptions serve both as blueprints for organizational action and as powerful drivers for selection. They create structural similarities across organizations. They motivate the adoption of socially appropriate practices, influence tastes and preferences, and shape the boundaries of economic activity. (Dacin, 1997, p. 51)

There has been much exploration of the link between cultural norms and organizational structure. One major phenomenon that has been well researched is described by Ju (1994), who provides an in depth look at how organizations in Japan are uniquely structured to incorporate Japanese cultural values. Specifically, it investigates the priority of relationship building in Japanese culture and how organizations have structured to mirror that priority to facilitate business in Japan. In his discussion, Ju (1994) comments on the origin of Japanese organizational structures as reflecting traditional culture: “We believe that the supremacy of human relationships as a Japanese organizational model is rooted in Japanese management philosophies and the nation’s traditional culture” (p. 68).

The prioritization of human relationships even in a business setting is a well-developed social construct in Japan. This collection of relationships and networks is known as “keiretsu”, and it has penetrated organizational structure in a variety of ways.

For one, internal communication is more informal and reflects personal connections (Ju, 1994). In addition, the emphasis on personal relationships has influenced organizational roles. For example, middle managers have a heightened responsibility to develop positive relationships with both upper and lower managers to foster more harmonious decision-making (Ju, 1994). Even certain organizational practices such as lifetime employment affects the development, maintenance, and emphasis on personal relationship building.

Ju (1994) sums up four primary features of this example of culturally influenced organizational structure. First, the principles of “keiretsu” are so widespread in Japan that it pressures other firms to participate. The second feature is that organizations provide opportunities for networking so that personal relationships can be fostered under the “keiretsu” system. Thirdly, because fewer processes are formalized in Japanese organizations, participation in “keiretsu” fosters smoother business exchanges on the inter-organizational level and can even help organizations secure easier access to capital and the national banking system in Japan. The final feature of “keiretsu” is that it is reinforced by the overarching network of human relationships in Japanese businesses, and therefore adherence to the principles of “keiretsu” have been equated with success in business (Ju, 1994).

This is a rich example of how culture, as an environmental context, has powerfully influenced the structure of organizations in one part of the world. This is quite consistent with the principles of Institutional Theory regarding environment-organization interaction, as well as structuration theory, which is demonstrated by the cycle of mutual reinforcement in the “keiretsu” system.

It is very important to note that these examples of cultural influence on organizational structure in China and Japan are culturally specific. These phenomena are unique to their respective cultures and should not be taken out of context. Ju (1994) states very clearly, "It is important to remember that once cultural variables are involved, one is not supposed to copy the model, no matter how effective it has been, and apply it in a new cultural environment without examining its unique cultural background" (p. 68).

Overall, this discussion has covered the major paradigms of conceptualizing organizational structure to better understand how it has been reframed over time as well as its increasingly observed relationship with communication. It has also discussed two theories that conceptually accommodate the potential for cultural values to influence organizational structure and various phenomena that exhibit this influence. Hopefully future study will continue to address the extent to which culture can influence organizational structure, which is an especially important in an increasingly globalized and standardized world.

2.2.3. Legitimacy and Institutional Theory

Legitimacy is an important concept that describes the idea of justification and acceptance of an institution or organization with respect to societal values and norms. Suchman (1995) asserts the following definition of legitimacy which accounts for the its evaluative and cognitive aspects: "Legitimacy is a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions" (Suchman, 1995, p. 574). The concept of legitimacy is an important part of a body of literature surrounding

Institutional Theory, which addresses how social structures, including organizations, operate in constrained and ever-changing environments. Because subunits, standards, practices, and procedures exist within organizations, not only are they susceptible to the same environmental constraints and influences as the organization itself, but are also subject to a variety of internal factors. Therefore, the following discussion first addresses the environment of the organization itself followed by internal contexts that moderate the legitimization process. Lastly, there will be a discussion of how internal and external cultural values help frame these contexts and why thorough cultural understanding is critical to the legitimization process.

One key concept of Institutional Theory is environmental interaction because it defines the contexts of the organization-society relationship, which will later be applied to the organization-subunit relationship. Research has identified three major ways in which environments influence institutions (Hanson, 2001). The first, environmental shifts, explores how changes in the social or political environment affect an institution's operations or expectations. For example, a new law requiring all domestic air carriers to limit the length of nonstop flights to only 5 hours would dramatically impact the institution of aviation in the United States. This is because of the necessary changes airlines will make to ensure compliance as well as a variety of indirect outcomes, such as increased cargo shipping times and changes to crew scheduling policies.

The second environmental influence on an institution is described as environmental regression, which is the detachment of an organization from its environmental expectations through its operations or actions. For example, a pizza restaurant that has a delivery zone of only one square block might encounter a degree of

environmental regression because of its violation of community expectations regarding its operations. Institutions that encounter environmental regression are generally questioned about their justification to exist because they are no longer responding to pressure from the environment to adhere to standards (Hanson, 2001). Avoiding environmental regression naturally influences organizations to homogenize to some degree. Organizations will naturally tend to behave similarly within an institution because they encounter the same environmental pressures and expectations.

The third environmental interaction with an institution is environmental shock. This occurs when an environment changes so rapidly that an organization is unable to change itself fast enough to meet new expectations. Along with longevity, organizations and institutions naturally develop a degree of rigidity, that is, resistance to change (Hanson, 2001). Organizations and institutions become vulnerable to environmental shock when they become too inflexible and lose their adaptive ability. Of course, environmental shock is not necessarily the failure of an organization; in fact, it can also come from unforeseeable or rapid changes in the environment. For example, after the September 11, 2001 terrorist attacks, airports could not possibly adapt right away to the rapid changes in airport security legal requirements. This resulted in delays, long lines, and chaos as airports struggled to catch up to the changes. Hanson (2001) identifies three sources of environmental shock: developments in technology, ever-changing legal requirements, and varying levels of public awareness. He argues that environmental shocks have the ability to weaken institutional structures, which can allow for major changes to occur (p. 657).

2.2.4. Isomorphism

Because organizations within an institution are often situated in the same environment, as well as organizational subunits with respect to the environment of the organization itself, they are subject to similar pressure and demands that result in a degree of convergence among them. This idea, described by Institutional Theory as isomorphism, is defined as "...a process resulting from the interrelations between the institutional context and the organization" (Fernandez-Alles & Valle-Cabrera, 2006, p. 506). Another possible reason for isomorphic tendency comes from the interconnectedness of organizations and institutions and therefore standardization is a possible byproduct. Not only does it promote isomorphism within institutions, it also complicates change, as many aspects of organizations are interconnected (Zucker, 1987). Another factor contributing to isomorphism is mimicry: institutions and organizations try to replicate good ideas and aspects that work well within a given environment. This is a common theme with legacy air carriers in the United States. When one carrier has a successful policy or product, other carriers tend to introduce similar competing products. Whatever the cause, isomorphism is a well-researched phenomenon that is a key concept of Institutional Theory and strongly tied to the development of legitimacy for both organizations in their institutional environments as well as organizational subunits within organizations.

Organizational isomorphism is important to aviation safety as well. As aviation organizations such as airports and airlines attempt to minimize safety threats, risks, and hazards, the concept of isomorphism suggests a potential degree of standardization among them. In this dissertation, research questions 2.3 and 4.3 seek to address the

perception of the level of isomorphism among airport safety management programs as well as how that degree of isomorphism may be influenced by local culture, respectively. The former question is particularly important to legitimacy, which will be explained in further detail in the next section. This is because if the nature of safety management isomorphism lies primarily in perception (i.e. individuals contribute to a safety program because others do rather than its inherent legitimacy), there could be implications as to how genuinely motivated individuals are to participate in the safety management program, which is so critical to its success. While in either case legitimacy might be achieved, appealing to different forms of legitimacy could impact the operation and development of Safety Management Systems. These different kinds of legitimacy will be described in the next section.

2.2.5. Fundamental Concepts of Legitimacy

Literature identifies three distinct types of legitimacy, all of which relate to the concepts of credibility, usefulness, and importance within the legitimacy process (Suchman, 1995). Pragmatic legitimacy describes how an organization fulfills the wants and needs a specific audience and often is the result of direct contact between organizations and audiences. For example, an airline might lose pragmatic legitimacy with its most frequent fliers if it alters their benefits.

Moral legitimacy refers to an organization's ability to follow moral obligations and do what is "right" based on societal values. Because of this, non-profit and charitable organizations (as well as some religious organizations) often inherently have increased legitimacy.

The final type of legitimacy, referred to as cognitive legitimacy, addresses legitimacy based on how people value actions and organizations relative to its necessity and importance with respect to their own lives. This category of legitimacy is centered on culture and often reflects judgment based on society's need or lack thereof. This phenomenon is easily observable for new technology and innovation that is often not embraced by society because people, at this point, simply do not recognize or appreciate its potential, because it is being judged relative to their current lives and time. For example, most people appreciate the legitimacy of the airplane today, but when it was first invented people questioned its cognitive legitimacy with questions about what usefulness such a machine could bring to society other than entertainment value.

The process of gaining legitimacy is challenging for a variety of reasons. For one, organizations and institutions that take new actions or modify existing operations must justify a need for the change. Suchman (1995) also identifies two other challenges to the legitimacy process. First, organizations or actions that are new must develop and/or identify relevant audiences from which to earn legitimacy and receive support. Second, organizations that change already existing actions, or new organizations to an institution must receive acceptance and support from preexisting legitimate organizations. For example, low-fare airlines that are new entrants to the market must identify the audience of passengers who only care about the cheapest ticket price, and similarly, must earn the unstated support of traditional airlines by having them justify their own operations as not low-fare. This defines them as meeting a different demand from a different audience, implying they are not interested in meeting the demand of the new audience. Applying the same concepts to a within-organization perspective, a new subunit will have the same

challenges of identifying its audience and receiving acceptance from already legitimate subunits. The next portion of the discussion explores additional factors that pose challenges to building legitimacy.

Ashforth & Gibbs (1990) explain the process of developing legitimacy as being necessary in a variety of cases for five possible reasons. The first is if the organization does not have the necessary training, education, or knowledge base to be successful in a new endeavor. The second factor is the case that society does not accept the means and ends of the organization's purpose or operations. Ashforth and Gibbs (1990) provide an example of animal testing for cosmetics to demonstrate how legitimacy might be challenged for practices that may not have society's full support (p. 182). The third issue with building legitimacy is that the organization may not have the support of societal norms and traditions (as opposed to *values* in the previous example), which links well to Suchman's (1995) concept of cognitive legitimacy. The fourth consideration for establishing legitimacy is whether there is a considerable amount of risk in the organization or its activities, and the final issue is if "constituents anticipate a long-term relationship with the organization" (Ashforth & Gibbs, 1990, p. 182). Both of these issues demonstrate Suchman's (1995) explanation of pragmatic legitimacy. Several of these contexts apply directly to aviation safety, and their extent should be investigated thoroughly in subsequent research.

Research Question 3.2 explores the perception of organizational members toward legitimacy of their safety management programs. As in the case with organizational isomorphism, legitimacy could be an important factor to genuine participation in Safety Management Systems. Along these lines, research question 4.1 investigates the

connection between safety culture and the level of legitimacy perceived by organizational members. This has the potential to link personal attitudes toward the benefit and usefulness of safety management to behaviors that contribute to healthy Safety Management Systems. The next section describes other aspects of group members that may be present within an organization that could help shape the operation of a safety management program.

2.2.6. Organizational Constraints from Within

Just as the environment surrounding an institution provides constraints and influences, the environment within an organization so affects the development of organizational subunits. Company culture as well as climate are well observed and researched phenomena that are linked to concept of legitimization because they serve in part as the environment from which legitimization is validated. Kotter and Heskett (1992) describe organizational culture as having two distinct subsets. The first, existing on a deep level within the organization, refers to the values of the organization (money, innovation, etc) which last must longer than individual members of the organization and are described as “shared values”. The more superficial level of culture refers to that which is considered “group norms” that persist not because of underlying values but because they are actively taught to new members who, in turn, pass those norms to other members (Kotter & Heskett, 1992, pp. 4-5). Because members of the organization are also members of other cultures, such as national, religious, political, etc, the external culture of an organization and its internal culture are not mutually exclusive. Therefore, both the company culture and local culture are valid environments from which to explore

the legitimization of an organizational subunit. The successful legitimization of SMS – especially in Eastern cultures – is very much rooted in both internal and external culture. Kotter and Heskett (1992) comment on the criticality of cultural acceptance for organizational changes:

The beliefs and practices called for in a strategy may be compatible with a firm's culture or they may not. When they are not, a company usually finds it difficult to implement the strategy successfully. But even when successfully implemented, the behavior patterns that represent a given strategy are not cultural *unless* most group members tend actively to encourage new members to follow those practices. (Kotter & Heskett, 1992, p. 5).

Adding to the challenge of legitimization and cultural change, Zucker (1991) points out that organizational cultures tend to persist in an institutionalized environment despite environmental pressures: "...internalization, self-reward, or other intervening processes need not be present to ensure cultural persistence because social knowledge once institutionalized exists as a fact..." (Zucker, 1991, p. 83). Kotter and Heskett as well as Zucker's comments indicate that the legitimization process is very strongly connected to culture and cultural acceptance.

Along these lines, examining both internal and external culture is critical to understanding the legitimization process. This is especially important to a growing international standard such as aviation safety practice, which is intended to be implemented in all cultures in the same way. Pan, Scollon, and Scollon (2002) describe

this challenge in detail, explaining attempts to develop international standards without respect to culture are mistaken. "...Most of these so-called standardizations are not really attempts to develop an international standard that everyone can accept as workable. Instead, they are attempts to get everyone to accept the cultural and communication practices of one group of people as 'the standard'" (Pan et al., 2002, pp. 3-4). This ties in directly to the legitimization as a function of the cultural environment, and, as Pan et al. (2002) continue, ignoring multiculturalism during the development of standards and practices "...does not work simply because it can only be achieved by doing violence to very important cultural practices within other groups" (p. 4).

There is therefore little doubt about several organizational contexts that affect the legitimization process of an organizational subunit, standard, procedure, etc. The nature of the organization, as previously described by Ashforth and Gibbs (1990), as being high risk or having high uncertainty, affects the legitimization process. Isomorphic tendency and mimicry of the legitimization process within institutions and organizations reveal how other subunits have achieved legitimacy, which serves as a valuable roadmap for a new sub-unit or standard. In addition, the support of the regulatory environment (both on the external legal level as well as the internal policy level) is an important context for legitimization. Also, the strength of the relationship of the organizational subunit or standard with its audience(s), as well as how the members of the organization perceive its value, plays a role in the legitimization process. And of course, cultural values (some of which may even moderate other factors of legitimization), both internal and external, are essential.

2.3. Cultural Dimensions

This section discusses validated ways research has measured culture. Hofstede (1984) is perhaps the foremost scholar in distinguishing dimensions of culture that can be clearly observed and used as a basis for cultural comparison. The cultural dimensions defined by Hofstede describe the nature of interactions among members of the culture and values held by the culture. Specifically, they are known as “power distance”, “individualism/collectivism”, “uncertainty avoidance”, “masculinity/femininity”, and “long-term orientation”, which will be discussed separately in the next sections. Several of the research questions address not only how these values are present at an aviation organization, but also how they relate to each other as well as other important concepts such as safety culture, isomorphism, and the regulatory environment. The next subsections describe each of these cultural dimensions in greater detail.

2.3.1. Power Distance

Power distance describes the strength of authority in dyadic relationships. Specifically, “power distance describes the extent to which individuals accept social stratification and unequal distribution of power in the society” (Ng et al, 2011, p. 1035). Power distance can and has been measured in a variety of ways. For individuals with a higher perceived power distance, authority is more significant, and such individuals would be less likely to question orders or commands from superiors. In addition, individuals with a higher power distance are more aware of differences in status and behave accordingly (Ng et al, 2011). Furthermore, the concept of power distance indicates the extent to which subordinates express disagreement or dissatisfaction with

their supervisors, especially in the decision-making process (Hofstede, 1984, Taras et al, 2010). Power distance is an especially important concept because it relates to leadership structure as a specific form of interaction, whereas other cultural dimensions address other aspects of individual interactions and attitudes.

2.3.2. Uncertainty Avoidance

The cultural dimension of uncertainty avoidance describes how open individuals are to exploring new situations and straying away from pre-defined rules and structures that govern behavior and actions. In more detail, individuals that exhibit high uncertainty avoidance exhibit a greater preference for structure and less ambiguous situations, and are less likely to reject “deviant ideas and behaviors” (Lee et al, 2010, p. 1357).

However, it is important to note that uncertainty avoidance does not equate to avoiding risk. Rather, it attempts to describe preferences for rules and guidance rather than willingness to adopt risky attitudes and/or behaviors (Taras et al, 2010). Uncertainty avoidance has been addressed in various ways, including in aviation safety management, where it has been addressed to help understand aviation organization employees’ willingness to acknowledge hazards in an SMS reporting system (Leib et al, 2012). Especially in this way, uncertainty avoidance has meaningful implications in the high risk, high consequence field of aviation.

2.3.3. Individualism/Collectivism

Individualism (and its opposite, collectivism), refers to the extent to which people identify as being part of a larger group, or as a single entity. It attempts to address how

people value their own goals above group goals and how individuals see themselves in the group context. Rhee, Uleman, and Lee provide an excellent in-depth review of this dimension:

Features associated with collectivism include being concerned with the ingroup's fate and giving its goals priority over one's own; maintaining harmony, interdependence, and cooperation and avoiding open conflict within the ingroup; reciprocity among ingroup members, who are related in a network of interlocking responsibilities and obligations; self-definition in terms of one's ingroups; and distinguishing sharply between ingroups and outgroups. (Rhee, Uleman, & Lee, 1996, p. 1037).

One important note is that there is some disagreement as to whether individualism and collectivism are poles on the same axis, or whether they exist as separate and distinct cultural dimensions in themselves (Taras et al, 2010). In either case, individualism and collectivism are important aspects of culture as they help explain how individuals behave in group settings, and their accompanying attitudes (Wagner et al, 2012).

2.3.4. Masculinity/Femininity

Masculinity (and its opposite extreme, femininity) assesses the behaviors and attitudes of individuals as they relate to fulfilling traditional gender role expectations. These expectations are generally centered on ideas that men should be “breadwinners” and take a dominant role as a provider, and women are more nurturing and sensitive, among other traits. Although gender roles have indeed changed over time in many places, this dimension can be considered to be addressing the extent different genders

face historical pressures, not necessarily the contemporary situation of gender role mobility (Weisgram et al, 2011). Various values are associated with masculinity, such as “assertiveness”, “dominance”, “performance”, and “success”, versus values of femininity which include “friendliness”, “security”, “cooperation”, and “warmth” (Taras et al, 2010). This dimension was considered the last of the four initially developed cultural dimensions (Hofstede, 1984), but recently a fifth dimension has been identified as a valid addition to the group of cultural metrics, which will be discussed next.

2.3.5 Long-Term Orientation

The newest cultural dimension to achieve the same level of validity as the original four is known as “Confucian dynamism”, or, informally, as long-term orientation. This dimension is meant to address another aspect of culture that the other four do not address; that is, consideration of long-term and short-term goals and how they affect behaviors and attitudes. Specifically, “long-term orientation refers to future-oriented values such as persistence and thrift, and short term orientation refers to past- and present-oriented values such as respect for tradition and fulfilling social obligations” (Taras et al, 2010, p. 407).

Long-term orientation takes into account how time might factor into an individual’s decision-making process, which is especially valuable as many decisions are time sensitive (Lumpkin & Brigham, 2011). Similarly, given that generational turnover is a critical aspect for long-lasting organizations, long-term orientation can help provide insight as to the decision-making process on both the individual and organizational levels (Lumpkin & Brigham, 2011). While this is the most recently defined cultural dimension,

it has important value to understanding decision-making, which is a critical component of an effective safety management program such as SMS.

2.4. Summary

This chapter has provided an in-depth review of the theoretical backgrounds associated with organizations and institutions functioning in their environments. In addition, it has provided a thorough discussion on the development of ICAO Safety Management Systems and other relevant system safety tools, with specific emphasis placed on safety culture.

CHAPTER 3. METHODOLOGY

This section describes the methodology that was used for this dissertation. Due to the breadth of the study, the methodology is multifaceted and each step in the data collection process is clearly defined and explained.

3.1. Research Type and Framework

This dissertation used a mixed-method multi-level approach to collect and analyze data. A qualitative approach helped address all possible sources of data and allowed for the most holistic view of a region's safety program. It also allowed the flexibility to make additional discoveries about the nuances of a safety program. Similarly, a quantitative approach for assessing the orientation of various cultural values helped provide more specific and comparable insights. Therefore, the most explanatory approach to understanding SMS implementation in the context of environmental constraints was one that combined qualitative and quantitative research methods.

To help ensure validity and reliability of the study, this research adopted several components of verified survey tools, and incorporated various questions addressing environmental and cultural factors. Because the surveys used in this study were the product of several other tools, pilot testing was an important process to ensure the survey was easy to use and understand by participants. This was especially critical because

survey tools had to be translated into Chinese, and the pilot test process ensured that such translation was done accurately.

Figure 3.1 explains the framework of the dissertation, shows how data was collected, and the relationships among the different concepts investigated by this study.

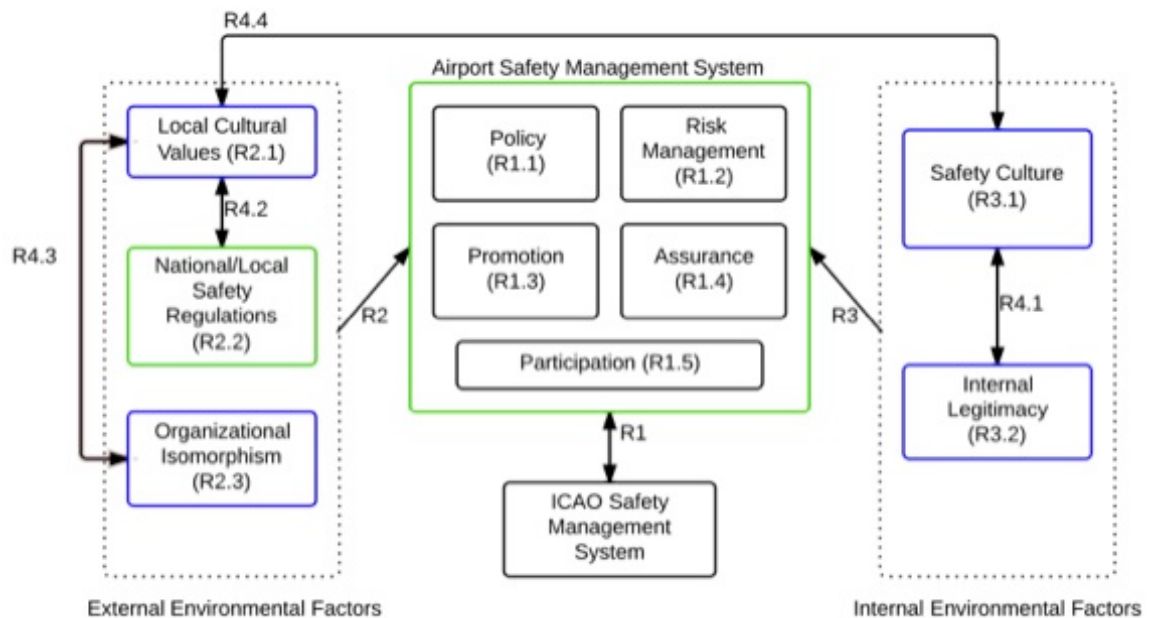


Figure 3.1. Research Framework for the Dissertation.

Green boxes in Figure 3.1 indicate data that was qualitatively collected, and blue boxes indicate data that was collected quantitatively. In addition, numbering associated with the various concepts and their relationships to airport Safety Management Systems correspond to the research questions proposed in Chapter 1. The following section explains the approvals that were necessary for this dissertation, and the subsequent sections explain how data was collected.

3.2. Approvals

The complexity, breadth, and international nature of this dissertation are such that several levels of approval were necessary to conduct this research. First, approval was necessary from the Institutional Review Board (IRB) of Purdue University, which oversaw this research on behalf of Purdue. This approval included authorization to conduct research in the various administrations of Greater China, as well as certification from a foreign expert to certify that research materials and data collection methods were culturally appropriate. An application was submitted and approved to conduct this research and included the survey questions and translations as well as a summary of procedures for contacting and soliciting participants. In addition, this research required cooperation and approval from airport authorities for the sample used in the study, key gatekeepers, as well as approval from individuals from whom data was collected.

3.3. Sample

This section and corresponding sub-sections describe the sample that was used for this dissertation. The sample used in this study existed on two levels. The first level consisted of individuals who work at airports in Greater China either directly in safety management, or front line workers who are expected to participate in the airport's SMS. The second level consisted of regions of Greater China.

3.3.1. Sample Determination on the First Level

Convenience sampling was used as the initial method of determining participants, and snowballing technique, the process of using participants to help locate additional

participants, we employed to increase the sample. This was very useful to help distribute surveys to airport safety managers and front line workers in Greater China. For example, air traffic controllers in Guangdong province helped spread the survey to their colleagues in Zhejiang province.

3.3.2. Sample Determination on the Second Level

The second level in this dissertation was a sample of regions of Greater China. A given geographical region can be divided into any number of sub-regions. Greater China was broken into three regions for the purpose of this dissertation based on colloquial definitions of areas of Greater China. For example, while Zhejiang Province is geographically not in the southern part of Mainland China, it is culturally more associated with the south. There is nonetheless a degree of subjectivity as to how different regions can be generalized into three major regions of China. To ensure higher validity, regional distinctions were:

- Determined through discussion with Chinese nationals using both English and Chinese over the course of several months.
- Verified with key gatekeepers during dissemination of the survey.

The final grouping of all administrative areas in Greater China was determined as shown in Table 3.1. It is important to note that Table 3.1 shows the complete list of all possible administrative areas of Greater China and the region that they fall under. The actual sample of provinces based on participant data that was used to represent the regions of Greater China for this study will be discussed in Chapter 4.

Table 3.1. *Division of Provinces and Sub-Regions into Regions for the Sample*

| Province/Administrative Area | Region |
|------------------------------|----------|
| Anhui | Northern |
| Beijing | Northern |
| Chongqing | Southern |
| Fujian | Southern |
| Gansu | Northern |
| Guangdong | Southern |
| Guangxi | Southern |
| Guizhou | Southern |
| Hainan | Southern |
| Hebei | Northern |
| Heilongjiang | Northern |
| Henan | Northern |
| Hubei | Northern |
| Hunan | Southern |
| Inner Mongolia | Northern |
| Jiangsu | Northern |
| Jiangxi | Southern |
| Jilin | Northern |
| Liaoning | Northern |
| Ningxia | Northern |
| Qinghai | Northern |
| Shaanxi | Northern |
| Shandong | Northern |
| Shanghai | Northern |
| Shanxi | Northern |
| Sichuan | Southern |
| Taiwan | Taiwan |
| Tianjin | Northern |
| Xinjiang | Northern |
| Xizang (Tibet) | Southern |
| Yunnan | Southern |
| Zhejiang | Southern |

The collections of these provinces as northern, southern, and Taiwan regions constitute the second level of the sample.

3.3.3. Participants

It is the relationships between the regions (the second level of the sample) that were used to draw conclusions for this dissertation. The characteristics of these regions are defined by participant responses from within that region. There were two types of individuals who were included as participants representing a region. The first group was comprised of participants at sample airports who were individuals that either manage or participate in the management of the airport's safety program. The other group was comprised of airport employees or stakeholders who realistically might participate in the safety program. Participants from both groups were necessary to ensure a more valid description of safety management, as SMS requires participation from all levels of individuals (ICAO, 2013A). This was due to their managerial role and greater knowledge of their SMS. In all cases, as previously discussed, participation in this dissertation was at the discretion of the individual and subject to approval from their organization.

3.3.4 Sample Size

Sufficient sample size was necessary to make generalizations from the sample of participants on the first level to the sample of regions on the second. Because this dissertation used both qualitative and quantitative methods, the necessary sample sizes for both types of methodologies were explored.

For qualitative research, it is difficult to determine an appropriate sample size. According to Trotter (2012), "...the ideal standard for qualitative sample size is to interview to redundancy" (p. 399). This is concept, also known as saturation, has been achieved at different numbers of participants for different studies. For example, Francis

et al (2010) found that theme saturation occurred at 14 participants and 17 participants for two different research studies, respectively. Similarly, a multi-level qualitative analysis study by the Fridtjof Nansen Institute (2007) utilized a combination of written documents and a set of seven in-depth interviews to draw conclusions about influences of different levels of governments on Europe's compliance with the Kyoto Protocol. Mason (2010) found that most qualitative studies exhibit theme saturation at between 20-30 participants, with a recommended minimum of 15 to exhibit reliability.

As this study also used quantitative methods, it is important to discuss sample sizes with regard to statistical analysis. Because participants were divided into three regions, it was necessary to have appropriate sample sizes for each region. Moore et al (2009) recommend at least 15 participants in a sample to avoid violating the assumption of normality, which is a baseline of assumption for statistical comparison. Furthermore, because the regions were compared, it was equally critical make sure the sample sizes of the regions did not violate statistical assumptions. This can be tested and the statistical test selections used for this dissertation are explained in further detail later in Chapter 3.

3.4. Threats to Validity

The complicated nature of this research design allowed for validity of the dissertation to be threatened. Internally, there are several threats to validity that may weaken the impact of the study. For one, the data was collected over a period of several months. During this time, the internal environment, external environment, or implementation status could have changed. For example, new training implemented at organizations in a region could have affected how participants perceive the legitimacy of

safety management. A new law in either of the two regulatory environments of Greater China could have changed the implementation status of SMS.

In addition, although snowballing technique is very effective for finding additional participants, it tends to follow social connections. This not only identifies more like-minded individuals, but also could have excluded parts of the population (Small, 2009).

The validity of this study was also threatened externally. The extent that this research may be generalized, or transferred (in the case of qualitative research), may be limited (Watts et al, 2011). This is due to a variety of factors, especially that this dissertation is rooted in the acknowledgement of the importance of culture. Although this study used commonly accepted cultural metrics to define environments and subsequently observe their influences on SMS implementation status, these metrics constitute only one portion of culture. The possibility that the same relationships exist in another part of the world (Brazil, for example), is certainly threatened by this study being performed exclusively in Greater China.

Another common threat to external validity is the behavioral change caused when individuals are observed. This is sometimes referred to as the “Hawthorne Effect”, and can be a reaction from participants who are involved in the research because of that involvement. This effect is extremely difficult to observe directly (Chisea & Hobbs, 2006), but steps can be taken to attempt to reduce it. In this dissertation, no identifying data was collected from participants, and participants were reminded in the survey instrument that the data was being collected for research purposes only. For participants who were interviewed, discussions took place over the course of the data collection time

period to build relationships that encourage honesty and openness. This is especially critical in the cultural context of Greater China (Chang, 2011). Lastly, snowballing technique helped reduce the possibility of the Hawthorne Effect because participants who are solicited by their friends and colleagues will have a higher regard for the study and be more willing to participate (Small, 2009).

3.5. Data Collection Tools

The data collection tools for this dissertation were surveys and interviews. An online survey that was developed and used in the study consisted of three parts:

1. A 26-item list of cultural metric questions with Likert-scale responses.
2. A 15-item list of safety culture, legitimacy, and isomorphism questions with Likert-scale responses.
3. A short answer section with 17 open-ended questions about the participant's SMS.

The survey also provided the opportunity for participants to add any comments they felt were necessary to better understanding their safety management system.

For the first part of the survey, to assess local culture, this dissertation adopted a previously validated survey tool. Although culture is an abstract concept, much research has been done to understand and quantify various dimensions of culture; the most notable being Hofstede (1984, 1997). Hofstede's dimensions are well researched and supported. As this dissertation did not seek to define new cultural metrics or verify/debunk the existing metrics, using a tool that measures the best-supported existing metrics was most

appropriate. The tool that was used for the first part of the survey was the CVSCALE (Yoo, Donthu, & Lenartowicz, 2011), which is a 26-item survey divided in to the five cultural metrics determined by Hofstede (1980, 2001). This tool has been validated through rigorous comparison tests between different cultures and comparing the results with theoretical guidance. In addition, the test has shown to be very reliable (Schumann, Wunderlich, Zimmer, 2012), and the survey items have been demonstrated to consistently produce high Cronbach's alpha coefficients across cultures. The full CVSCALE is available in Appendix A.

The second part of the survey intended to investigate the breadth of the local environment. First, specific survey items addressing legitimacy were included in the study. Adapted from Weatherford (1992), these questions addressed perceptions of trust, accountability, efficiency, and fairness, all of which are important concepts of legitimacy (Suchman, 1995).

Also included in this group of survey items were several questions about safety culture. These questions were adapted from the ICAO SMS Gap Analysis Survey. This survey is a powerful tool for understanding some portions of SMS implementation, but is limited in that it does not address individuals' perceptions, enthusiasm, use, support, and other human elements that are relevant to truly understanding the airport's safety program. Modifications, as was done by Leib and Lu (2013) and Leib et al (2012), were centered on changing dichotomous responses (yes/no) to Likert-scale responses. This was important because the extent to which an SMS has adopted a certain procedure, value, or method is a function of perception, and might have been subjective across individuals. Using a Likert-scale for this purpose has proved to be useful for data

analysis, and a Likert-scale ranging from 1 (strongly disagree) to 5 (strongly agree) was used in this study.

Lastly, the second part of the survey included questions regarding isomorphism. These questions were developed specifically for use in this study and were guided by theory; Fernandez-Alles and Valle-Cabrera (2006) and Zucker (1986) provided a good background for developing isomorphism questions tailored to safety management. Because these questions were not adapted from previous sources, care had to be taken to ensure they were worded properly to reduce the potential threat to internal validity.

Part two of the survey, including the aforementioned question sets of legitimacy, safety culture, and isomorphism, can be found in Appendix B.

The final section of the survey was a series of 17 open-ended questions that asked participants to comment briefly on different aspects of their safety management system. These questions were also adapted from the ICAO SMS Gap Analysis Survey, and had several questions about each of the main concepts of SMS according to the SMM: safety policy and objectives, safety risk assessment, safety assurance, and safety promotion. A full list of all of the open-ended questions is available in Appendix C.

The other method of data collection was with interviews. One of the challenges of conducting research at airports is that the number of qualified participants from which to get appropriate data is limited. For this reason, triangulation was a critical tool to help ensure the validity of conclusions. As part of triangulation, semi-structured interviews were conducted with safety managers within each region in order to allow for more detailed descriptions of various aspects of the airport's safety management program. The questions used in the interviews were the same open-ended questions that were used in

the survey, but provided the opportunity for follow up questions to further investigate participants' responses. The following is an example of two open-ended questions and subsequent follow-up questions.

Table 3.2. *Sample Interview Questions and Follow-Up Questions* (Adapted from Leib & Lu, 2013)

| Primary Question | Possible Follow-Up Questions |
|--|--|
| Does the safety committee use a risk assessment matrix? | How does the safety committee assess risks? What are some examples of different levels of risks? |
| How was safety managed before SMS? What tools were a part of that management program? | What input information does the safety committee use when determining the level of risk for a given activity? How did the organization promote safety? How did the organization identify risks? What parts, if any, of your previous safety management program still exist? |

It was also important to utilize Delphi technique when conducting these interviews, to ensure that participants could discuss as much as possible about their organization's SMS to fully provide their comments. During interviews, per Delphi technique, other participants' answers were discussed with the interviewee. This allowed for the interviewee to comment on others' responses and discuss additional features of their own SMS that they may not have considered discussing otherwise.

3.5.1. Regulatory Environment

To understand another aspect of environmental influence on organizational structure, it was important understand the regulatory environment of SMS. This understanding was based on analysis of documents that were identified by gatekeepers

such as legal documents and aviation authority publications. This portion of data collection was centered on document review and did not involve human subjects, but was critical to help answer the research questions, especially with regard to environmental influence.

3.6. Data Collection Process

Data collection began with developing the survey and interview questions. After the questions were determined, the survey was built online as part of the Purdue University Qualtrics system for electronic survey development. Because the data was being collected in Greater China, all of the questions had to be translated to Chinese. Questions were translated by a native Chinese graduate student in the United States and verified by a native Chinese graduate student living in China. This was necessary to ensure that the translations were proper and maintained the original intent of the questions in English.

Pilot testing was the next phase, which was especially critical due to the translations. A group of three air traffic controllers in Greater China verified that they could understand the intent of the questions and provide meaningful answers. Pilot testing also helped determine whether the survey was unreasonably long, and how many open-ended questions could be included. The full survey in Chinese is provided in Appendix D.

Another testament to the value of pilot testing was that it helped ensure that the survey was acceptable in the two administrative regions of Mainland China and Taiwan. In order to determine which region to aggregate a participant's data, the survey asked

which province their organization was located in. This was problematic for participants in Taiwan who do not regard themselves as a province, an area of politics that is unrelated to this dissertation. To avoid offending the people of Taiwan, the survey was copied without the question asking about the location of their organization, and a separate link was provided.

The next step was contacting key gatekeepers who provided access to participants. This dissertation utilized the assistance of five gatekeepers that were willing to help disseminate the survey to colleagues and associates who fit the qualifications for this study. The gatekeepers were qualified participants themselves and, in addition to passing along the survey, served as the interviewees for the study. The gatekeepers did not take the survey themselves.

The gatekeepers were provided with a link to the online survey and passed it through a variety of means (e-mail, chat programs, social networking sites) to potential participants. Through this data collection process, the study utilized networks of social and professional connections to expand the number of participants. During this part of the data collection, legislation from the two regulatory environments of Greater China was gathered. After the surveys were circulated, the gatekeepers were interviewed as the final step of the data collection process.

Interviews were conducted in English and therefore no translation was necessary. However, nearly all of the open-ended questions from the online survey were in Chinese (one participant used English to answer the questions). This data had to be translated from Chinese to English. To do this, a bilingual Chinese doctoral student in China

helped translate the results, and these translations were confirmed with a bilingual Chinese graduate student in the United States.

The next section discusses how the data was analyzed quantitatively and qualitatively. Lastly, Chapter 3 will revisit the original research questions and describe how they were answered.

3.7. Data Analysis

This section describes how the data collected for this dissertation was analyzed. First, data existed on two levels and a mixed-methods multi-level approach will be discussed. In addition, as there were both quantitative and qualitative data collection methods involved, this section will describe the analysis used to answer each of the research questions. Ultimately, the first three research questions were qualitative in nature; however, to enhance interpretability as well as provide a standardized framework for comparison, several subparts of the research questions were measured quantitatively. The fourth research question was measured and analyzed quantitatively to help isolate the sources of influence from the internal and external environments to the status of SMS implementation.

3.7.1 Multi-level Model

This research questions seek to first establish the implementation status of SMS in Greater China followed by observing the influence of an aviation organization's internal and external environments on that status. To do this, this study required a second level of

the sample to allow for comparison of multiple sets of relationships between SMS implementation statuses and internal/external environments.

While many multi-level models are quantitative in nature, qualitative multi-level analysis is not without precedent. For example, the Fridtjof Nansen Institute (2007) conducted a broad multi-level analysis of the connection between European Union member states and global climate change policy. The study observed the influence from different levels (the state level, union level, and global level) on the “Linking Directive”, the European Union’s alignment program with the Kyoto Protocol. This dissertation applied a mixed-method multi-level model by allowing for parts of the internal and external environments to be measured and analyzed quantitatively to statistically determine the differences between them. Statistically comparing some aspects of the internal and external environments provided more support than only qualitatively assessing the differences between the environments across the three regions.

Ultimately, this study analyzed and drew conclusions from the change in the level-two relationships; that is, the change in the environments of each region was observed and compared to the change in SMS implementation status. However, unlike the Fridtjof Nansen Institute (2007) study, this dissertation used three sets of environment/implementation status relationships rather than one to increase validity of the findings.

A concern of multi-level studies is the possibility of aggregating data in a way that overlooks important sub-level differences. For example, in this study, participants worked at different aviation organizations that may have had widely varying SMS compliance levels. This study aggregated that data by region to reach an overall

compliance level for the region. In this dissertation, that risk was minimized in the following ways:

- The study determined appropriate regional distinctions as previously discussed.
- The study investigated the change in relationships between regional environments and compliance levels, rather than generalizing the three environments and the three compliance levels to draw conclusions about Greater China.

Although using this approach was quite complex to manage, it provided more data sources to help increase the validity of the dissertation. The next section discusses the statistical tests that were used for those relevant parts of the internal and external environments.

3.7.2. Quantitative Analysis

Several of the concepts in the internal and external environments of SMS in the regions of Greater China were measured quantitatively.

For the survey Likert-scale data (addressing both local cultural metrics, as well as a portion of SMS implementation status metrics and organization metrics), statistical analysis was used to determine significance of responses.

Several statistical tests were performed to analyze the data. First, it was necessary to perform a reliability analysis, because each concept was the aggregation of several survey items. Cronbach's alpha scores were determined for each set of questions to ensure they showed acceptable instrument reliability. While there is no set standard for what is an appropriate alpha coefficient, George and Mallery (2003) indicate that alpha

levels below .5 are unacceptable, and Gliem and Gliem (2003) recommend around .8 as reasonably reliable.

Next, an Analysis of Variance (ANOVA) was performed to determine if there were significant differences among the three regions for a particular metric. In order to avoid violating ANOVA assumptions, a Levene's test for equal variances was performed to ensure the three groups were candidates for comparison.

To further examine differences in the event of a statistically significant ANOVA test, a Tukey's HSD multiple comparison test was used to determine which regions were significantly different. Although there are many multiple comparison tests for this purpose, Tukey's HSD was selected due to its robustness to unequal sample sizes (Moore et al, 2009). Lastly, eta-squared values were calculated to determine effect size where significance was found. Eta-squared values include thresholds of .02, .13, and .26 for small, medium, and large effects, respectively, and are useful for understanding the practical expression of differences between groups (Cohen, 1992).

The last kind of statistical test used for this dissertation was a Pearson R correlation. Because the internal and external environments are broken into components, correlations were used to explore the relationship between those components. This was important to ensure that the influence of those components did not overlap, or confirm that they did and acknowledge it.

Choosing a significance level for any given piece of research is difficult. In fact, "The choice of a particular significance level is subjective and depends on the nature of the problem as well as on the degree of risk the decision maker is willing to take" (Parasuraman et al, 2007, p. 405). Although .05 is commonly accepted as an appropriate

significance level, researchers often use .01 or .1 as significance levels, especially in social research (Parasuraman et al 2007). For the purpose of this study, given that it is social research with a higher potential for subjectivity and reduced consequences of making a Type I error, a confidence level of .1 is applied instead of the traditional .05. However, as in many research studies, both will be noted in the analysis, as well as .01.

It is important to note that the quantitative portion of the analysis provides only some of the insight as to the relationship between environments and SMS implementation statuses. This insight will be used to support the overarching qualitative research questions. Next, the analysis of the qualitative portion of data will be discussed.

3.7.3. Qualitative Analysis

There are two aspects of qualitative analysis that will be addressed in this section. The first establishes how consistent the regulatory environment is with the international standards of Safety Management Systems. This process required coding of regulatory documents based on SMS values and procedures guided by the ICAO SMM. To do this, regulatory documents were reviewed and compared to the ICAO SMM components for SMS. The SMS components in the SMM are broken into elements, and the number of elements accounted for in the two regulatory environments' legislation determined the overall compliance of the regulatory agency with ICAO standards. Documents were coded as "present" or "not present" based on whether they addressed each of the element areas and "consistent", "partially consistent", or "not consistent" for each of the component areas. If all of the elements were present, the component would be determined "consistent". If not all of the elements were present, the component would be

considered “partially consistent”. If none of the elements were addressed in the documents, the component would be considered “not consistent”. The outline of topics used for this analysis is available in Appendix E.

The second portion of qualitative data analysis is regarding the open-ended survey questions and interview data collected from participants. This portion of the analysis also used the ICAO SMS components from the SMM as a coding scheme. The topics for this part of the qualitative data are also available in Appendix E.

The open-ended questions and interview data were analyzed by determining how strongly each region complied with the SMM components. Responses were coded according the areas of the coding scheme into three levels: weak, moderate, and strong. Three levels were chosen to express strength rather than yes/no dichotomies to avoid over generalizing a region’s compliance, which (as mentioned earlier) can be threaten the validity of multi-level models. To determine whether compliance in a particular area was weak, moderate, or strong, the responses for each area were organized their most dominant theme by frequency of response. The relationship between a particular compliance area and responses was deemed to be:

- “Strong” if it was both the most frequently mentioned theme and present in a majority of the responses.
- “Moderate” if it was the most dominant theme but not present in a majority of the responses, or if it was not the most dominant theme but present in a majority of the responses.
- “Weak” if it was neither the most dominant theme nor present in a majority of responses.

Each of the subcategories of the coding scheme were assigned an adherence strength, and these strengths were averaged to determine the adherence strength to the four components of SMS. In addition, an overall adherence strength for SMS compliance was determined by averaging the compliance of the four major components.

This dissertation was particularly complex because it used both qualitative and quantitative data together to understand the influence of the environments on a region's SMS. The next section explains specifically how each research question was answered.

3.8. Answering the Research Questions

This dissertation poses four research questions, each with several subparts. This section explains how each research question was answered as well as its sub-questions.

3.8.1. Research Question 1

Research Question 1 addressed the overall implementation level of each region of Greater China's safety management based on both the participants' survey responses as well as interview data. To answer this question, the perceptions of the implementation status of SMS from participants was compared to international standards as determined by the components of the ICAO Safety Management Manual (SMM). This involved investigating what participants felt about each the areas of compliance outlined by the SMM and each area was a sub-question. These sub-questions were addressed both in the survey administered to participants as well as the interviews with gatekeepers and was collected and analyzed qualitatively as previously described, to ultimately draw conclusions about the status of SMS implementation in Greater China simply when

compared to the international standard. It is important to emphasize that the status of SMS implementation was as perceived by participants, and there was not an audit of the SMS directly.

3.8.2. Research Question 2

Once the similarities and differences between SMS in Greater China and international standards were known, Research Question 2 explored how the external environment associated (if at all) with the status of SMS. This association was defined as the combination of three sub-categories: local cultural values, national/local safety regulations, and perception of organizational isomorphism. Local cultural value metrics and the perception of organizational isomorphism were collected and analyzed quantitatively. These metrics were combined with the qualitative analysis of the applicable regulatory framework to qualitatively assess the external environment of each region. Then, using Institutional Theory, the relationships between the external environment and the status of SMS implementation for each region were compared to answer Research Question 2.

3.8.3. Research Question 3

Similarly, Research Question 3 sought to answer how the internal environment associated with the status of SMS implementation in Greater China. The internal environment was divided into two concepts; safety culture and internal legitimacy. Both were collected and addressed quantitatively using the previously described statistical procedures. Answering Research Question 3 was completed by comparing the

relationships between the internal environment and the status of SMS implementation of each region with the guidance of Institutional Theory.

3.8.4. Research Question 4

Research Question 4 was intended to address potential relationships between concepts of both the internal and external environments in order to more clearly explain how they relate to the status of SMS. Exploring the relationships between the quantitative concepts of the internal and external environment showed how they overlapped and shared association with the overall development and operation of Safety Management Systems in Greater China.

3.9. Summary

This chapter has discussed the methodology of this dissertation in great detail. It has discussed the research type and framework, as well as the sample that was studied, and the individuals who participated in this research within that sample. In addition, this section introduced both of qualitative and quantitative methods of data collection and analysis. Lastly, it provided a summary of how each specific research question was answered.

CHAPTER 4. FINDINGS AND ANALYSIS

This chapter describes the data that was collected from participants. It begins with a description of the sample used in the study, followed by the quantitative and qualitative data that was collected.

4.1. Sample

Ultimately, regardless of the constraint of research time and distrust from targeted participants, this study was able to incorporate data from 126 participants across Greater China. The participants came from the following provinces, which have been grouped into the three regions as outlined in Chapter 3. Therefore, these are the provinces that represented the three regions of this study. Table 4.1 lists these provinces that were represented.

Table 4.1. *Regional Diversity of Participants*

| Province/Administrative Area | Region |
|------------------------------|----------|
| Xinjiang | Northern |
| Liaoning | Northern |
| Heilongjiang | Northern |
| Shanxi | Northern |
| Shanghai | Northern |
| Guangdong | Southern |
| Zhejiang | Southern |
| Taiwan | Taiwan |

In addition to Table 4.1, Figure 4.1 shows visually the regional diversity of participants in this study. In it, blue, red, and purple provinces/administrative regions represent the northern, southern, and Taiwan regions, respectively.

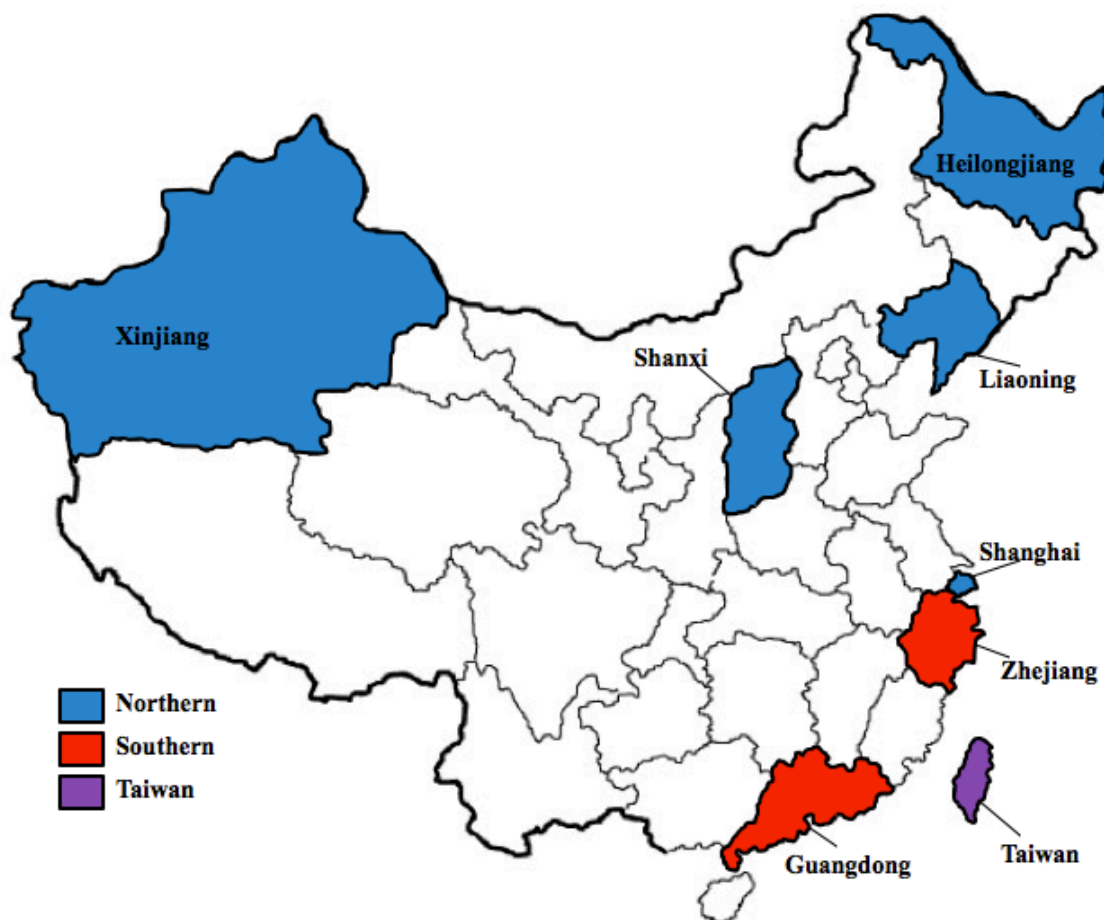


Figure 4.1. Visual Representation of Participating Provinces/Administrative Areas

With a total $N=126$, participants were grouped according to their regional designation (Northern, Southern, and Taiwan). Table 4.2 outlines the number of participants that came from each of the three regions.

It is important to note that there are unequal sample sizes in the regional subgroups. As outlined in Chapter 3, appropriate statistical procedures were chosen to accommodate this imbalance.

Table 4.2. *Groupings of the Sample Population*

| Region | n |
|----------|----|
| Northern | 19 |
| Southern | 30 |
| Taiwan | 77 |

The survey distributed to participants did not ask for biometric data, so it was not possible to know their position in the SMS beyond the basic qualifications provided to the key gatekeepers as describe din Chapter 3. In addition, it was not possible to know how many airports were represented in each region. However, the five key gatekeepers who distributed the survey as part of snowballing technique indicated during discussions that they had provided the survey to multiple airports within that region to groups of participants that included safety managers, air traffic controllers, and maintenance technicians. This was especially important in the Taiwan region, which has a very limited population of qualified individuals and only a few airports. However, as previously mentioned, it was not possible to know definitively the number of airports in each region and the complete spread of positions represented by participants.

The five key gatekeepers themselves were all safety managers directly involved in SMS. The fact that this study did not collect biometric data from participants further highlighted the importance of using Delphi technique during interviews with key gatekeepers to reduce the threat to validity.

The following sections summarize the findings from this study based on the methodology outlined in Chapter 3.

4.2. Review of Research Questions and Concepts

The remaining sections of this chapter detail the findings based on the research questions posed in Chapter 1. Following these findings will be a detailed presentation of the data and analysis used to reach the findings. First, however, it is important to maintain an overview of how the research questions are related and what will guide the drawing of conclusions in Chapter 5. In Chapter 3, Figure 3.1 is a good example of the summary of the internal and external environments and how they might have been related to the implementation status of SMS. Figure 3.1 depicts the sketch of research questions that this study explored. However, because the relationships between the external environment, internal environment, and SMS implementation was not know before completing the study, a better model organizing the environment in which SMS is placed can be expressed. Figure 4.2 shows the relationship of environments and SMS that were explored in this study.

Research Question 1 qualitatively measured the compliance of SMS in regions of Greater China based on the perceptions of individuals who work within the SMS. In Figure 4.2, this implementation status is expressed conceptually as the difference in shapes of the region's SMS and the ICAO standard. The trapezoid representing SMS in the center of Figure 4.2 represents a (potential) distortion of the original square SMS as observed with respect to environmental contexts.

Then, as guided by Institutional Theory, this study followed the possible association between the external environment and SMS implementation status (Research Question 2), the possible association between the internal environment and SMS implementation status (Research Question 3), and the relationship between the external

and internal environments (Research Question 4). Research Question 4 also addressed some intra-environmental relationships (subparts 1-3), which are not reflected in Figure 4.2. The subsequent sections detail the analysis that led to the findings from these questions.

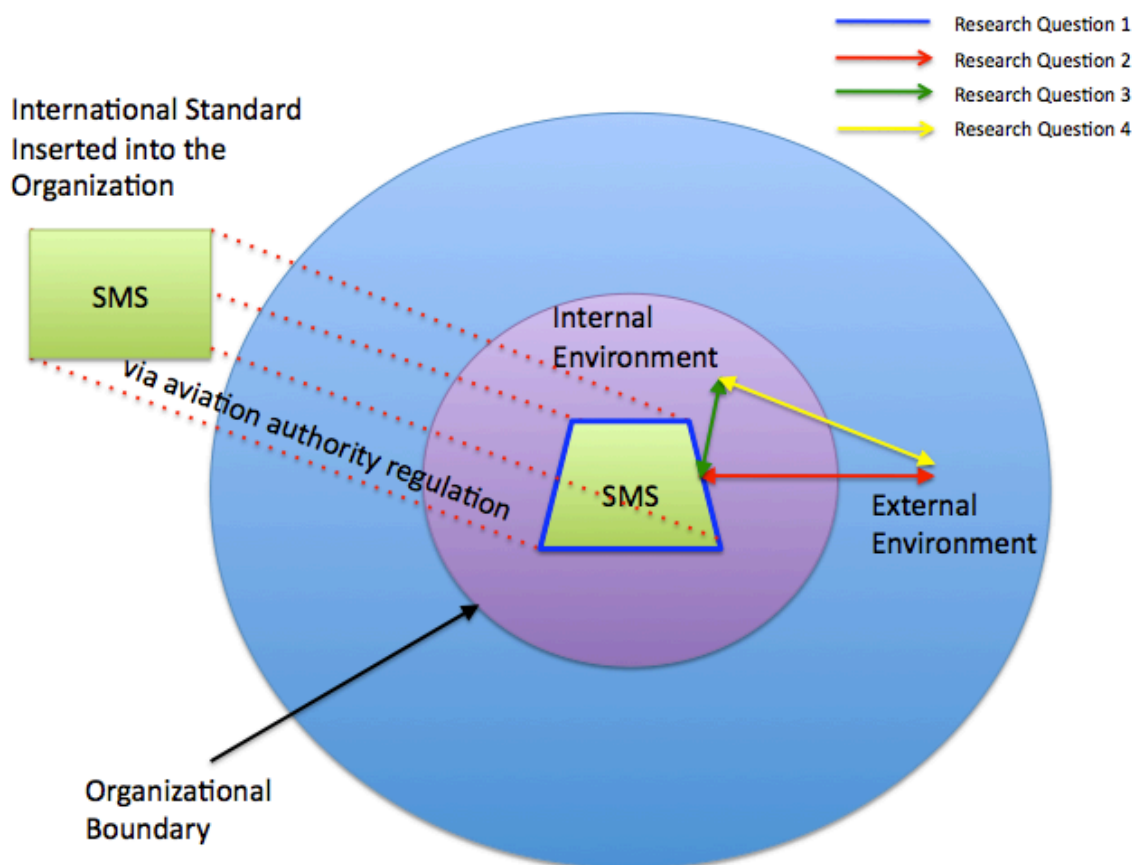


Figure 4.2. Conceptual Overview of Relationships

4.3. Research Question 1: “What is the Status of SMS Implementation in Greater China”?

This section looks at data collected from participants of the three different regions. For each of the SMS main component, participants’ responses were organized into themes and coded as described in Chapter 3. The following subsections describe the

participants' responses for each area and the subsequent themes drawn from those responses for each region.

4.3.1. Research Question 1.1: "What is the level of compliance of safety policy and objectives with respect to ICAO standards?"

Research Question 1.1 addressed the adherence of SMS in the area of safety policy and objectives. Participants provided several notable responses in this area. Before the development of SMS, the northern region and Taiwan reported the use of ISO standards to manage safety. In fact, one participant noted that, "SMS should parallel other systems (such as ISO, etc)" [translated]. However, it is important to note that participants in the northern region indicated that the use of punishment was common to motivate workers to reduce hazards and make fewer mistakes during operations. In the southern region, participants responded that there was no system in place before SMS, and there was no reporting system. Participants in Taiwan also responded that they used "experience" to identify hazards as well as several system safety tools that, as discussed in Chapter 2, were precursors to SMS.

Participants were also asked about the implementation of their SMS. The northern region had responses ranging from 2008-2011 as the year their SMS commenced. In the southern region, participants reported their SMS implementation began as early as 2000. In Taiwan, the vast majority of participants were unsure of their SMS implementation date. As all regions have currently adopted SMS, participants from each of them reported having SMS documentation and procedures as part of their SMS policy (although it was not the most frequent response in the northern region because

several participants were unsure). In addition, participants from all regions reported having safety managers and a safety committee.

Regarding the commitment to safety from management, responses were inconsistent across the three regions. The northern region participants overwhelmingly responded that they did indeed feel management was committed to safety and was making an adequate effort to demonstrate that commitment. In the southern region and Taiwan, less than half of participants felt that management was committed to safety, and comments from both regions mentioned that the commitment to safety they saw from managers was more image than substance.

The following table (Table 4.3) contains the coding of responses based on the coding scheme described in Chapter 3:

Table 4.3. *Coded Responses for Safety Policy and Objectives*

| Coded Responses from Participant Responses for Safety Policy and Objectives (dominant theme matches area / area present in a majority of responses) | | | |
|--|---------------------|-----------------|------------|
| Area | Region | | |
| | 1 | 2 | 3 |
| Managerial Commitment and Responsibility | Yes, Yes * | No, No # | No, No # |
| Key Personnel | Yes, Yes * | Yes, Yes * | Yes, Yes * |
| Documentation | Yes, No ^ | Yes, Yes * | Yes, Yes * |
| Overall | Strong | Moderate | Moderate |
| *Strong Adherence | ^Moderate Adherence | #Weak Adherence | |

As indicated in Table 4.3, the dominant theme of participants' responses was compared to each sub-area of adherence under Safety Policy and Objectives. The level of adherence in a particular region's SMS was determined based the combination of whether the dominant theme matched the adherence area and whether it was present in the majority of responses among participants. Then, as indicated at the bottom of the

table, data in a particular area were converted into adherence levels, which were combined to determine an overall adherence level for that SMS component.

4.3.2. Research Questions 1.2 and 1.5: “To What Extent is Safety Risk Management Incorporated into the Region’s Safety Programs?” and “To What Extent do Organizational Members Participate in Aviation Safety?”

Research Question 1.2 explored the regions’ SMS adherence to international standards with regards to safety risk management. This was grouped with Research Question 1.5 because these two concepts overlap with regards to hazard reporting: individuals must participate in the organization’s hazard reporting system, which is a primary component of safety risk management.

Participants from the three regions provided responses related to their hazard identification and their risk assessment, both of which comprise the primary components of safety risk management. Participants from all regions have methods of notifying their supervisors or upper management of hazards and risks, although with varying degrees and formats. In the northern region, participants primarily provide reports to their direct supervisors who then pass the hazard information up the communication chain to safety managers. In addition, participants can use e-mail and fax to identify hazards. Participants from the northern region also identified worker reports and inspections as the primary source of data for hazard identification. In the southern region, participants responded that the primary means of reporting hazards was face-to-face with supervisors, and that worker reports and audits were the two most common sources of data. In Taiwan, participants cited face-to-face interactions with supervisors, e-mail, paper

reports, and submission through SMS software as the primary methods of hazard reporting. These participants also responded that the majority of reports come from workers themselves, and only few hazards are identified through inspections.

Participants were also asked about the anonymity of their reporting system. In the northern region, participants reported that corrective actions are private, but that there is really no true anonymity in the reporting system. In the southern region, there were two common answers regarding anonymity of the reporting system. First, participants indicated that they believed the reporting system is anonymous but that they had not used it. In addition, participants responded that their reporting system is anonymous for small or less serious issues, but for major hazards it is not. Participants from Taiwan were largely unsure about the anonymity of their system, but noted that for paper and electronic reports writing their name or other personal information is not required. Several participants noted that the anonymity of the system needs to be improved.

When asked if the participants felt that employee participation in the hazard reporting system was sufficient, half of the individuals from both the northern and southern regions felt that there was enough participation. In the Taiwan region, the majority of participants were unsure, and few said that they did feel participation in the reporting system was adequate. One participant mentioned, “There are enough people, but not enough positive attitude” [translated].

Lastly, with regard to the reporting system, participants were asked what prevents employees from submitting additional reports. In the northern region, the most common responses were from those employees who either do not feel they will be protected by management, or that there will not be an appropriate corrective action to their report. In

Taiwan, participants indicated that the biggest reasons employees don't submit more reports was that they either simply do not care or are unaware of how to use the system. In the southern region, participants indicated that, similar to the northern region, employees are unsure of the proper corrective action will be taken. One participant commented, "Workers should be more aware of the outcomes so they will be motivated more" [translated].

The other key component of safety risk management is risk assessment. Participants' responses regarding risk assessment were related to two categories. First, participants commented on the existence of their organization's safety committee and the frequency of its meetings. In the northern and Taiwan regions, all participants reported that their airport has a safety committee, and the frequency of meetings ranged from monthly to "seasonally" (once every three months). Participants from the southern region also have safety committees at their organizations and reported that on a departmental level their safety committee meets on a weekly basis, with larger and broader safety meetings at less frequent intervals.

Participants also reported the use of a risk assessment matrix as part of their safety committee's risk assessment. In the northern region approximately half of respondents said their organization did use a risk assessment matrix to make decisions about risk assessment and mitigation. In the Taiwan region, most participants said that their organization does use a risk assessment matrix, although one participant noted "The airport SMS has a risk assessment matrix, but the committee doesn't usually use it."

The following table (Table 4.4) contains the coding of responses based on the coding scheme described in Chapter 3:

Table 4.4. *Coded Responses for Safety Risk Management*

| Coded Responses from Participant Responses for Safety Risk Management (dominant theme matches area / area present in a majority of responses) | | | |
|--|---------------------|-----------------|-----------|
| Area | Region | | |
| | 1 | 2 | 3 |
| Safety Risk Assessment and Mitigation | No, Yes ^ | No, Yes ^ | No, Yes ^ |
| Hazard Identification | No, No # | No, No # | No, Yes ^ |
| Overall | Weak | Weak | Moderate |
| *Strong Adherence | ^Moderate Adherence | #Weak Adherence | |

As indicated in Table 4.4, the dominant theme of participants' responses was compared to each sub-area of adherence under Safety Risk Management. The level of adherence in a particular region's SMS was determined based the combination of whether the dominant theme matched the adherence area and whether it was present in the majority of responses among participants. Then, as indicated at the bottom of the table, data in a particular area were converted into adherence levels, which were combined to determine an overall adherence level for that SMS component.

4.3.3. Research Question 1.3: "How is Safety Promoted Within the Organization?"

Research Question 1.3 sought to establish a region's adherence to ICAO standards regarding Safety Promotion. Safety Promotion includes several subcomponents that participants discussed, including training, managerial support, and areas where safety promotion improvement is necessary. Regarding training, participants across all three regions responded that they did receive SMS training, with some notable differences. In the northern region, participants responded that all employees receive initial SMS

training at their airports. Participants in the southern region agreed, however, several participants commented that the safety training was insufficient. In Taiwan, most participants indicated that they did receive SMS training, although several commented that some employees do not receive SMS training.

As discussed in Section 4.3.1, managerial commitment to the SMS varies within the three regions. When asked if management does enough to promote safety, participants from the northern region overwhelmingly indicated that management does indeed do enough. Half of the participants in the southern region felt that the safety promotion at their airport was adequate, as well as half of the participants in the Taiwan region. However, one important difference between the southern and Taiwan regions were that the participants in the southern region who felt that management was not doing enough to promote safety commented that management's primary concern is its image toward safety. Along these lines, one participant noted, "Actions speak louder than words" [translated]. In contrast, the participants from the Taiwan region who did not feel management's safety promotion was adequate acknowledged that management was genuinely trying to promote safety.

When asked for suggestions on how management can improve its safety promotion, one answer was common in all regions: improve the SMS training given to employees. However, additional comments varied across regions. Several participants in the northern region mentioned improving safety culture. In the southern region, participants commented that the SMS itself needs to be refined. One participant noted, "We shouldn't just care about the image. We have to really care to make it work" [translated]. Lastly, in Taiwan, one common answer was that management should

encourage better teamwork among employees. It is also important to note that several participants from both the southern and Taiwan regions commented that punishment could be an effective way to enhance safety, although they did not suggest that management employ this method.

The following table (Table 4.5) contains the coding of responses based on the coding scheme described in Chapter 3:

Table 4.5. *Coded Responses for Safety Promotion*

| Coded Responses from Participant Responses for Safety Promotion (dominant theme matches area / area present in a majority of responses) | | | |
|--|---------------------|-----------------|------------|
| Area | Region | | |
| | 1 | 2 | 3 |
| Training and Education | No, Yes ^ | No, Yes ^ | No, Yes ^ |
| Safety Communication | No, Yes ^ | No, Yes ^ | Yes, Yes # |
| Overall | Moderate | Moderate | Strong |
| *Strong Adherence | ^Moderate Adherence | #Weak Adherence | |

As indicated in Table 4.5, the dominant theme of participants' responses was compared to each sub-area of adherence under Safety Risk Management. The level of adherence in a region's SMS was determined based the combination of whether the dominant theme matched the adherence area and whether it was present in the majority of responses among participants. Then, as indicated at the bottom of the table, data in a particular area were converted into adherence levels, which were combined to determine an overall adherence level for that SMS component.

4.3.4. Research Question 1.4: “What is the extent of Safety Assurance and How is it Conducted?”

Research Question 1.4 described the adherence of a region’s SMS to ICAO standards regarding Safety Assurance. Participants provided information about how their SMS assures safety in a variety of ways, including the frequency of safety audits, the materials and standards used for inspections, and whether the safety committee provides a “closed-loop” of review for safety information. In the northern region, participants reported different audit frequencies; monthly, quarterly, biannually, or annually were all mentioned approximately equally. For audit materials, participants overwhelmingly responded that the safety committee uses checklists based on “national standards”. When asked if the safety committee revisits their previous decisions to mitigate risks, all participants responded that they did indeed have a “closed-loop” system.

The southern region reported that their audits come from both the CAAC and a “quality control bureau”. These safety audits are done on approximately a monthly basis and adhere to national standards for materials. As one participant noted, “regular inspections are important” [translated]. However, participants did not know if resultant decisions from these audits were revisited as part of a “closed-loop” system.

The Taiwan region participants responded that their safety audits were done regularly at either three-month or six-month intervals. The materials used from the audits come from a combination of checklists and previously received safety reports. Regarding the “closed-loop” system of review, half of the participants from the Taiwan region said there was a closed system, while the other half did not believe there was a closed system or were unsure.

Continuous improvement is also a key component of safety assurance.

Participants from the different regions provided information about how the frequency and ease of changing their SMS, and what approvals were necessary to do so. Participants in the northern region reported several levels of approvals were necessary to alter the policies and procedures of the SMS. These levels include the airport authority, a safety committee and/or a safety manager, a general manager, and the CAAC itself. In the southern region, participants reported that approval to develop SMS policy was necessary from airport management and the CAAC. Comments from the southern region also noted that changes to the SMS are “very rare”. In Taiwan, participants reported fewer levels of necessary approvals, which included the airport operator and the CAA.

The following table (Table 4.6) contains the coding of responses based on the coding scheme described in Chapter 3:

Table 4.6. *Coded Responses for Safety Assurance*

| Coded Responses from Participant Responses for Safety Assurance (dominant theme matches area / area present in a majority of responses) | | | |
|--|---------------------|-----------------|-----------|
| Area | Region | | |
| | 1 | 2 | 3 |
| Safety Performance and Monitoring | No, Yes ^ | Yes, Yes * | Yes, No ^ |
| Management of Change | No, No # | No, No # | Yes, No ^ |
| Continuous Improvement | No, Yes ^ | No, No # | Yes, No |
| Overall | Moderate | Moderate | Moderate |
| *Strong Adherence | ^Moderate Adherence | #Weak Adherence | |

As indicated in Table 4.6, the dominant theme of participants’ responses was compared to each sub-area of adherence under Safety Assurance. As in the previous two

sections, the level of adherence in a particular region's SMS was determined based the combination of whether the dominant theme matched the adherence area and whether it was present in the majority of responses among participants. Then, as indicated at the bottom of the table, data in a particular area were converted into adherence levels, which were combined to determine an overall adherence level for that SMS component.

4.3.5. Overall Findings for Research Question 1

Using the ICAO 2013 SMM and Leib and Lu (2013) as a coding scheme, responses from participants were coded in the three categories of strength of adherence to ICAO SMS standards: strong, moderate, and weak. Table 4.7 provides a summary overview of the results based on this coding.

Table 4.7. *SMS Implementation Status Comparison by Region.*

| SMS Implementation Status Comparison by Region | | | |
|---|-----------------|-----------------|-----------------|
| | Northern | Southern | Taiwan |
| Safety Policy and Objectives | Strong | Moderate | Moderate |
| <i>Managerial Commitment and Responsibility</i> | <i>Strong</i> | <i>Weak</i> | <i>Weak</i> |
| <i>Key Personnel</i> | <i>Strong</i> | <i>Strong</i> | <i>Strong</i> |
| <i>Documentation</i> | <i>Moderate</i> | <i>Strong</i> | <i>Strong</i> |
| Safety Risk Management | Weak | Weak | Moderate |
| <i>Hazard Identification</i> | <i>Weak</i> | <i>Weak</i> | <i>Moderate</i> |
| <i>Safety Risk Assessment and Mitigation</i> | <i>Moderate</i> | <i>Moderate</i> | <i>Moderate</i> |
| Safety Assurance | Moderate | Moderate | Moderate |
| <i>Safety Performance and Monitoring</i> | <i>Moderate</i> | <i>Strong</i> | <i>Moderate</i> |
| <i>Management of Change</i> | <i>Weak</i> | <i>Weak</i> | <i>Moderate</i> |
| <i>Continuous Improvement</i> | <i>Moderate</i> | <i>Weak</i> | <i>Moderate</i> |
| Safety Promotion | Moderate | Moderate | Strong |
| <i>Training and Education</i> | <i>Moderate</i> | <i>Moderate</i> | <i>Moderate</i> |
| <i>Safety Communication</i> | <i>Moderate</i> | <i>Moderate</i> | <i>Strong</i> |

The findings indicate two important points about the SMS implementation status in Greater China. First, the data suggested that none of the three regions were entirely consistent with ICAO standards with regard to SMS implementation. Secondly, the data suggested that the implementation status of SMS was not consistent across the three regions themselves, and each region appeared to have a unique signature of adherence to SMS.

For the purpose of answering Research Question 1, and conceptually the dimensions of the trapezoidal shape (from Figure 4.2) representing the net influence of environments can be illustrated as shown in Figure 4.3.

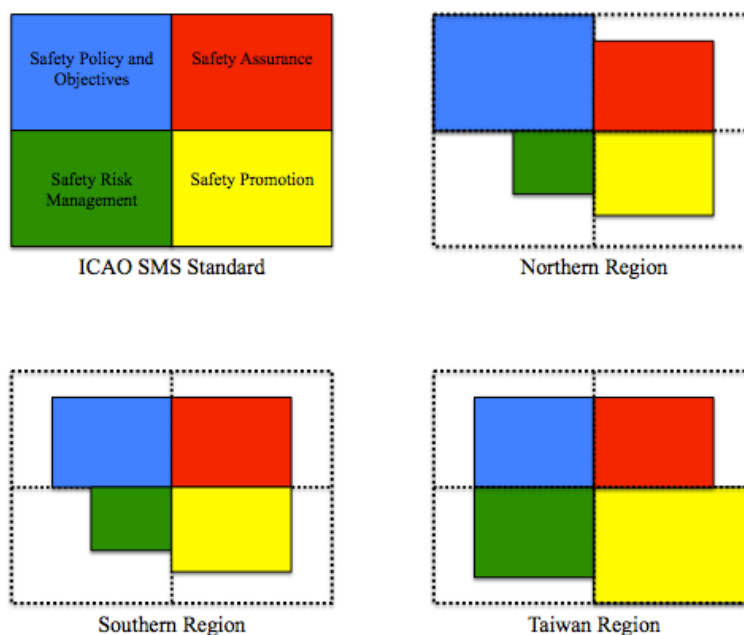


Figure 4.3. Visual Representation of SMS Implementation Status by Region

Figure 4.3. Shows conceptually (as a rectangle equally emphasizing the key components of SMS) the ICAO-prescribed SMS in the upper-left corner. The remaining boxes indicate the strengths of compliance of each area for the three regions of the study. Compared to the ICAO SMS standard, indicated by dashed lines, the strength of the

implementation status of SMS in the three regions is shown by the different sizes of the components. The colors in Figure 4.3 do not have any inherent meaning and serve only to help visually distinguish the different components within the SMS.

The northern region appeared to be the most compliant in the area of safety policy and objectives, followed by safety assurance and safety promotion. The data suggested that the weakest area of SMS implementation was the northern region's safety risk management.

The southern region did not appear to have strong adherence to ICAO SMS standards in any of the areas. The data suggested that three of the areas, safety policy and objectives, safety assurance, and safety promotion, were moderately implemented with respect to the SMM, and the weakest area of implementation (similar to the northern region) was safety risk management.

The Taiwan region seemed to have highest overall implementation status. Taiwan's strongest area of implementation was safety promotion. Moderate areas of SMS implementation were safety policy and objectives, safety risk management, and safety assurance.

Figure 4.4 provides a visual summary of a comparison of the SMS implementation status of the three regions broken down by SMM components. The information presented in Figure 4.4 is the same as that presented in Figure 4.3 except it is organized by SMM components rather than region. In the y-axis of Figure 4.4, the values 1, 2, and 3 represent weak, moderate, and strong levels of adherence, and the overall adherence to ICAO SMS is also shown.

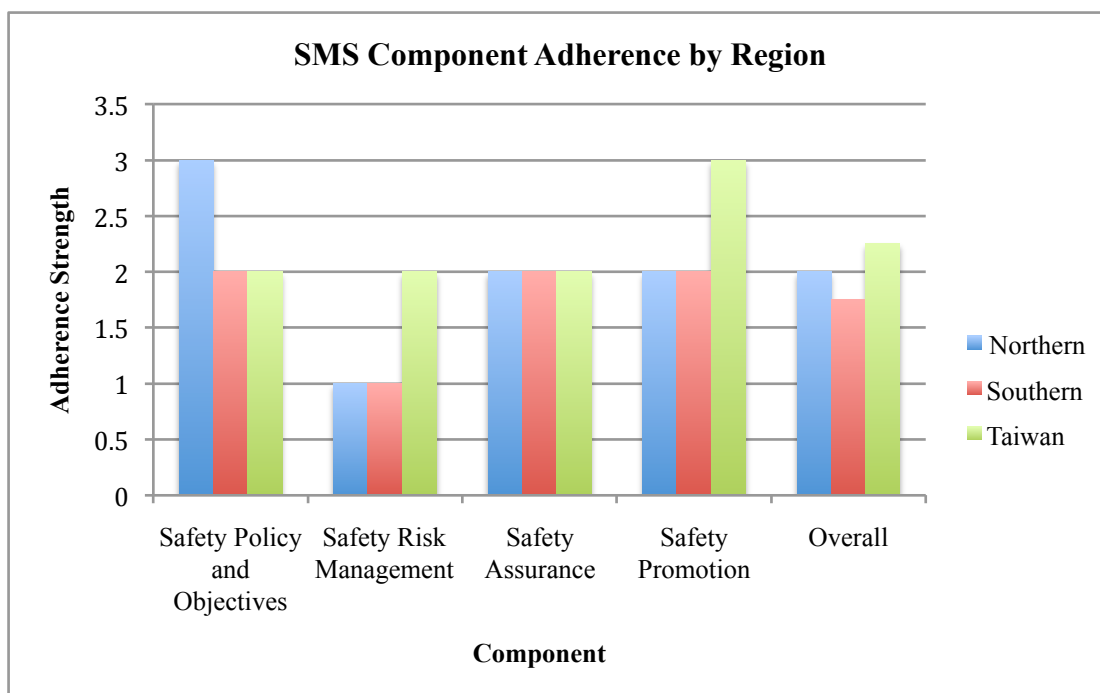


Figure 4.4. SMS Component Adherence by Region

The relationships shown in Figure 4.4 were critical to drawing parallels to variations to the external and internal environments as measured by Research Questions 2 and 3, which are described in sections 4.3 and 4.4, respectively.

While the SMS implementation status did not appear to be consistent across regions and none of them seemed to show complete adherence to ICAO SMS standards, there are some notable observations from the current level of SMS implementation in the regions. First, the overall weakest area of compliance was in the area of safety risk management. This stemmed primarily from issues of anonymity in reporting systems, the safety risk decision sources of input by safety managers, and employee participation in the hazard reporting system. However, while the data suggested that the overall area was the weakest, within the safety risk management component the Taiwan region stood out as having a stronger compliance than the northern and southern regions.

In addition, this same relationship was observed in the area of safety promotion. With its apparently strong compliance level of both internal and external safety promotion, Taiwan was notably different from the northern and southern regions, which were moderate and comparable.

For safety assurance, the implementation status seemed to be consistent across the three regions, as all reported similar auditing behaviors and materials. The three regions also exhibited a similar level of procedural complication for making changes to the SMS itself.

The last component of SMS is safety policy and objectives. A notable difference among the three regions was that data suggested that the northern region displayed a strong adherence to ICAO standards and stood out from the southern and Taiwan regions, both of which were moderate and similar due to their concerns about managerial support and safety documentation. The next section will look at how these differences in SMS implementation status parallel changes in the external environment.

4.4. Research Question 2: “How is the External Environmental Context Associated with the Status of SMS Implementation in Greater China?”

The external environment of the organization included local cultural values (Research Question 2.1), the regulatory environment (Research Question 2.2), as well as the perception of organizational isomorphism (Research Question 2.3). In addition, two subparts of Research Question 4 addressed two relationships within the external environment. They included the relationship between of local cultural values and the regulatory environment, and the relationship between local cultural values and the

perception of isomorphism. These were Research Questions 4.2 and 4.3, respectively, and are discussed in this section because the overall findings for Research Question 2 include their analysis.

4.4.1 Research Question 2.1: “What Are the Local Cultural Dimensions?”

This study investigated five cultural values from Hofstede’s metrics and explored through the use of the CV scale, shown in Appendix A. First, it is necessary for reliability to determine whether the four to six questions on the CV scale for each cultural metric were congruent in that they indeed ask about a single metric. For this reliability analysis, Cronbach’s alpha coefficients were calculated for each set of questions within each region and then averaged to produce a standardized value for each metric. Analysis of the data set yielded coefficients as shown in Table 4.8.

Table 4.8. *Average Cronbach’s Alpha Values Across Regions*

| | |
|------------------------|------|
| Power Distance | 0.45 |
| Uncertainty Avoidance | 0.62 |
| Collectivism | 0.67 |
| Long Term Orientation | .044 |
| Masculinity/Femininity | 0.69 |

Looking at Table 4.8 and using standard Cronbach’s alpha interpretation procedures as described in Chapter 3, three metrics demonstrated reliability among survey items at the .6 threshold: uncertainty avoidance, collectivism, and masculinity/femininity. Power distance was weakly reliable with a standardized Cronbach’s alpha value of .448. Long term orientation produced an extremely low value which suggests violations of reliability assumptions (namely that the questions themselves may not have been describing the same metric). However, Chinese

translations and positive/negative alignment of survey items were double-checked to confirm they were not the source of this low reliability. Regardless of the source, this indicates that the long term orientation measurements are not reliable.

Continuing the analysis of the cultural metrics, an equal variance test was performed to ensure assumptions of subsequent comparison tests were not violated. Levene's test of equal variances revealed no significance for the five cultural metrics, indicating they do not violate equal variance assumptions as shown in Table 4.9.

Table 4.9. *Homogeneity of Variance Values*

| Test of Homogeneity of Variances | | | | | |
|----------------------------------|------------------|-----|-----|-------|--|
| | Levene Statistic | df1 | df2 | Sig. | |
| AvgPowerDist | 0.398 | 2 | 69 | 0.673 | |
| AvgUncert | 1.391 | 2 | 69 | 0.256 | |
| AvgCollectivism | 0.104 | 2 | 69 | 0.901 | |
| AvgLongTerm | 0.028 | 2 | 69 | 0.972 | |
| AvgMascFem | 2.072 | 2 | 69 | 0.134 | |

Next, a one-way ANOVA was performed to determine if statistical significance existed between groups for each data set. Table 4.10 illustrates the results of the ANOVA test for all of the cultural metrics and corresponding p-values to determine statistical significance.

The ANOVA table indicates that significant differences between regions is apparent for power distances, collectivism, and masculinity/femininity at the .1 significance level as described in Chapter 3. These differences were investigated using Tukey's HSD multiple comparisons to determine which group(s) were statistically differentiated from others.

Table 4.10. ANOVA Results for Cultural Metrics

| ANOVA | | Sum of Squares | df | Mean Square | F | Sig. |
|-----------------|----------------|----------------|----|-------------|-------|-------|
| AvgPowerDist | Between Groups | 2.634 | 2 | 1.317 | 6.016 | 0.004 |
| | Within Groups | 15.103 | 69 | 0.219 | | |
| | Total | 17.737 | 71 | | | |
| AvgUncert | Between Groups | 0.522 | 2 | 0.261 | 1.028 | 0.363 |
| | Within Groups | 17.506 | 69 | 0.254 | | |
| | Total | 18.028 | 71 | | | |
| AvgCollectivism | Between Groups | 1.53 | 2 | 0.765 | 2.416 | 0.097 |
| | Within Groups | 21.844 | 69 | 0.317 | | |
| | Total | 23.374 | 71 | | | |
| AvgLongTerm | Between Groups | 0.369 | 2 | 0.184 | 1.563 | 0.217 |
| | Within Groups | 8.138 | 69 | 0.118 | | |
| | Total | 8.507 | 71 | | | |
| AvgMascFem | Between Groups | 8.368 | 2 | 4.184 | 7.663 | 0.001 |
| | Within Groups | 37.671 | 69 | 0.546 | | |
| | Total | 46.038 | 71 | | | |

For power distance, the southern region had a significantly higher mean power distance than the northern region by .412, corresponding to a p-value of .051. In addition, the southern region had a significantly higher power distance than Taiwan by a mean value of .416 corresponding to a p-value of .004. The mean difference between the northern region and Taiwan was .003 and was not significant; therefore, their levels of power distance were statistically indistinguishable, though the southern region stood out with a higher power distance than both the northern region and Taiwan. With regard to effect size, eta-squared was calculated to be .13, a medium effect from a practical standpoint.

The next statistically significant metric was collectivism. Looking at a comparison of group means, the northern region had a higher (more collectivist) mean difference than the southern region by .455, corresponding to a p-value of .097. A comparison of the northern region and Taiwan as well as the southern region in Taiwan did not yield significant results. The northern region had the highest collectivism mean score, followed by Taiwan, and lastly the southern region. However, statistically speaking, only the northern region and southern regions were distinguishable. The overall effect size (eta-squared) for collectivism was .065; a small to medium effect size.

The final statistically significant value from the ANOVA table was masculinity/femininity. In this case, the Taiwan region was statistically more feminine than both the northern and southern regions. The mean difference between Taiwan and the northern region was .596, corresponding to a p-value of .054. Similarly, the mean difference between Taiwan and the southern region was found to be .721, corresponding to a p-value of less than .001. The mean difference between the northern and southern groups was not statistically distinguishable. The measure of effect size, eta-squared was calculated to be .18 for masculinity/femininity, which is a medium to large effect. Next is an analysis of the second area of external environment, the regulatory environment.

4.4.2. Research Question 2.2: “What are the legal regulations (national and local) SMS requirements?”

The compliance of the regulatory environment with ICAO SMS standards was addressed by Research Question 2.2. As described in Chapter 3, key gatekeepers recommended documents for review to further understand the regulatory environment in

which the organizations are situated. One challenge to reviewing the regulatory environment was that the three regions investigated by this study fall under two different aviation authorities.

In Mainland China, the Civil Aviation Administration of China administers all aviation law, including requirements for safety management at airlines and airports. This includes China's regulatory environment for Safety Management Systems. CAAC's regulations regarding SMS have been published since 2005. According to the Chinese delegation to ICAO (PRC, 2012), by the end of 2013 period all airports were expected to be certificated by CAAC regarding their SMS.

The operations and procedures of SMS in China are regulated a national level and no additional requirements exist from regional, provincial, or local governments. CAAC provides for these requirements in several documents. In the Chinese Civil Aviation Regulations (CCARs), CAAC provides guidance on establishing SMS at airports and airlines throughout the country (CAAC, 2010, p. 12). Operational requirements for SMS include that it can identify the sources that could affect safety, ensure necessary corrections can be implemented to maintain an acceptable level of safety, and that it can supervise and regularly evaluate safety.

In addition, CCARs require SMS to clearly define the boundaries of safety throughout the organization and determine individual responsibilities, including high-level individuals. Lastly, a Chinese SMS, according to CCARs, must provide for a non-punitive reporting system that can collect reports and handle safety issues systematically. This provision includes requirements to protect data resources.

ICAO conducts safety audits regularly for its member states, and regarding China its most recent audit was conducted in 2007. The results from the SMS audit display the effective implementation rate of several categories, including SMS legislation itself. The ICAO audit found China's effective implementation rate for legislation to be 85.71%, compared to a 2007 global average of 63.55% (ICAO, 2007).

Taiwan (administered by the Republic of China) is not a member state of ICAO and therefore no SMS audits are conducted and there are therefore no ICAO-determined effective implementation rates for SMS compliance. However, the Taiwan Civil Aeronautics Administration (CAA) publishes a comprehensive SMS advisory circular for airlines and airports (CAA, 2011a). The important areas for SMS identified in this advisory circular by the CAA include safety policy and objectives, safety risk management, safety assurance, and safety promotion.

The CAA further breaks down these categories into key points. For safety policy and objectives, CAAC details legislative framework and policy, responsibility and accountability, preventing accidents and incidents, enforcement, and documentation (CAA, 2011b). For safety risk management, the CAA requires risk management requirements and performance reporting. In addition, the CAA includes policy on oversight, data collection, and data-driven hotspot identification. Lastly, for safety promotion, CAA highlights both internal and external training and communication.

Taiwan's CAA also includes a safety policy statement regarding its approach to safety:

The CAA is committed to developing, implementing, maintaining and constantly improving strategies and processes to ensure that all aviation activities that take

place under its oversight will achieve the highest level of safety performance, while meeting both national regulations and international standards. All service providers shall be required to demonstrate that their management systems adequately reflect an SMS approach. The expected result of this approach is improved safety management, and safety practices, including safety reporting within the civil aviation industry. (CAA, 2011b, p. 24).

The CAA further defines its safety commitment in a ten-point model. Relevant SMS-related points include its commitment to developing policy based on SMS principles, developing and managing reporting systems, resolution of safety concerns, ensuring proper training, and oversight of SMS at aviation organizations.

Per the methodology outlined in Chapter 3, the ICAO SMM was used as a coding scheme to determine if Mainland China and Taiwan's regulatory environments adhered to international standards. Table 4.11 shows the findings of Research Question 2.2: the regulatory environment.

These findings suggest that, with respect to published legislation, the regulatory environments showed a high degree of compliance with the SMM. This is consistent with ICAO's previously published findings for Mainland China (no ICAO data for Taiwan was available).

These findings do not suggest any association between the regulatory environment and the implementation status of SMS in the regions of Greater China. The suggestion that the regulatory environments show a high level of similarity both to ICAO standards and each other helps isolate the relationship between local cultural values/perception of isomorphism and the SMS implementation status of the regions.

Table 4.11. Consistency of Regulatory Environments with SMM Standards

| | CAAC (China) | CAA (Taiwan) |
|--|----------------|----------------|
| State Safety Policy and Objectives | Consistent | Consistent |
| <i>State Safety Legislative Framework</i> | <i>Present</i> | <i>Present</i> |
| <i>State Safety Responsibilities and Accountabilities</i> | <i>Present</i> | <i>Present</i> |
| <i>Accident and Incident Investigation</i> | <i>Present</i> | <i>Present</i> |
| <i>Enforcement Policy</i> | <i>Present</i> | <i>Present</i> |
| State Safety Risk Management | Consistent | Consistent |
| <i>Safety Requirements for the Service Provider's SMS</i> | <i>Present</i> | <i>Present</i> |
| <i>Agreement on the Service Provider's Safety Performance</i> | <i>Present</i> | <i>Present</i> |
| State Safety Assurance | Consistent | Consistent |
| <i>Safety Oversight</i> | <i>Present</i> | <i>Present</i> |
| <i>Safety Data Collection, Analysis and Exchange</i> | <i>Present</i> | <i>Present</i> |
| <i>Safety-data-driven Targeting of Oversight of Areas of Greater Concern or Need</i> | <i>Present</i> | <i>Present</i> |
| State Safety Promotion | Consistent | Consistent |
| <i>Internal Training, Communication and Dissemination of Safety Information</i> | <i>Present</i> | <i>Present</i> |
| <i>External Training, Communication, and Dissemination of Safety Information</i> | <i>Present</i> | <i>Present</i> |

However, one notable difference between SMS legislation of the two aviation authorities that could not be detected by the coding scheme was stronger emphasis from the CAA (Taiwan) for safety promotion outlined both in its civil aviation regulations and its safety commitment documents.

This document review constitutes one part of the external environment, specifically the regulatory environment, in which participants are situated. The next

section will discuss the third part of the external environment, the perception of organizational isomorphism.

4.4.3. Research Question 2.3: “What is the Perception of Isomorphic Tendency of SMS Development?”

Research Question 2.3 addressed the perception of isomorphic tendency among organizations. This part of the external environment was assessed with four survey items. For reliability, Cronbach’s alpha across all three regions was calculated to be .602, an indication of an acceptable level. The assumption of equal variances was tested with Levene’s test of homogeneity, and produced a p-value of .478, indicating the equal variance assumption was not violated. An analysis of variance yielded an F-statistic of 4.89 corresponding to a p-value of .01. To investigate this significance, Tukey’s HSD comparison was used to compare group means. Taiwan had the highest perception of isomorphism, followed by the southern region, and lastly the northern region. The mean difference between Taiwan and the northern region was statistically significant, with $p=.017$, however, between the two, the southern region was statistically indistinguishable. The eta-squared value for effect size was calculated to be .127, indicating a medium effect size.

The findings from this portion of the analysis suggest that Taiwan has a significantly higher perception of organizational isomorphism than the northern region. Falling between the two was the southern region, but could not be statistically distinguished from either.

4.4.4. Research Question 4.2: “What is the Relationship Between Local Cultural Values and National/Local Safety Regulations” and Research Question 4.3: “What is the Relationship Between the Perception of Isomorphism and Local Cultural Values?”

To properly determine the influence of the external environment, the relationship between local cultural values and the regulatory environment as well as local cultural values and the perception of isomorphism had to be explored. These were actually posed as Research Question 4.2 and 4.3, respectively, however their analysis and findings are relevant to fully answering Research Question 2.

Regarding the relationship between local cultural values and the regulatory environment, there was no evidence to suggest there was any connection between the two. The original research question was posed to account for the possible differences in local aviation regulations of each region, and analysis of these environments from section 4.3.2 suggested they were consistent with international standards. There is therefore no evidence to suggest any relationship between local cultural values of the regions and the aviation authority’s regulations and documents.

For the relationship between local cultural values and the perception of isomorphism, correlations were used to identify conceptual overlap as outlined in Chapter 3. The results of these correlations are shown in Table 4.12:

Table 4.12. *Correlations Between Isomorphism and Local Cultural Values*

| Isomorphism Correlations (r, sig.) | | | | |
|------------------------------------|---------------|---------------|---------------|---------------|
| Cultural Metric | Northern | Southern | Taiwan | Overall |
| Power Distance | (.415, .204) | (.159, .490) | (.265, .108) | (.175, .147) |
| Uncertainty Avoidance | (-.060, .860) | (-.243, .289) | (-.032, .848) | (-.075, .535) |
| Collectivism | (-.268, .425) | (.277, .225) | (.363, .025) | (.164, .176) |
| Long Term Orientation | (-.058, .866) | (.460, .036) | (.006, .971) | (.049, .688) |
| Masculinity/Femininity | (-.052, .880) | (.122, .598) | (.436, .006) | (.081, .503) |

According to these calculations, there were three significant correlations. The first was between isomorphism and long term orientation in the southern region. However, the data regarding long term orientation has been demonstrated to violate assumptions of reliability. The other two significant correlations occurred in the Taiwan region between isomorphism and collectivism as well as isomorphism and masculinity/femininity.

Based on this statistical analysis, the data indicated that there was no overall correlation between isomorphism and any of the cultural metrics at the .1 significance level, with one exception: for the Taiwan region alone, isomorphism was significantly correlated to masculinity/femininity as well as collectivism. This suggests that isomorphism shares influence with masculinity/femininity and collectivism in the Taiwan region, but is orthogonal to the other metrics in the northern and southern regions.

4.4.5. Overall Findings for Research Question 2

The overall findings for Research Question 2 are summarized in Figure 4.5 and are discussed thoroughly in this section.

Figure 4.5 shows how, based on the analysis of the relationships between the external environments and the SMS implementation statuses of the three regions, the data suggested an association between the external environment and the status of SMS in Greater China.

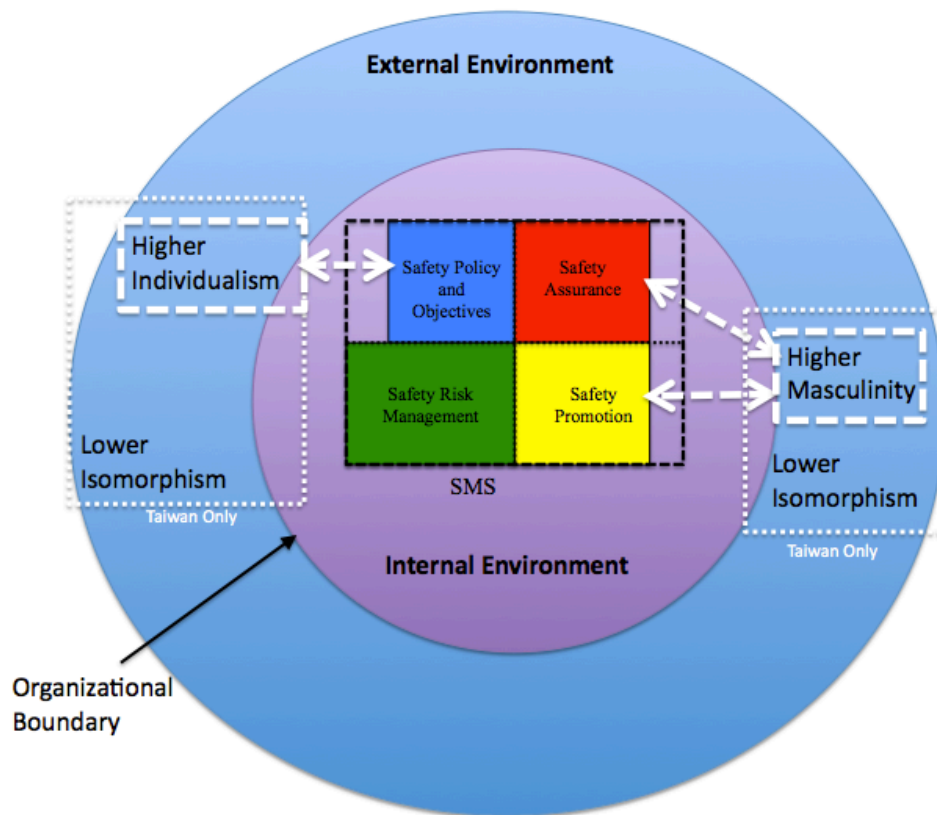


Figure 4.5. *Summary of External Environment Associations to SMS Implementation*

First, the findings from Research Question 2.3 suggested that both regulatory environments (the northern and southern regions governed by the CAAC, and Taiwan governed by CAA) showed a high level of similarity to the ICAO SMS standards. There was no evidence to suggest that there was any relationship between the regulatory environment and the variation of the status of SMS implementation in the regions. Therefore, there is no reflection of this in Figure 4.5.

In addition, there were several statistically significant relationships between regions within the local cultural values. A summary of these significant relationships is shown in Table 4.13.

Table 4.13. *Summary of Significant Relationships Between Regions by Cultural Value*

| Cultural Metric | Statistically Significant Relationships | Effect Size |
|------------------------|---|-----------------|
| Power Distance | Southern higher than both northern and Taiwan | Medium |
| Uncertainty Avoidance | None | |
| Collectivism | Northern higher than southern | Small to Medium |
| Long Term Orientation | None | |
| Masculinity/Femininity | Taiwan higher than both northern and southern | Medium to Large |

Table 4.13 illustrates three cultural metrics that were found to significantly vary between regions. Of the remaining two metrics, uncertainty avoidance could not be demonstrated to vary significantly between regions, and long term orientation data was not reliable due to extremely low inter-item reliability (Cronbach's alpha value).

The significant difference between the regions for masculinity/femininity paralleled the variation between the regions of two areas of SMS compliance: safety risk management, and safety promotion. In both cases, Taiwan had a stronger compliance to ICAO SMS standards than both the northern and southern regions. This suggests the change in the level of masculinity/femininity appears to at least partially associate with the variation of these two areas of SMS compliance. These are reflected in Figure 4.4 by white boxes with white arrows from those metrics to safety risk management and safety promotion.

It is not likely that the variation of masculinity/femininity is uniquely related to the variation of safety risk management and safety promotion, because the overall levels

safety risk management adherence were lower than that of safety promotion. However, the medium to large effect size observed from the data does support the observed relationship between this cultural value and those two areas of SMS implementation status.

In addition, the statistical significance found for the variation of collectivism levels appeared to correspond to the variation of implementation status of safety policy and objectives. Based on participants' responses, the northern region appeared to have the strongest adherence to SMS standards for safety policy and objectives above both the southern and Taiwan regions. Similarly, the northern region had a significantly higher collectivism level than the southern region. However, the relationship between the northern region and Taiwan was not consistent for that particular area of SMS implementation and cultural value. For the implementation status of safety policy and objectives, Taiwan's implementation status was similar to the southern region's implementation status, but it was not significantly lower than the northern region's collectivism. This could be accounted for by a correlation between collectivism and isomorphism in the Taiwan region. This is consistent with the finding that the Taiwan region appeared to have a statistically significantly higher perception of isomorphism than the northern and southern regions. This is shown in Figure 4.5 by grouping isomorphism with individualism and masculinity in the narrower white dashed boxes.

Nonetheless, the relationship between the northern and southern regions alone appeared to be consistent. Furthermore, because the northern and southern regions lie within the same administrative area of Greater China, the between the safety policy and objectives implementation status and the variation of collectivism is more isolated. From

this analysis it appears that an increased level of collectivism in the local culture was associated with the increased strength of SMS policy and documentation adherence to ICAO standards.

The final significant relationship within the external environment was power distance. For this local cultural metric, the southern region was statistically higher than both the northern region and Taiwan. This relationship between the regions was not found to parallel any of the variations of SMS implementation components. Therefore, barring possible correlation with other cultural metrics, and bearing in mind a lower and less valid reliability coefficient, there did not appear to be any relationship between power distance and the implementation status of any of the components of SMS. This is reflected in Figure 4.5.

Looking at the relationship between the variation of cultural metrics and the local regulatory environment, there did not appear to be any connection between the two. The regulations from the two aviation authorities (CAAC and CAA) were very consistent with international standards. Overall, safety policy and objectives, safety assurance, and safety promotion were all found exhibit an association to external environment factors, as is shown in Figure 4.5. The next section will discuss the analysis and findings of the internal environment's relationship to the status of SMS implementation.

4.5. Research Question 3: “How is the Internal Environmental Context Associated with SMS Development in Greater China?”

Research Question 3 inquired about the influence of the internal environment on the implementation of SMS in Greater China. The internal environment consisted of two

concepts: safety culture and perception of legitimacy. The following subparts describe the analysis and findings for both of these concepts. In addition, Research Question 4.1 will also be discussed in this section, as it explored the relationship between the two concepts of the internal environment. This relationship was important to fully understanding the influence of the internal environment for the purpose of answering Research Question 3. The following sections explore each of those sub-questions and their analysis. The last section of the internal environment will, as in answering Research Question 2, combine the findings of the subparts summarize the overall findings of Research Question 3.

4.5.1. Research Question 3.1: “What is the Safety Culture Among Individuals at Their Organizations in Greater China?”

Safety culture was measured using six survey items. Reliability analysis yielded a Cronbach’s alpha value of .68, indicating adequate reliability. In addition, Levene’s test for homogeneity of variances produced a p-value of .701, indicating the assumption of equal variances was not violated. A one-way ANOVA of safety culture among the three regions yielded an F-statistic of 2.893 corresponding to a p-value of .062, which is significant at the .1 level. Further investigation of this significance using Tukey HSD comparison procedures found the significance to occur between the northern and southern regions. The mean difference between the two was found to be .312 with a p-value of .073, indicating that the northern region has a stronger safety culture at a .1 significance level. Taiwan’s mean safety culture value fell between northern and southern means and was not statistically distinguishable from either. Nonetheless, all

three regions had high safety culture values with mean scores of 4.44, 4.31, and 4.12 for the northern, southern, and Taiwan regions, respectively. The effect size eta-squared was determined to be small, with a value of .079.

4.5.2. Research Question 3.2: “What is the Extent of Individuals’ Perceived Legitimacy of their SMS?”

Perception of legitimacy of SMS in Greater China was measured with five survey items. An initial reliability analysis yielded a Cronbach’s alpha coefficient of .801, indicating high reliability. In addition, Levene’s test of homogeneity of variances produced a p-value of .089, indicating the equality of variance assumption was not violated. Next, an ANOVA was performed to determine if there was a significant variance between the means of each group. The ANOVA F-statistic was calculated to be 3.512 corresponding to a p-value of .035.

A Tukey HSD procedure was again utilized to explore the data further. The mean legitimacy score for the northern region was 4.2, which was statistically significantly higher than the southern region (3.67) with a p-value of .04. Once again, Taiwan’s score fell in between the two groups (3.98) and was not statistically distinguishable from either the northern or southern region. The effect size eta-squared for legitimacy was calculated to be .095; a small to medium effect size. The next section, as previously mentioned, observes the relationship between the two concepts of the internal environment.

4.5.3. Research Question 4.1: “What is the Relationship Between Safety Culture and Internal Legitimacy?”

This section explores the relationship between safety culture and internal legitimacy. Correlations between the two for each region were all found to be statistically significant, as shown in Table 4.14.

Table 4.14. *Correlations between Safety Culture and Legitimacy*

| Correlations Between Safety Culture and Legitimacy | | |
|--|-------------|--------------|
| Region | Correlation | Significance |
| Northern | 0.733 | 0.01 |
| Southern | 0.429 | 0.052 |
| Taiwan | 0.548 | <.001 |
| Overall | 0.570 | <.001 |

While the strength of these correlations vary, all of them are statistically significant at the .1 level. Figure 4.6 exhibits the overall relationship between the safety culture and legitimacy graphically.

Because of the statistically significant conceptual overlap between safety culture and legitimacy as found by the correlations, it was possible to pool the values of the two concepts to assess the internal environment as a whole.

Testing the pooled score for the internal environment yielded an ANOVA F-statistic of 4.208 corresponding to a p-value of .019 (Levene’s statistic was determined to be 1.488 corresponding to a p-value of .233, suggesting the assumption of equal variance was not violated). This was associated with an eta-squared effect size of .11, which is approximately a medium effect.

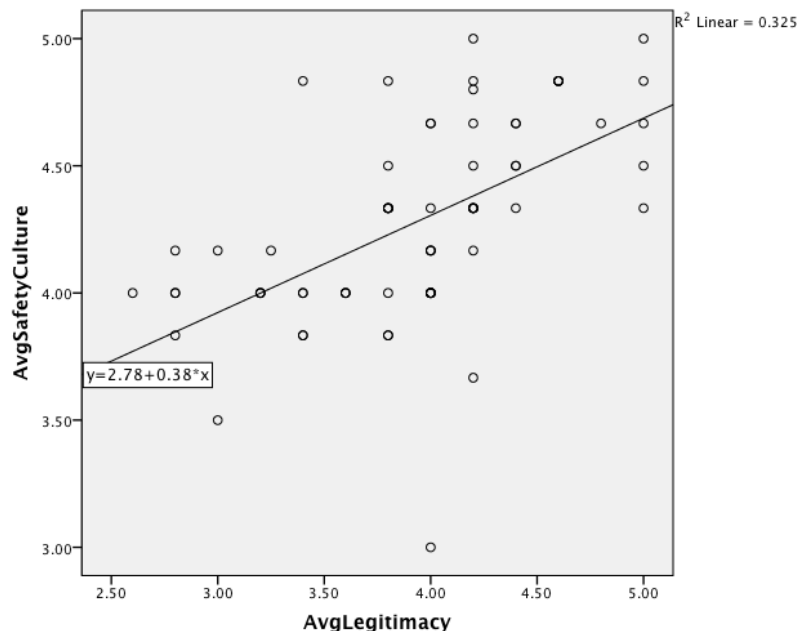


Figure 4.6. Overall Correlation Between Safety Culture and Legitimacy

Further analysis found that the southern region had a significantly weaker internal environment than both the northern and Taiwan regions, with p-values of .023 and .081, respectively. There was no significant difference observed between the northern region and Taiwan, though both were independently higher than the southern region. The following section brings together the findings of these sub-questions to determine the overall findings for the observed relationship between the internal environment and the implementation status of SMS.

4.5.4. Overall Findings for Research Question 3

Findings from the quantitative analysis showed that the northern region has a significantly higher safety culture than the southern region, and a significantly higher

legitimacy score than the southern region. In both cases, there was not a significant difference between Taiwan's scores and the northern and southern regions.

Furthermore, safety culture and perception of legitimacy were found to be highly correlated for all three regions and overall. This indicates a strong degree of interconnectedness of the two concepts. Pooling the internal environment concepts found the southern region to have the weakest internal environment with statistical significance.

The next step was to relate the variation of these concepts across the three regions to their implementation status of SMS. The relationship of the southern region being significantly lower than the northern and Taiwan regions was not directly observed in any of the SMS components themselves. However, this relationship can indeed be observed in the overall SMS compliance for the regions. This suggests that the internal environmental factors (and subsequently the internal environment itself) are associated with the overall SMS rather than any of the SMS components individually, as suggested by Figure 4.7.

Figure 4.7 illustrates the suggestion that the internal environment is related to the overall SMS implementation status rather than a single component individually. In the figure, the thickness of the internal environment (highlighted in purple) as determined by the pooled legitimacy and safety culture metrics, appeared to correspond to the overall level of compliance of SMS.

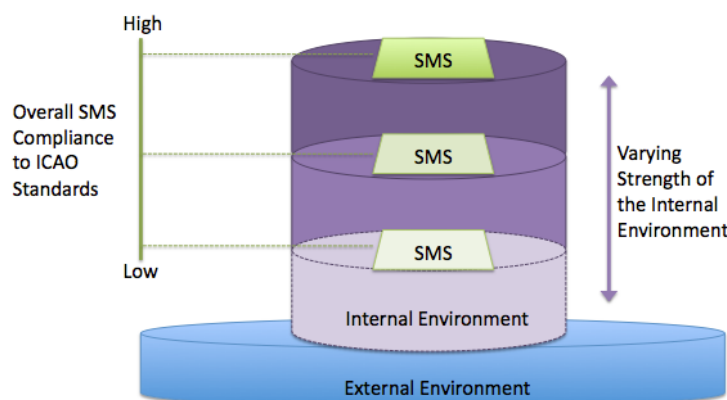


Figure 4.7. Apparent Internal Environment Association to Overall SMS Compliance

It is important to note the possibility that the internal environment could have had a mediating effect on concepts of the external environment. For the suggestion of a mediating effect to be apparent, there should have been a relationship between the internal environment factors and the external environment factors. Research Question 4.4 addressed this very issue and will be discussed in the next section.

4.6. Research Question 4: “ What is the Relationship Between Certain Elements Within the Internal and External Environments?”

As Research Question 4, several relationships among concepts of the internal and external environments were explored. Three of the four sub-research questions have already been discussed as part of the influence of the internal and external environments. The relationship between internal legitimacy and safety culture was described in section 4.4.3. The relationship between local cultural values and perception of isomorphism as well as the regulatory environment and local culture values were described in section

4.2.2 along with local cultural values and the regulatory environment. The remaining relationship to describe is that of safety culture and local cultural values.

4.6.1. Research Question 4.4: “What is the Relationship Between Safety Culture and Local Cultural Values?”

This sub-question of Research Question 4 explored the relationship between the internal and external environments themselves. Correlations between safety culture (a specific subculture related to the organization) and the local cultural values were performed to better understand the shared influence and/or mutual exclusivity of the influence of the internal and external environments. Table 4.15 aggregates the correlations between safety culture and local cultural values for the different regions.

Table 4.15. *Correlations Between Safety Culture and Local Cultural Values*

| Correlations Between Safety Culture and Local Cultural Values (r, sig.) | | | | |
|---|--------------|---------------|---------------|---------------|
| Metric | Northern | Southern | Taiwan | Overall |
| Power Distance | (.089, .795) | (-.157, .497) | (-.472, .003) | (-.331, .005) |
| Uncertainty Avoidance | (.694, .018) | (.547, .01) | (.631, <.001) | (.623, <.001) |
| Collectivism | (.469, .146) | (.234, .307) | (-.172, .3) | (.127, .293) |
| Long Term Orientation | (.314, .348) | (.542, .011) | (.209, .207) | (.313, .008) |
| Masculinity/Femininity | (.423, .195) | (.324, .151) | (-.216, .192) | (-.023, .848) |

The data in Table 4.15 indicate a strong overall negative correlation between safety culture and power distance ($r = -.331$, $p = .005$) as well as a strong positive correlation between safety culture and uncertainty avoidance ($r = .623$, $p < .001$). However, further analysis revealed that for power distance, only the Taiwan region exhibited this strong correlation (exploring the correlations within the regions was necessary to avoid multi-level overgeneralization as was discussed in Chapter 3). There

also appeared to be a strong positive correlation between safety culture and long term orientation, although the long term orientation data was demonstrated to be unreliable.

The findings of Research Question 4.4 indicate the connection between safety culture and two cultural metrics: power distance, and uncertainty avoidance. In the case of power distance, there was a significant correlation between it and safety culture in the Taiwan region only. For uncertainty avoidance, all three regions had very strong significant correlations with safety culture. Given that there were no significant differences between the regions' uncertainty avoidance values, yet they were strongly correlated to safety culture the relationships of these concepts, the data suggests that uncertainty avoidance has no direct effect on the SMS components, but rather seems to be expressed through safety culture. In the case of Taiwan, both power distance and uncertainty avoidance appeared to be expressed through safety culture. Figure 4.6 provides a graphic representation of these relationships.

Figure 4.8 summarizes the findings as to how two cultural metrics, uncertainty avoidance and power distance (in the case of Taiwan) do indeed influence the implementation status of SMS through the internal environment. Initially, the differences between regions of uncertainty avoidance and power distance were not shown to be statistically significant and therefore no direct effect on the implementation status of SMS could be observed until they were connected to safety culture and legitimacy, which do have a statistically significant difference across regions.

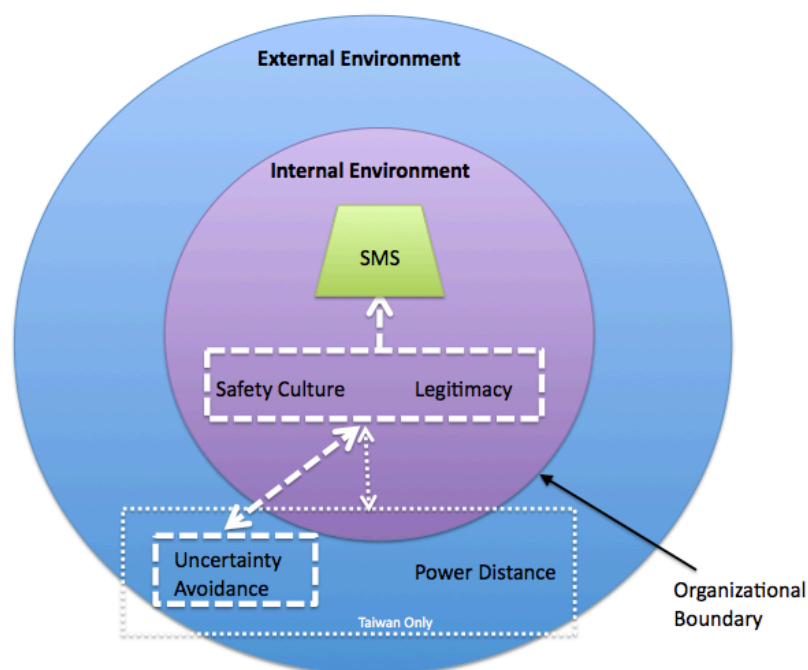


Figure 4.8. Apparent Expression of External Concepts through the Internal Environment

This effect is shown by the connection between the internal environment and uncertainty avoidance in white boxes. For the Taiwan region alone, power distance was included in the connection, which is shown in a smaller white box and white arrow.

The next section summarizes the findings from Research Question 4.

4.6.2. Overall Findings for Research Question 4

Parts of Research Question 4 have already been answered in previous sections of Chapter 4, as they have been relevant to determining the findings of the other research questions. However, this section summarizes the findings from all four sub-questions of Research Question 4 in Table 4.16:

Table 4.16. *Research Question 4 Findings*

| Research Question 4 Findings | |
|---|---|
| Research Question | Findings |
| 4.1: "What is the relationship between safety culture and internal legitimacy?" | The two concepts are highly correlated for all three regions and overall. |
| 4.2: "What is the relationship between local cultural values and nation/local safety regulations?" | There was no relationship apparent between these two concepts. |
| 4.3: "What is the relationship between the perception of organizational isomorphism and local cultural values?" | Isomorphism was conceptually connected to masculinity and collectivism for the Taiwan region only. |
| 4.4: "What is the relationship between safety culture and local cultural values?" | Safety culture was connected to uncertainty avoidance for all regions. For Taiwan alone, safety culture was also connected to power distance. |

As indicated in Table 4.16, exploration of these concepts yielded relationships that impacted the findings for the other research questions. The following section summarizes what was discussed in Chapter 4 of this dissertation.

4.7. Summary

Chapter 4 has provided the findings of the study as well as an in-depth analysis of the data that was collected via the procedures outlined in Chapter 3. This chapter analyzed data from and subsequently answered each of the research questions of the study. Chapter 5 will explain what conclusions can be drawn from the findings presented in this chapter and their implications, as well as provide a discussion and recommendations for future study.

CHAPTER 5. CONCLUSIONS, DISCUSSION, AND RECOMMENDATIONS

This chapter draws conclusions from the findings of the study and analysis of the data presented in Chapter 4. In addition, this chapter proceeds with a discussion and recommendations for future study.

5.1. Conclusions

This study made several findings regarding the apparent association between the internal/external environments and the implementation status of SMS. Some of the relationships observed were between environmental concepts and individual components of SMS. Others were between environmental concepts and overall level of SMS compliance and not any individual component directly. Table 5.1 summarizes the results that were suggested by this study. It identifies the concept that was observed, the environment in which that concept was located, and which area of SMS implementation it appeared to be connected to.

To supplement Table 5.1 with a visual representation, the aggregate collection of suggested connections between the environments is shown in Figure 5.1. This representation, albeit complicated, shows the summation of findings from this study and emphasizes the conclusion that ultimately there were several ways in which the internal and external environments appeared to be associated with the implementation status of SMS in Greater China.

Table 5.1. Summary of Environmental Associations to SMS Implementation Status

| Concept | Environment | Area of Association |
|------------------------------|-------------|--|
| Masculinity/Femininity | External | Safety Promotion and Safety Assurance |
| Collectivism | External | Safety Policy and Objectives |
| Isomorphism (Taiwan Only) | External | Safety Policy and Objectives, Safety Assurance, and Safety Promotion |
| Safety Culture | Internal | Overall Compliance |
| Legitimacy | Internal | Overall Compliance |
| Uncertainty Avoidance | External | Overall Compliance (through safety culture and legitimacy) |
| Power Distance (Taiwan only) | External | Overall Compliance (through safety culture and legitimacy) |

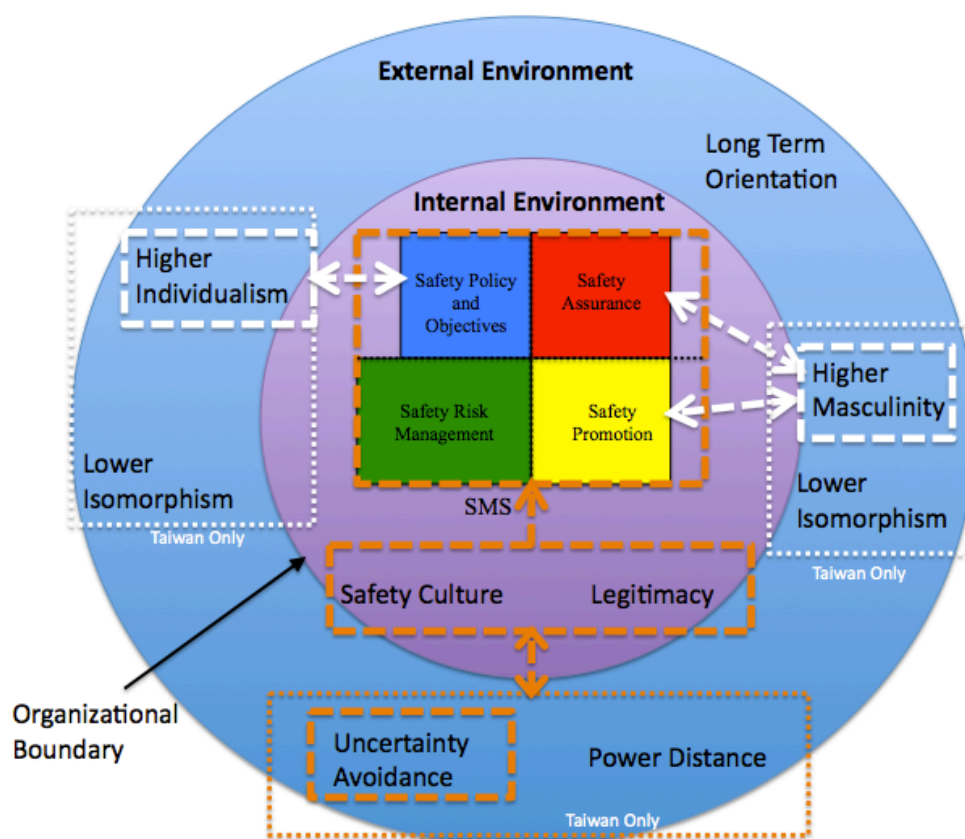


Figure 5.1. Visual Summary of Findings

Figure 5.1 shows these associations as observed by this study. In it, white boxes and arrows represent the observed connections to individual components of SMS implementation status, and orange represents the pathway of observed connections to the overall SMS implementation status. As indicated in the figure, there were several associations unique to the Taiwan region, namely the inclusion of isomorphism on the association to individual SMS components and the inclusion of power distance in the association to overall SMS through the internal environment.

Overall, using Institutional Theory as a guide, this study found several ways in which factors from both the internal and external environment appeared to relate to the implementation status of SMS in Greater China. Although this study observed only the relationship between environmental context and the implementation of SMS, the theoretical framework predicts the influence of environments on organizations, which is certainly something that future studies can explore. The remainder of this chapter will provide discussion and recommendations taken from the experience of conducting this study.

5.2. Discussion and Recommendations

This section provides several areas of discussion, including recommendations for future study. These discussion items have been developed from the process of conducting this study and are organized into three areas: SMS policy observations, developing a better understanding of cultural context, and the further study of environmental interaction.

5.2.1. Goal-Oriented SMS Policy

Revealing the influence of culture on the implementation status of SMS presents an inherent paradox to the implementation of any global standard when applied in a local setting. If it is the expectation for all organizations to adhere to a single standard, yet the environment in which the organization is situated influences the operation of that standard, is it a realistic goal to have all SMS at aviation organizations look and operate in the same way?

When it comes to ensuring a safe aviation operation, the goal is to identify and reduce hazards and risks, make sound decisions regarding risks, ensure that the system is working as intended, and make sure individuals understand their role in the safety system. It's no surprise that these are included in the components of SMS as prescribed by ICAO. Given that everyone can agree on the overarching goal of reducing incidents and accidents, how necessary is it to ensure that the processes and procedures for achieving that goal are the same worldwide?

A more goal-oriented approach to evaluating the effectiveness of SMS would not only preserve the grand goal of the reduction of incidents and accidents, but also allow organizations the flexibility to implement such a system in a way that is most agreeable to their environments and members.

Further complicating the matter is the difficulty of accurately determining a well-running SMS. Is the organization that has no hazard reports each year safer than the organization that has fifty reports every month? Without dedicated time and research into a single organization, there is no easy way to accurately answer that question. The current evaluation technique, which was used in this study, is to explore policy and

documentation as well as interview members of an organization and qualitatively draw conclusions. But there is no way to avoid one reality of current SMS evaluation: an SMS that is perfectly compliant with ICAO standards does not guarantee a safer operation.

To address this issue, further research could focus on evaluating SMS from an outcomes perspective, not just by policy analysis. Given the environmental influence on the implementation and operation of the SMS at an organization, it is quite plausible that some organizations would require that which others might try to eliminate to ensure their operation's safety. For example, anonymity has been strongly encouraged in a hazard reporting system, yet the hazard reporting systems in Greater China did not display the level of anonymity suggested by the ICAO SMM. While it may be true that these organizations are less compliant to the international standard in this area, it may not be fair to conclude that such noncompliance has a detrimental effect on the organization's safety. In fact, a reporting system with less anonymity may function better within the cultural context of these organizations. Unfortunately, with the current techniques of SMS evaluation it is difficult to see this possible reality.

In the future, hopefully SMS evaluation can better accommodate outcomes in its determination as to whether an organization meets the goals of a safe operation. In addition, future research can also emphasize the role of culture of in SMS implementation and operation, and consider cultural context when making determinations about the functionality of SMS in that environment.

5.2.2. Understanding Culture

The complexity, breadth, and depth of culture cannot be overstated. Hofstede has been a pioneer of defining and quantifying several cultural metrics that have been well verified over the past few decades. However, in the grand context of defining culture, research has only revealed a miniscule amount of how humans define culture, how culture guides the human reality, and how human actions and thoughts are the products of cultural and sub-cultural relationships.

For example, Hofstede's initial work with four cultural metrics (power distance, uncertainty avoidance, individualism/collectivism, and masculinity/femininity) has been demonstrated to be extremely insightful to understanding cultural differences. Their ability to be measured quantitatively and allow for multicultural comparison has provided much validated research with a comfortable concreteness of observing cultural differences. These observations can be used to at least partially explain many observable differences in culture, whether it be a culture's tendency to seek out other cultural members when outside cultural boundaries, or why some cultures have a much narrower variation of acceptable meal times throughout the day.

However, without a better understanding of how to define culture boundaries appropriately, it is possible if not likely for Hofstede's metrics to over generalize cultural behaviors. This is a good case for mixed-methods approaches to cultural research to allow for the appropriate definition of cultural boundaries (especially in the context of a particular research study). In addition, these initial metrics have the possibility to broadly ignore conditions that may moderate relationships within cultural groups. In one given situation, a given culture may be more masculine, but in a different context the same

individuals might be more feminine. Therefore, it may not be meaningful to assign a cultural value to a group without strong definition and justification of its boundaries. From a philosophical standpoint, does the same group of individuals in a different environmental context even constitute the same “culture”?

Another focus of the current cultural metrics is they primarily address the relationships between members of a given culture. Yet the interaction between group members is only one aspect of culture. There is no cultural metric that can address how people determine their self-worth. In addition, no metric describes a culture’s belief that individuals outside of that culture can understand it in the same way group members do.

Long term orientation is a good example of a newer cultural metric that is intended to assess how individuals focus on long term goals vs. short term goals. The data collected regarding long term orientation in this study is a good example of the immaturity of this cultural metric. The questions on the CV scale that address long term orientation showed no inter-item reliability. While this may also be the result of error in the study, from a practical standpoint the questions exhibit many potential issues presented in this discussion. Survey item LT3 states, “Personal steadiness and stability are important to me”. Meanwhile LT6 states, “It is important to work hard for success in the future.” While both of these survey items do have an axis of long term vs. short term, however, it is certainly possible that long term orientation differs vastly in the context of one’s personal life vs. one’s professional life. This is just one possible source of error that the CV scale does not distinguish. Of course, as previously mentioned, long term orientation is a more recently developed cultural metric, and as research continues to address its definition and implications, more can be learned about its value.

Furthermore, this discussion has so far assumed that culture is static. Cultural metrics have yet to address rates of cultural change, factors that moderate them, and how cultural change is connected to other concepts of global development (such as technology, travel, etc).

This discussion of culture is intended to highlight the vast amount of opportunities for further research into understanding its boundaries, implications, and applications. There are an infinite number of possibilities for further research, and similarly, applied research. This kind of understanding about people and cultural groups is even more critical in an increasingly globalized world and can help cultures relate to one another on the basis of their similarities and appreciate (and respect) their differences.

5.2.3. Future Study of Environmental Interaction

There are several areas in which future research can investigate environmental interaction. Institutional Theory provided a very useful framework in this study for improving understanding how environmental contexts were associated with SMS in three regions of Greater China. Institutional Theory also describes interaction between environments and sub-environments (nested environments), which is why this study addressed the interaction of the internal and external environments themselves. In addition, Institutional Theory suggests not only association but also influence of environments on the function and structure of institutions and organizations. Future studies can attempt to explore this idea of influence (especially longitudinal studies over time) to try to observe how environmental changes influence organizational practice and structure.

However, there are also other theories that can be applied to environmental interaction. For example, Structuration Theory addresses the relationship between structure and human agency; that is, individuals create structures that fulfill their needs, and that structure in turn influences their needs. Chapter 2 provides a more rigorous analysis of Structuration Theory and its tenets. But, for the purpose of discussing future research, these theories are certainly not mutually exclusive. If used in tandem, these theories can address not only how environments influence organizations, but also how organizations “push back” and influence the environments.

This study focused on the association between the changes of the environmental context and the implementation status of SMS. However, a Structuration Theory perspective would allow for a focus on the mutual influence of SMS and its environment.

Figure 5.2 illustrates this kind of application of Structuration Theory.

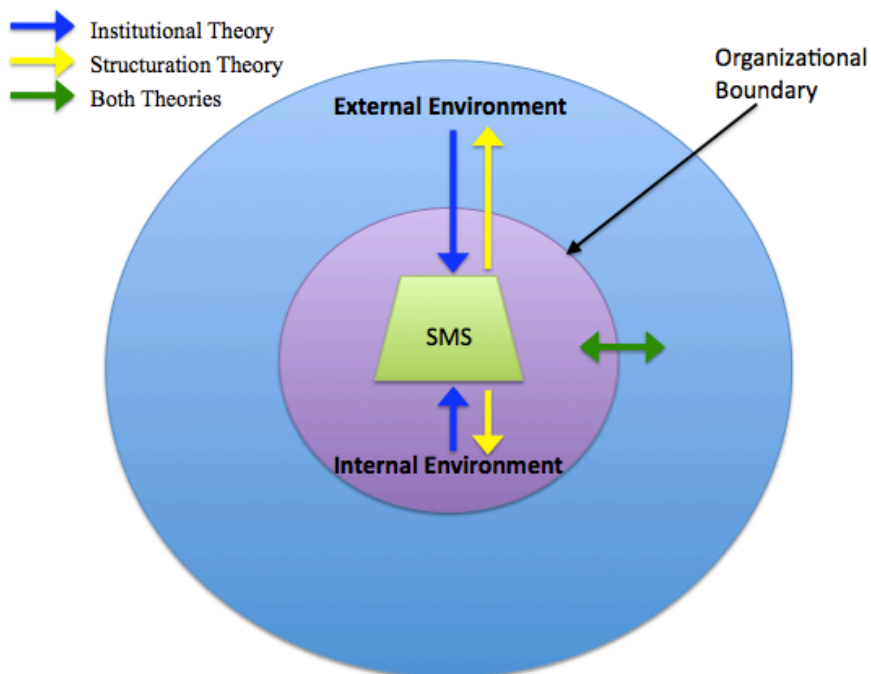


Figure 5.2. Application of Structuration Theory to SMS Implementation in Environmental Context.

In Figure 5.2, blue arrows indicate the relationship that was investigated by this study through the use of Institutional Theory. The yellow arrows show how structuration theory can be applied to show how SMS “pushes back” on the culture of the surrounding environments. The green arrow indicates overlap between the two theories in that Institutional Theory describes the influence of the external environment on the internal environment and simultaneously the influence of the internal environment back to the external environment. Structuration Theory describes this mutually influential relationship as well.

By defining the internal and external environments through project scope and guided by research, new research studies can utilize these theoretical concepts to provide a more holistic understanding of how environments influence organizational structure and how that structure in turn influences the environment. There is so much additional research that can be done and applications of this kind of research can help guide decisions for implementing structure and predicting its success.

Although this dissertation used Institutional Theory as a theoretical framework, future studies could employ different levels of detail when exploring environmental interaction with organizations. For example, this study used general concepts of legitimacy and isomorphism as components of the internal and external environments; however, these concepts can be further broken down into different sub-categories. Future studies could certainly look at the different types of legitimacy and/or isomorphism and how they relate to both the overall concepts as well as environmental interaction.

5.2.4. Methodological Considerations in Foreign Research Environments

While conducting research in a foreign environment presents rich opportunities to explore a new domain, it also presents several challenges that researchers should address when developing methodologies. Researchers who conduct studies in western environments may have an excellent understanding of privacy concerns, data protection, and participant solicitation, but the value or appreciation for these concepts is not necessarily consistent worldwide.

A good example of this issue is the common use of e-mail to contact participants to join a study. However, while e-mail use may be ubiquitous in the West, in other cultures (and especially in Greater China), this is not always the case. In fact, a far more common method of communication in Greater China, for both business and personal matters, is text messaging or instant message communication applications for smart phones. In Western culture, the use of instant message communication applications may not be considered appropriate or formal enough for business communications, but in Greater China, it is much more acceptable. Further complicating the issue is that the instant message applications commonly used to communicate in Mainland China are different from those used in Taiwan.

Even if a researcher knows about the most appropriate methods of communication in a given research environment, using them properly is still another concern. This is especially true in the presence of a language barrier.

The use of snowballing technique was a great way to identify and make use of proper communication channels to increase participation in this study. While snowballing technique has limitations and its own set of threats to validity, it allows for a

more harmonious implementation of research in a foreign environment that respects the ideals and values of that domain.

In addition, researchers should bear in mind that the cultural concept of face is not consistent worldwide. This has the potential to weaken research studies that rely on participant responses to draw conclusions. The possibility that participants will provide responses that they feel the researcher is looking for (the Hawthorne Effect) is especially high in Greater China because of both the strong concept of face as well as the necessity of trust in business relationships. Snowballing technique was also helpful to this study in this regard, because the participants were solicited from their associates/friends/colleagues rather than a foreigner who they did not know or trust. This likely impacted both the participants' willingness to participate as well as the accuracy of their responses.

For the same reason, the Delphi method was very useful in this study to verify participants' responses with experts from each region. This allowed the key gatekeepers to understand and comment on the survey responses and "see between the lines" in a way that a researcher from a foreign environment might not be able to.

Overall, conducting research in a foreign environment can be incredibly rewarding and provide meaningful insight as to how individuals around the world think and behave differently. However, from a methodological standpoint, researchers should take care to ensure the research will be conducted appropriately in a foreign environment and apply techniques that best identify how to do so.

5.3. Summary

This chapter has provided the conclusions from this research study based on the findings and analysis presented in Chapter 4. In addition, this chapter includes a discussion about future research in related areas and what perspectives can guide this kind of research.

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APPENDICES

Appendix A: Cultural Dimensions Assessment Tool

CVSCALE: A 26-Item Five-Dimensional Scale of Individual Cultural Values (Yoo, Donthu, & Lenartowicz, 2011).

| Cultural Dimension | Item Code | Survey Item |
|-----------------------|-----------|--|
| Power Distance | PO1 | People in higher positions should make most decisions without consulting people in lower positions. |
| | PO2 | People in higher positions should not ask the opinions of people in lower positions too frequently. |
| | PO3 | People in higher positions should avoid social interaction with people in lower positions. |
| | PO4 | People in lower positions should not disagree with decisions by people in higher positions. |
| | PO5 | People in higher positions should not delegate important tasks to people in lower positions. |
| Uncertainty Avoidance | UN1 | It is important to have instructions spelled out in detail so I always know what I'm expected to do. |
| | UN2 | It is important to closely follow instructions and procedures. |
| | UN3 | Rules and regulations are important because they inform me of what is expected of me. |
| | UN4 | Standardized work procedures are helpful. |
| | UN5 | Instructions for operations are important. |
| Collectivism | CO1 | Individuals should sacrifice self-interest for the group. |
| | CO2 | Individuals should stick with the group even through difficulties. |
| | CO3 | Group welfare is more important than individual rewards. |
| | CO4 | Group success is more important than individual success. |
| | CO5 | Individuals should only pursue their goals after considering the welfare of the group. |
| | CO6 | Group loyalty should be encouraged even if individual goals suffer. |
| Long-Term | LT1 | I believe in careful management of money |

| | | |
|-------------|-----|--|
| Orientation | | (thrift). |
| | LT2 | I go on resolutely in spite of opposition (persistence). |
| | LT3 | Personal steadiness and stability are important to me. |
| | LT4 | Long-term planning is more important than short term planning. |
| | LT5 | I believe in giving up today's fun for success in the future. |
| | LT6 | It is important to work hard for success in the future. |
| Masculinity | MA1 | It is more important for men to have a professional career than women. |
| | MA2 | Men usually solve problems with logical analysis; women usually solve problems with intuition. |
| | MA3 | Solving difficult problems usually requires an active, forcible approach, which is typical of men. |
| | MA4 | There are some jobs that a man can always do better than a woman. |

Appendix B: Additional Survey Items

Supplemental questions to be included in the local culture survey, in part adapted from Weatherford (1992):

| Subject | Item Code | Survey Item |
|----------------|-----------|--|
| Legitimacy | LG1 | Aviation safety is effective at identifying safety concerns and resolving them. |
| | LG2 | Aviation safety management increases my trust in the aviation system. |
| | LG3 | I value aviation safety management to accomplish what it intends to. |
| | LG4 | Aviation safety is worth the money spent on it. |
| | LG5 | The individuals who operate an aviation safety program are trustworthy. |
| Isomorphism | IS1 | It is important for all airports to manage safety in the same way. |
| | IS2 | Aviation safety issues are similar everywhere. |
| | IS3 | Safety Management Systems are similar around the world. |
| | IS4 | An international standard for aviation safety is necessary. |
| Safety Culture | SC1 | I individually have a direct impact on our airport's safety. |
| | SC2 | Employees should submit hazard reports when they notice a hazard. |
| | SC3 | It is important to always be aware of safety hazards around me. |
| | SC4 | I think everyone must contribute to a safe airport operation. |
| | SC5 | My mistakes should be used to make better training for employees. |
| | SC6 | I trust that management is using reports to improve safety and not punish employees. |

Appendix C: List of Open-Ended Survey Questions for Participants

The following questions were used in part three of the survey as well as interviews for participants.

| Question |
|--|
| What approvals are necessary to make changes to SMS rules and/or procedures? |
| How was safety managed before your SMS? What tools were a part of that management program? |
| What information is required for a hazard report? |
| What different media are available for individuals to submit reports? |
| Describe anonymity and related issues. |
| How are risks identified? |
| Is there a safety committee? Please describe its composition and frequency of meetings. |
| Does the safety committee use a risk assessment matrix? |
| What methods does the airport use to improve safety? |
| Does the airport management do enough to promote safety? What else could management do? |
| How often does the safety committee conduct audits? |
| What materials and standards are used to conduct audits? |
| Does the safety committee have a “closed loop” system of revisiting previous decisions? |
| Is employee participation in the hazard reporting system sufficient? |
| Do employees receive initial and/or recurrent training in the SMS? |
| What prevents employees from submitting additional reports? |
| What is the timeline of SMS implementation? |
| Any additional comments? |

Appendix D: Survey to Participants in Chinese

The following is the translated survey that was provided to participants in Chinese.

Part 1: General Culture

| Cultural Dimension | Item Code | Survey Item |
|-----------------------|-----------|--|
| Power Distance | PO1 | People in higher positions should make most decisions without consulting people in lower positions. |
| 权力距离 | | 上级做大部分决定并不需要询问下级。 |
| | PO2 | People in higher positions should not ask the opinions of people in lower positions too frequently. |
| | | 上级不应该频繁的询问下级的意见。 |
| | PO3 | People in higher positions should avoid social interaction with people in lower positions. |
| | | 上级应该避免和下级的社交活动。 |
| | PO4 | People in lower positions should not disagree with decisions by people in higher positions. |
| | | 下级不应该反对上级的决定。 |
| | PO5 | People in higher positions should not delegate important tasks to people in lower positions. |
| | | 上级不应该授权重要的任务给下级。 |
| Uncertainty Avoidance | UN1 | It is important to have instructions spelled out in detail so I always know what I'm expected to do. |
| 不确定性规避 | | 清楚的指令是重要的，以保证我完成交代的工作。 |
| | UN2 | It is important to closely follow instructions and procedures. |
| | | 严格遵照指令和流程是很重要的。 |
| | UN3 | Rules and regulations are important because they inform me of what is expected of me. |
| | | 规章和制度是很重要的，因为让我清楚知道该做什么。 |
| | UN4 | Without standardized work procedures, sometimes, I can still perform well. |
| | | 没有标准的工作流程，有时候也没关系。 |
| | UN5 | Instructions for operations are important. |
| | | 对于操作的指导说明是重要的。 |
| Collectivism | CO1 | Individuals should sacrifice self-interest for the |

| | | |
|-----------------------|-----|--|
| | | group. |
| 集体主义 | | 个人利益可被牺牲来满足团队的利益。 |
| | CO2 | Individuals should stick with the group even through difficulties. |
| | | 个人任何时刻都应该遵从团队默契。 |
| | CO3 | Group welfare is more important than individual rewards. |
| | | 团队的利益高于个人利益。 |
| | CO4 | Group success is more important than individual success. |
| | | 团队的成功比个人的成功重要。 |
| | CO5 | Individuals should only pursue their goals after considering the welfare of the group. |
| | | 在追求个人目标之前应该先满足团队利益。 |
| | CO6 | Group loyalty should be encouraged even if individual goals suffer. |
| | | 个人利益受损换来团队的忠诚是值得鼓励的。 |
| Long-Term Orientation | LT1 | I believe in careful management of money (thrift). |
| 长期取向 | | 生活勤俭对我很重要。 |
| | LT2 | I go on resolutely in spite of opposition (persistence). |
| | | 尽管存在反对意见，我会坚持己见。 |
| | LT3 | Personal steadiness and stability are important to me. |
| | | 我喜欢安稳生活。 |
| | LT4 | Long-term planning is more important than short term planning. |
| | | 长期计划比短期计划更重要。 |
| | LT5 | I believe in giving up today's fun for success in the future. |
| | | 放弃今天的休息，可换来将来的成功。 |
| | LT6 | It is important to work hard for success in the future. |
| | | 为了未来的成功而勤奋的工作和学习是很重要的。 |
| Masculinity | MA1 | It is more important for men to have a professional career than women. |
| 价值观的男性度 | | 男人比女人更需要事业。 |
| | MA2 | Men usually solve problems with logical analysis; women usually solve problems with |

| | |
|-----|--|
| | intuition. |
| | 男人使用逻辑分析解决问题，女人使用直觉。 |
| MA3 | Solving difficult problems usually requires an active, forcible approach, which is typical of men. |
| | 男性比较具有解决困难问题的主动性。 |
| MA4 | There are some jobs that a man can always do better than a woman. |
| | 有某些工作，男人永远比女人做得好。 |

Part 2: Organization Aspects

| Subject | Item Code | Survey Item |
|-------------|-----------|---|
| Legitimacy | LG1 | Aviation safety is effective at identifying safety concerns and resolving them. |
| 合理性 | | 航空安全管理体系在发现和处理安全隐患方面很有效果。 |
| | LG2 | Aviation safety management increases my trust in the aviation system. |
| | | 航空安全管理体系增加了我对航空运输的信心。 |
| | LG3 | I value aviation safety management to accomplish what it intends to. |
| | | 我觉得航空安全管理体系能够提升安全。 |
| | LG4 | Aviation safety is worth the money spent on it. |
| | | 航空安全是值得投资的。 |
| | LG5 | The individuals who operate an aviation safety program are trustworthy. |
| | | 我目前认识从事航空安全管理的人是值得信任的。 |
| Isomorphism | IS1 | It is important for all airports to manage safety in the same way. |
| 相似性 | | 所有的机场应该使用相同的 |

| | | |
|----------------|-----|---|
| | | 方式进行安全管理。 |
| | IS2 | Aviation safety issues are similar at other airports. 每个机场的安全问题都差不多。 |
| | IS3 | Safety Management Systems are similar around the world. 全世界的航空安全管理体系都是相似的。 |
| | IS4 | An international standard for aviation safety is necessary. 航空安全管理须有国际统一标准。 |
| Safety Culture | SC1 | I individually have a direct impact on our airport's safety. 个人的行为可影响机场的安全。 |
| 安全文化 | SC2 | Employees should submit hazard reports when they notice a hazard. 我们应该上报所发现的安全隐患。 |
| | SC3 | It is important to always be aware of safety hazards around me. 我们要经常注意身边的安全隐患。 |
| | SC4 | I think everyone must contribute to a safe airport operation. 机场每个员工都应该对安全运营做出贡献。 |
| | SC5 | My mistakes should be used to make better training for employees. 我的过失可用于培训案例。 |
| | SC6 | I trust that management is using reports to improve safety and not punish employees. 机场管理者用安全报告去提高机场的安全而不是去处罚员工。 |

Part 3: Safety Management Systems Implementation Status

| Topic | Item Code | Open-Ended Questions |
|------------------------------|-----------|--|
| Development of Safety Policy | OE1 | What approvals are necessary to make changes to SMS rules and/or procedures? |
| 安全制度的建立 | | 你所在的机场，对于SMS规定或者流程的修改，需要哪些批准和审定？ |
| | OE2 | How was safety managed before your SMS? What tools were a part of that management program? |
| | | 你所在机场，在使用SMS之前，航空安全如何管理？有哪些方式管理安全？ |
| Reporting Systems | OE3 | What information is required for a hazard report? |
| 报告系统 | | 你所在机场，安全隐患报告中包含哪些信息？ |
| | OE4 | What different media are available for individuals to submit reports? |
| | | 你可以通过哪些不同的渠道去提交安全隐患报告？ |
| | OE5 | Describe anonymity and related issues. |
| | | 描述一下你所在机场关于安全隐患报告提交的匿名制相关情况。 |
| Risk Analysis | OE6 | How are risks identified? |
| 风险分析 | | 你所在机场，如何发现安全隐患？ |
| | OE7 | Is there a safety committee? Please describe its composition and frequency of meetings. |

| | | |
|----------------------|------|--|
| | | 你所在机场是否存在一个安全管理委员会？请描述其组成和举行会议的时间周期安排。 |
| | OE8 | Does the safety committee use a risk assessment matrix? 安全管理委员会是否使用风险评价矩阵？ |
| Safety Promotion | OE9 | What methods does the airport use to promote safety? 你所在机场使用哪些方法去促进安全？ |
| 安全促进 | | |
| | OE10 | Does the airport management do enough to promote safety? What else could management do? 你所在机场管理部门是否做了足够的努力去保证航空安全？是否有其他方面需要努力或尝试？ |
| Safety Assurance | OE11 | How often does the safety committee conduct audits? 你所在机场的安全管理委员会多久进行一次安全检查或审计？ |
| 安全保证 | | |
| | OE12 | What materials and standards are used to conduct audits? 你所在机场使用哪些材料和标准去进行安全检查或审计？ |
| | OE13 | Does the safety committee have a “closed loop” system of revisiting previous decisions? 你所在机场，是否重新审视或者参考之前所做的安全相关决定？ |
| Participation in SMS | OE14 | Is employee participation in the hazard reporting system sufficient? 你的机场，是否有足够的员工参与到安全隐患报告系统中？ |
| SMS参与 | | |

| | | |
|--------------------|------|--|
| | OE15 | Do employees receive initial and/or recurrent training in the SMS? 你所在机场，是否有针对SMS的员工培训？ |
| | OE16 | What prevents employees from submitting additional reports? 你认为有哪些原因妨碍员工去提交相关安全隐患报告？ |
| SMS Implementation | OE17 | What is the timeline of SMS implementation? 请问你所在机场SMS实施的时间表？ |

Appendix E: Coding Schemes for the Regulatory Environment and SMS Implementation Status

The coding schemes for the regulatory environment and SMS implementation status were adapted from the ICAO SMM (2013) and Leib and Lu (2013), respectively. The coding scheme for the regulatory environment used the following components and elements:

- State Safety Policy and Objectives
 - State Safety Legislative Framework
 - State Safety Responsibilities and Accountabilities
 - Accident and Incident Investigation
 - Enforcement Policy
- State Safety Risk Management
 - Safety Requirements for the Service Provider's SMS
 - Agreement on the Service Provider's Safety Performance
- State Safety Assurance
 - Safety Oversight
 - Safety Data Collection, Analysis and Exchange
 - Safety-data-driven Targeting of Oversight of Areas of Greater Concern or Need
- State Safety Promotion
 - Internal Training, Communication and Dissemination of Safety Information
 - External Training, Communication, and Dissemination of Safety Information

The coding scheme for the SMS Implementation Status was as follows:

- Safety Policy and Objectives
 - Managerial Commitment and Responsibility
 - Key Personnel
 - Documentation
- Safety Risk Management
 - Hazard Identification
 - Safety Risk Assessment and Mitigation
- Safety Assurance
 - Safety Performance and Monitoring
 - Management of Change
 - Continuous Improvement
- Safety Promotion
 - Training and Education
 - Safety Communication

VITA

VITA

Steven M. Leib

ACADEMIC APPOINTMENTS

- Instructor, Nanshan Aeronautical College (2013-2014)
 - ICAO Aviation English
 - ATC operations and procedures
- Research Assistant, Aviation SMS Research Office, Department of Aviation Technology, Purdue University (August 2011-May 2013)
- Teaching Assistant, Purdue University, Department of Aviation Technology
 - AT 412: Airline Finance (Fall 2012)
 - AT 338: Airline Management (Fall 2012)
 - AT 285: Air Traffic Control Procedures and Weather (Spring 2013)
- Instructor, Civil Aviation University of China, Flight College (2010-2011)
 - Aviation English I and II

PUBLICATIONS

- Leib, S., Dillman, B., Young, J., & Petrin, D. (2012). A comparison of the effect of variations to US airport terminal signage on the successful wayfinding of Chinese and American cultural groups. *Journal of Aviation Technology and Engineering*, 1(2), 79-89.
- Leib, S., Lu, C-t. (in press). A gap analysis of airport safety using ICAO SMS perspectives: A field study of Taiwan. *Journal of Aviation Technology and Engineering*.
- Winter, S. R., Kirschner, J. E., Leib, S. M., Fanjoy, R. O. (in press). Implementing jet aircraft training in a university setting: Instructor perceptions and lessons learned. *Collegiate Aviation Review*.
- Leib, S., Lu, C-t., Sun, R-s., & Spence, T. (2012). Evaluation of safety programs at aviation organizations in Tianjin, China, with ICAO SMS standards. Manuscript submitted for publication to International Journal of Applied Aviation Studies.

RESEARCH PROJECTS

- **(2013) Purdue Aviation Project Team Exploration of Aviation Education in China**
Explored the process of cross-cultural collaboration to provide aviation education and training in China.
- **(2012) SMS Gap Analysis of Taipei International Airport**
Performed a gap analysis of Safety Management Systems with respect to ICAO standards (publication in press).
- **(2012) Lessons Learned in Phenom Aircraft Training Implementation**
Performed a qualitative phenomenological study to determine “lessons learned” from incorporating a jet aircraft into a traditional model of collegiate pilot training (publication in press).
- **(2011) SMS Gap Analysis of Airlines in Tianjin, China and International Standards**
Performed a gap analysis of Safety Management Systems across a range of aviation organizations in Mainland China (publication pending).
- **(2009) Stimulating Business Aviation Growth in China**
Collaborative project with Civil Aviation University of China to determine issues and challenges to the growth of business (corporate) aviation in China.

CONFERENCE PRESENTATIONS

- Leib, S. (2013, April). Motivating factors for hazard reporting in safety management systems: A pilot study. Paper to be presented at the Canadian Aeronautics and Space Institute’s Aeronautics Conference, Toronto, Ontario, Canada.
- Wang, Y. & Leib, S. (2013, April). Understanding the perceptions of aviation maintenance technicians related to the implementation and use of 3D aircraft maintenance manuals. Paper to be presented at the Canadian Aeronautics and Space Institute’s Aeronautics Conference, Toronto, Ontario, Canada.
- Winter, S. R., Kirschner, J. E., Leib, S. M., Fanjoy, R. O. (2012, October). Implementing jet aircraft training in a university setting: Instructor perceptions and lessons learned. Paper presented at the Human Factors and Ergonomics Society Annual Meeting, Boston, MA.

- Leib, S. & Lu, C-t. (2012, June). A gap analysis of airport safety using ICAO SMS perspectives: A field study of Taiwan. Paper presented at the Air Transport Research Society World Conference, Tainan, Taiwan.
- Leib, S., Lu, C-t., Sun, R-s., & Spence, T. (2012, April). Evaluation of safety programs at aviation organizations in Tianjin, China, with ICAO SMS standards. Paper presented at the Purdue University Graduate Aviation Applied Research Symposium, West Lafayette, IN.
- Leib, S. (2012, January). SMS and ISBAO. Presentation at the University Aviation Association Student Seminar, Washington, D.C.
- Leib, S. & Lu, C-t. (2011, September). Gap analysis of SMS in Asian operations. Presentation at the University Aviation Association Fall Education Conference, Indianapolis, IN.
- Leib, S., Dillman, B., Young, J., & Petrin, D. (2010, April). A comparison of the effect of variations to US airport terminal signage on the successful wayfinding of Chinese and American cultural groups. Paper presented at the Purdue University Graduate Aviation Applied Research Symposium, West Lafayette, IN.
- Lopp, D. & Leib, S. (2009, May). Forecasting aviation growth in Asia. Presented at the International Society of Transport Air Trading, Shanghai, China.

AWARDS AND DISTINCTIONS

- (Fall 2013) Nanshan Fellowship first-ever recipient
- (Summer 2012) Taiwan Fellowship Recipient from the Ministry of Foreign Affairs, Taiwan
- (Fall 2011) Technology Graduate Student Advisory Council Fellowship recipient
- (Fall 2010) AT travel grant recipient to attend the International Air Safety Seminar, Beijing, China.

WORKSHOPS AND ENGAGEMENT

- 2012 International SMS Workshop for Aviation Managers, workshop collaborator, Tianjin, China
- 2012 ATRS Annual Conference, Purdue University College of Technology booth representative
- 2012 International Air Safety Seminar attendee, Santiago, Chile

- 2010-2014 Study Abroad Assistant, China
- 2010 International Air Safety Seminar attendee, Beijing, China

LEADERSHIP EXPERIENCE

- Purdue University Peer Ombudsman (2012-2014)
- Flight Safety Foundation (first student chapter) Vice President of Programs, 2012-2013
- Aviation Graduate Council treasurer, 2011-2013
- Purdue Graduate Student Government senator from Aviation Technology, 2011-2013
- Aviation Graduate Council co-founder and treasurer, 2009-2010
- Purdue University Resident Assistant, 2007-2010

FAA CERTIFICATIONS

- Commercial Pilot (MEL)
- Instrument Rated